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

CONTENTS
PROJECT DESIGN DOCUMENT FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD)

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

B. Duration of the project activity / crediting period

C. Application of an approved baseline and monitoring methodology

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

E. Monitoring plan

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

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

H. Stakeholders' comments

Annexes

Annex 1: Contact information on participants in the proposed A/R CDM project activity

Annex 2: Information regarding public funding

Annex 3: Baseline information

Annex 4: Monitoring plan

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

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

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

>> Multiple-purposes Reforestation on Degraded Lands in Longyang, Yunnan, P.R. China

Version 1.0

Date: 23/03/2008

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

>>The purpose of the proposed A/R CDM project activity is to realize multiple socio-economic and environmental benefits (climate change mitigation, local community development, biodiversity conservation and soil erosion control) through restoring forest vegetation on degraded lands. Specific objectives include:

- To establish a buffer zone between the nature reserve and the surrounded communities by restoring forests at the fringe of the reserve, and alleviate pressure of communities on the nature reserve;
- To suppress the invasive weed, Eupatorium, and prevent its expansion toward the nature reserve, and as a result, to alleviate threat of the invasive species to the biodiversity conservation.
- To mitigate the soil erosion in the upper reaches of the Nujiang River and Lanchangjiang River, two important international rivers.
- To contribute to climate change mitigation by removing CO_2 from atmosphere through the growth of planted trees.
- To increase income and alleviate poverty of local communities.

To achieve the objectives, Longyang Forestry Farm, in cooperation with local farmers, will establish 1342.2 ha of multiple-purposes forests on degraded lands in Longyang County of Yunnan Province, China, among which 93.4 ha of lands are located within the Gaoligongshan National Nature Reserve, using native tree species, i.e., Armandi pine (*Pinus armandi* Franch), Szemao pine (*Pinus khasya* Royle et Gord) and Yunnan pine (*Pinus yunnanensis* Franch). The proposed A/R CDM project activity is expected to produce 223,189 tCO_2-e of tCER (7,773 tCO_2-e annually in average) within 30 years of crediting period.

Both the operating entity (Longyang Forestry Farm) and local farmers hold a view that the proposed A/R CDM project activity will contribute to poverty alleviation and environment (biodiversity conservation and soil erosion control), thus contribute to sustainable development.

A.3. Project participants:

>>

Table A-1 Project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
People's Republic of China	Private entity: Longyang Forestry Farm	Yes
(*) In accordance with the CDM A/R modalities and procedures, at the time of making the CDM-AR-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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

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

A.4.1.1. Host Party(ies):

>> P. R. China

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

>>Yunnan Province

A.4.1.3. City/Town/Community etc:

>> Lands to be reforested are located in 9 villages of 5 townships, 1 forestry farm and 1 conservation post in Longyang County.

Table A-2 List of townships and communities involved

Town/Township/Forestry Farm/Conservation Post	village	Area (ha)
Wafang	Xiping	227.3
	Shuigouwa	128.7
	Dangdong	66.6
Wadu	Huangtian	66.2
	Langba	116.8
	Sanping	92.0
Mangkuan	Damengkan	251.0

Bingma	Taihe	54.8
Pupiao	Huangni	26.3
Longyang Forestry Farm		219.1
Longyang Conservation Post		93.4
Total		1342.2

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

>> The geographical locations and project boundaries are indicated in figures below. The specific geographical positions (longitude, latitude) at each corner of each of parcels of sites (Spreadsheet attached) have been determined using satellite images (Landsat-5 Nov 29 1989, Landsat-7 Feb 09 2002 and Spot-5 2006) followed by land-based checking using GPS and interviewing with local stakeholers (see Fig. A-1 to Fig. A-7). See also Annex 3 for the details.

Fig.A-1 Locations of the project county

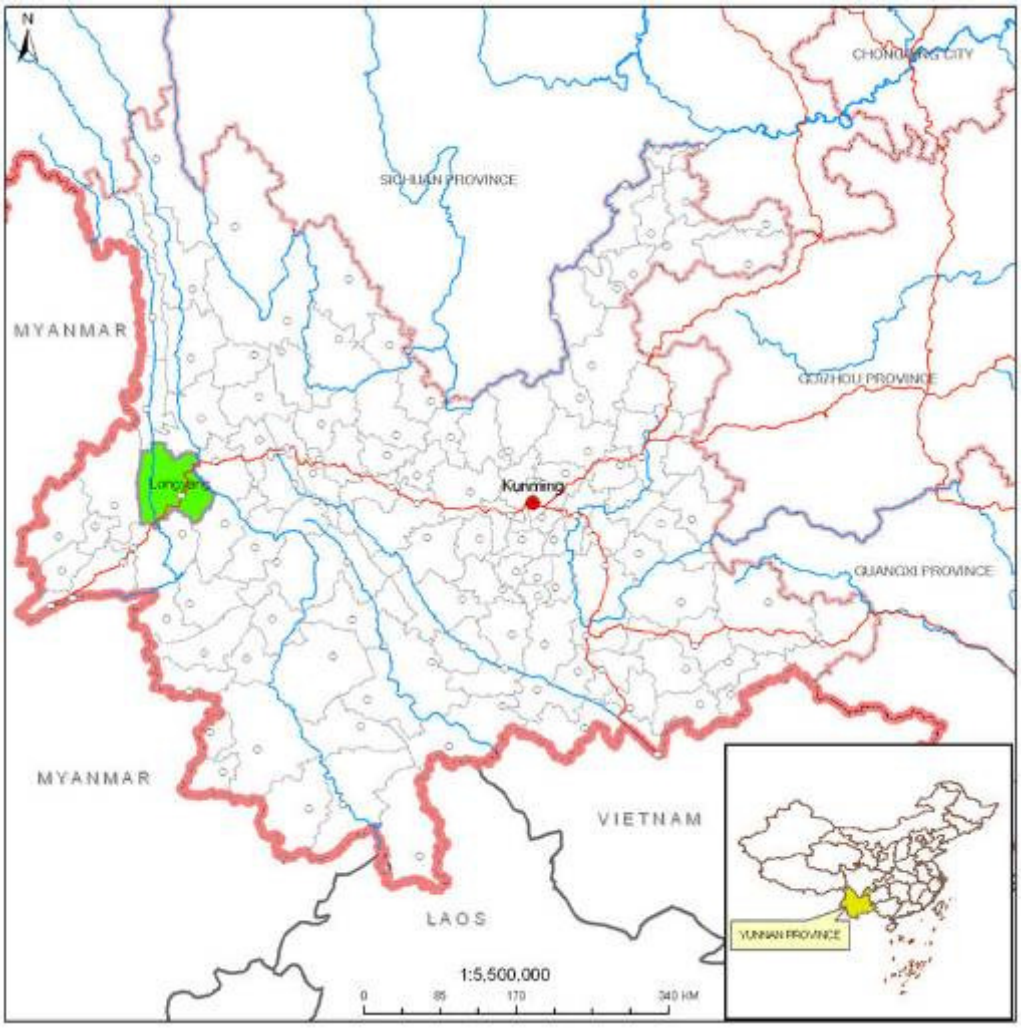


Fig.A-2 Locations of the project towns/townships

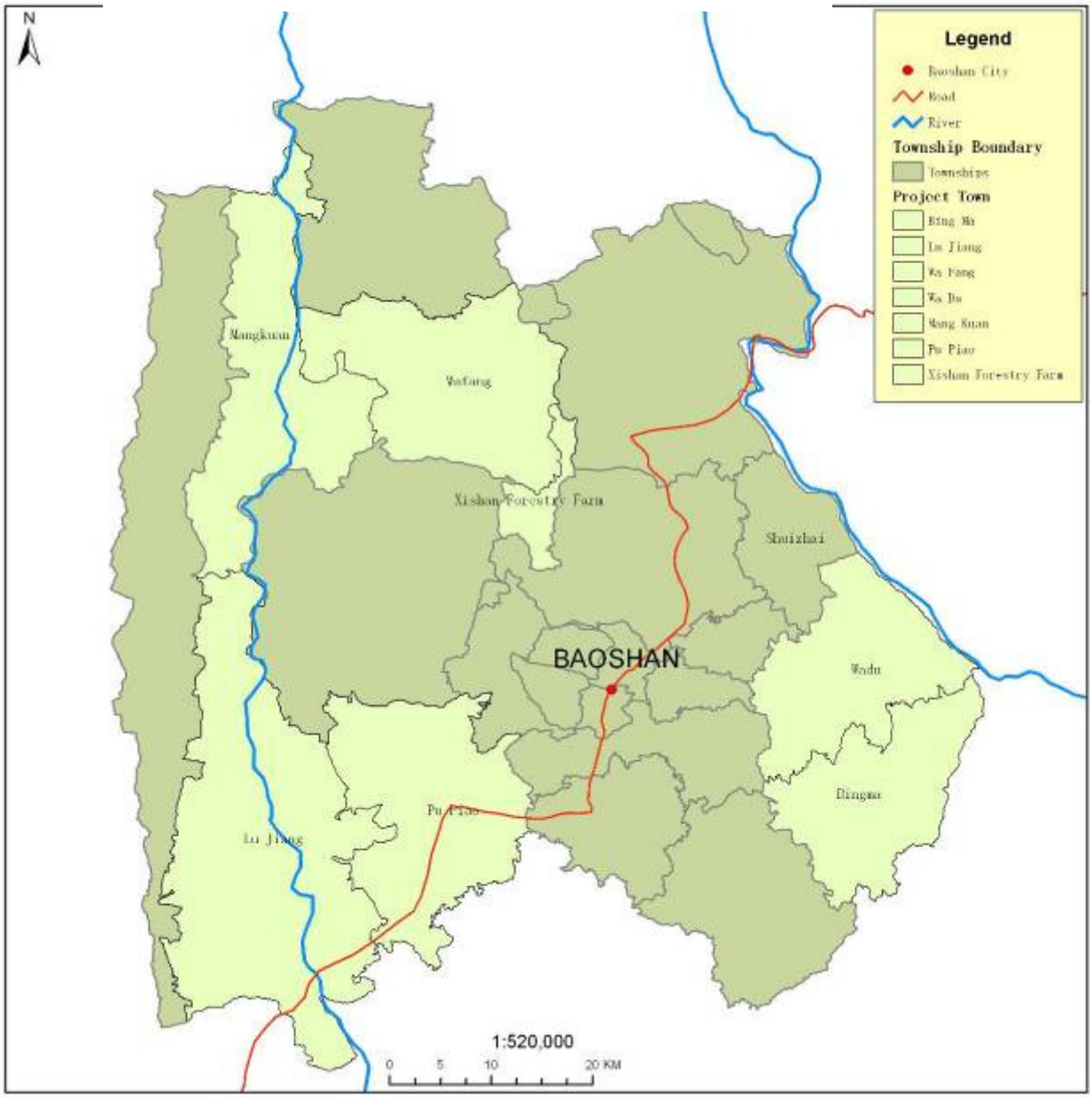


Fig.A-3 Project boundary and Land use/cover map in 2002 in Mangkuan

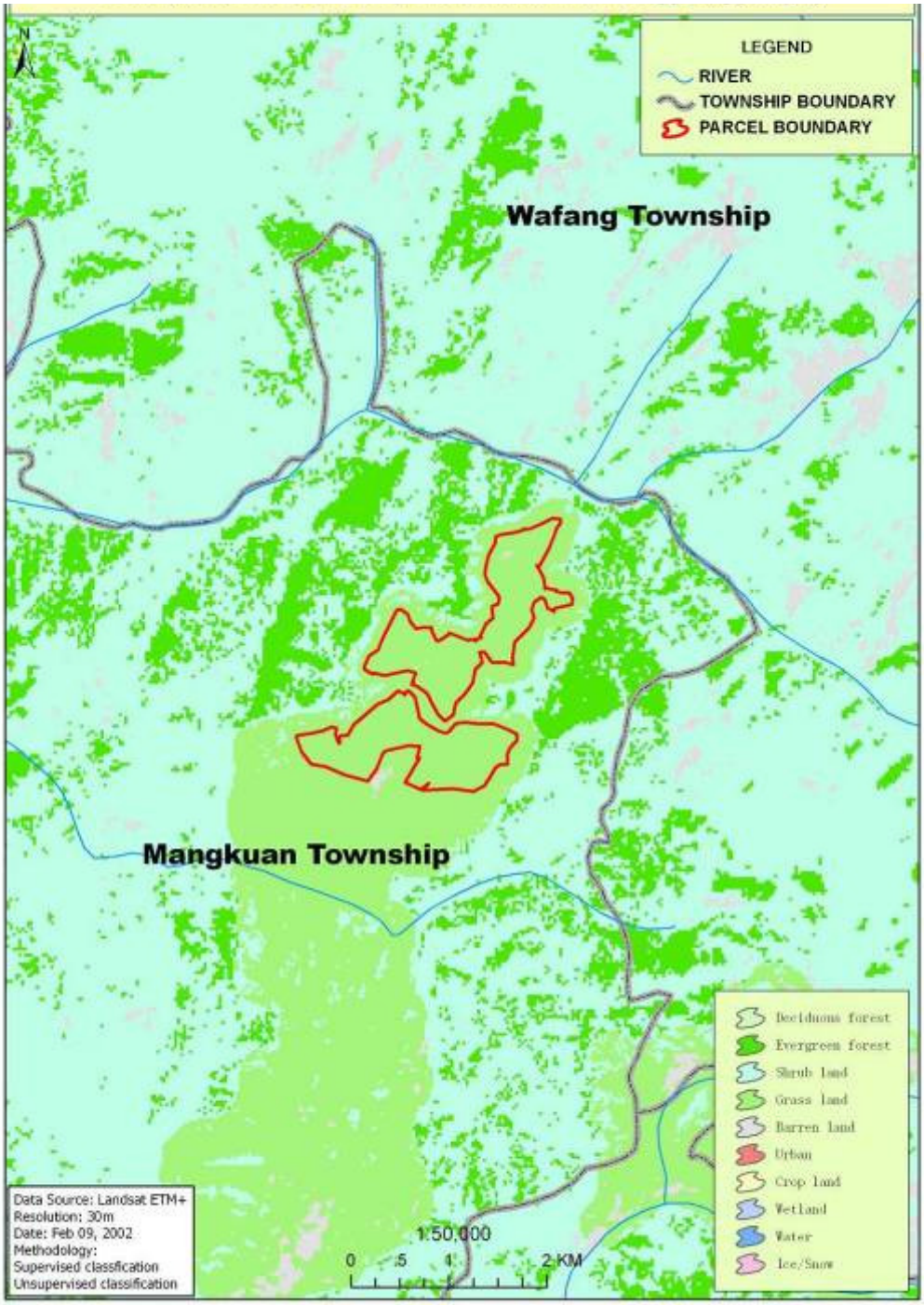


Fig.A-4 Project boundary and Land use/cover map in 2002 in Longyang Forestry Farm and Longyang Conservation Post

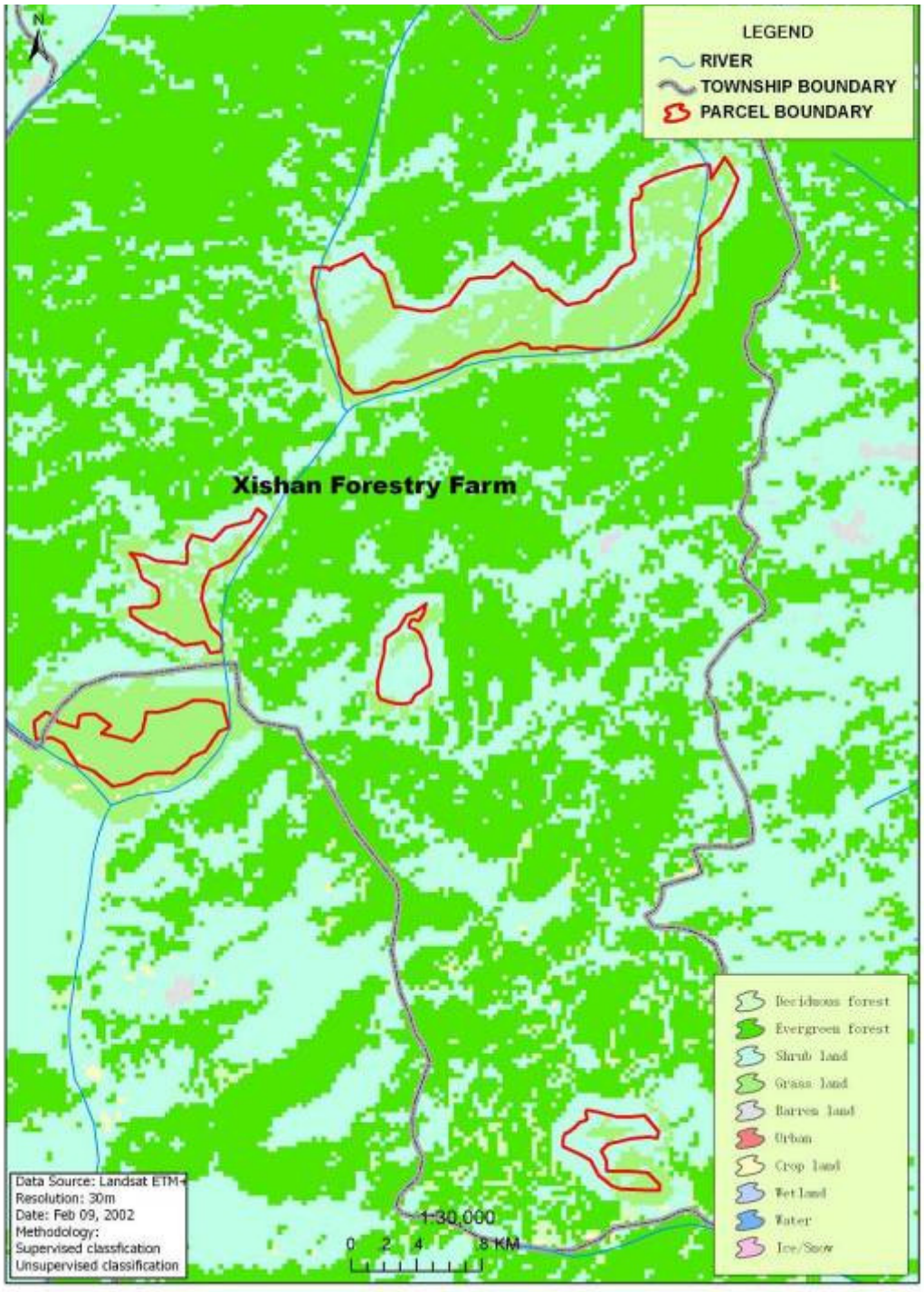


Fig.A-5 Project boundary and Land use/cover map in 2002 in Wafang Township

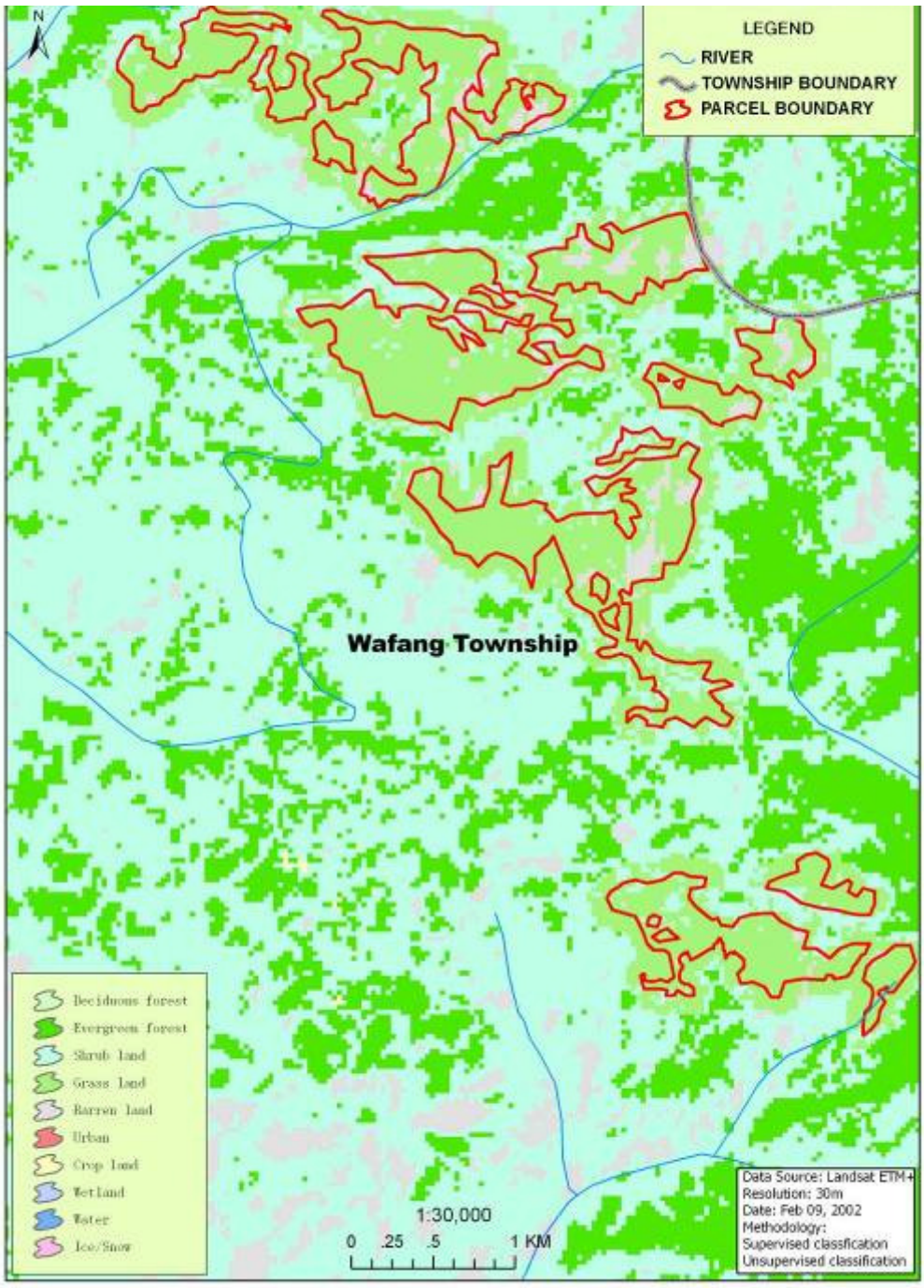


Fig.A-6 Project boundary and Land use/cover map in 2002 in Wadu and Bingma Townships

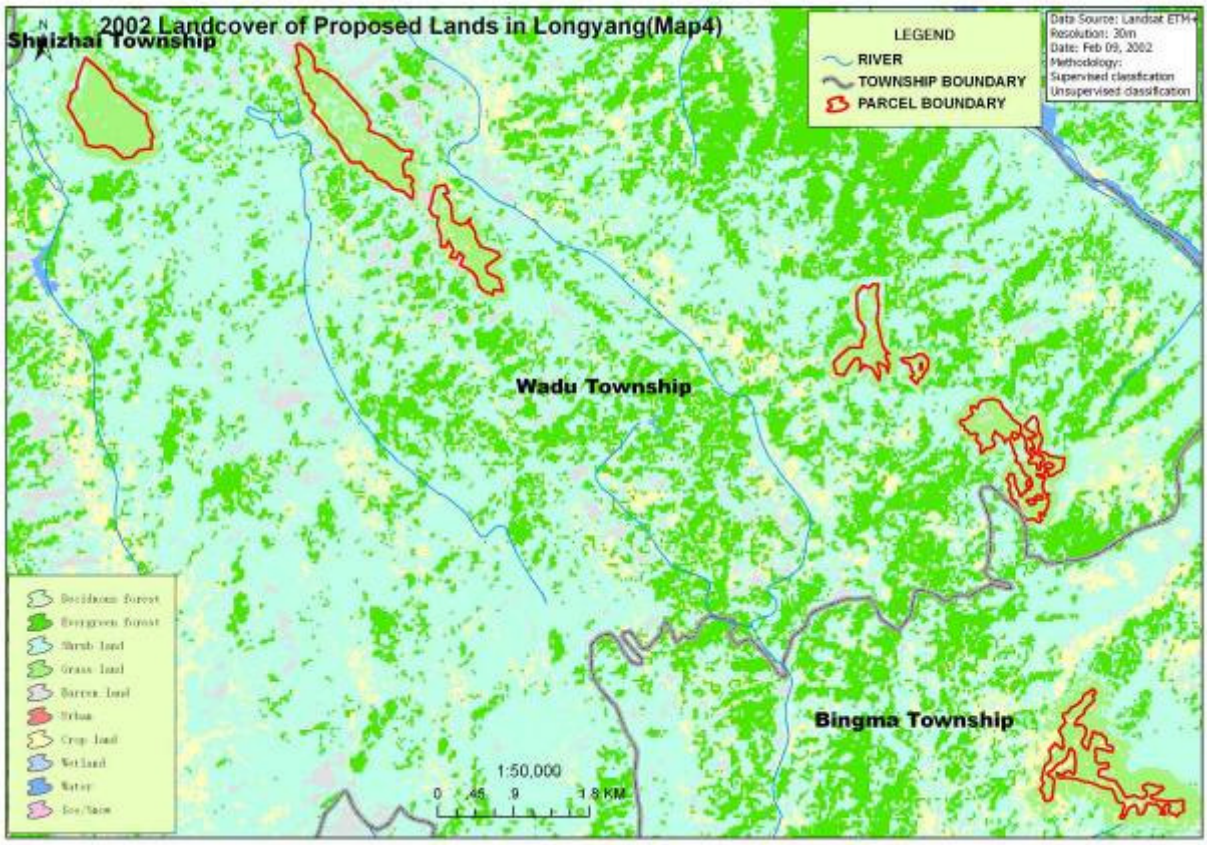
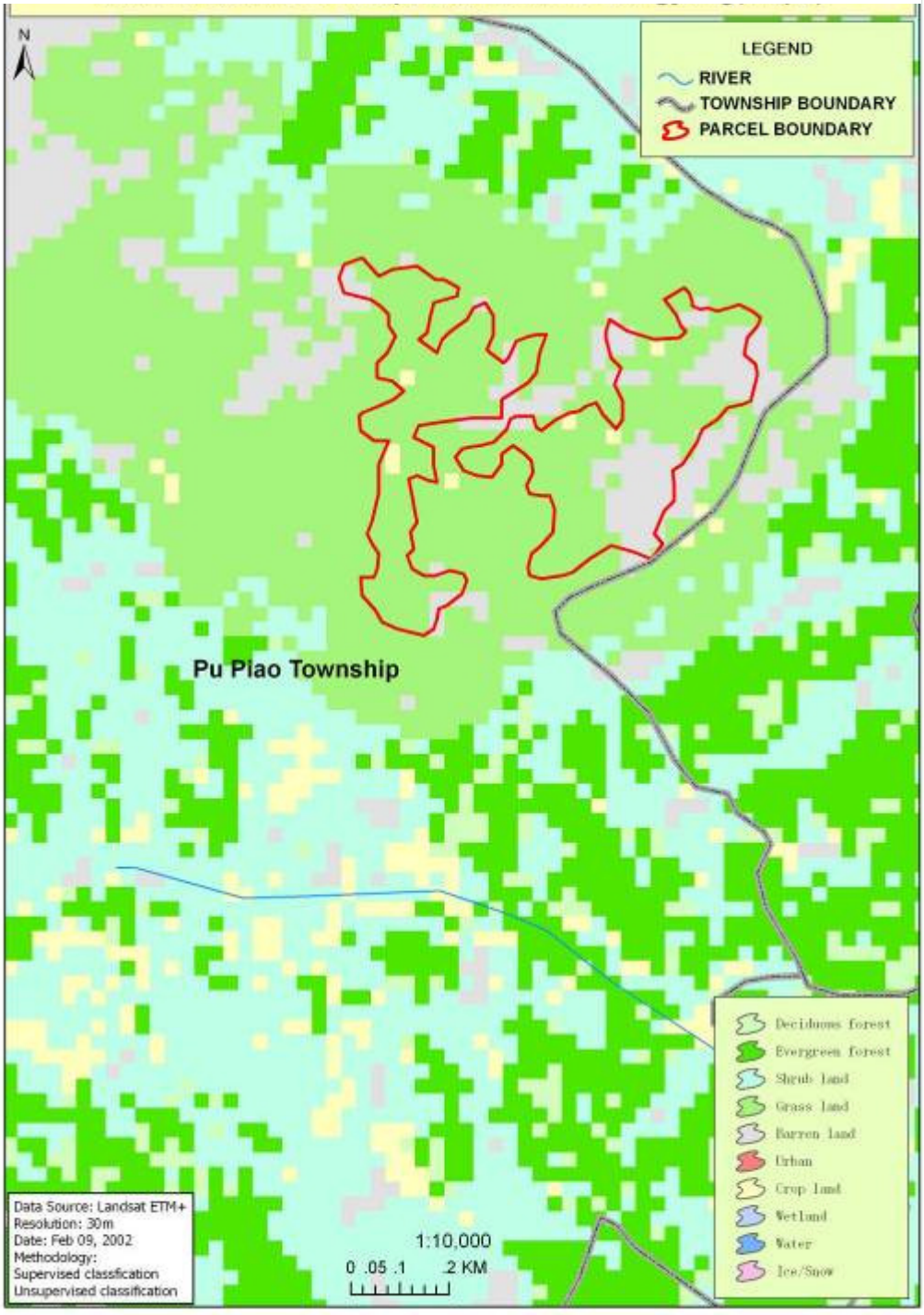


Fig.A-7 Project boundary and Land use/cover map in 2002 in Pupiao Town



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

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

>> The environmental conditions of the project area are summarized as follows[1]

Climate

Climate in the project area belongs to the sub-tropical plateau monsoon climate zone. The mean annual temperature is 15.5 ^{0}C. The mean temperature in the coldest month and hottest month, i.e., January and August, is 8.2 ^{0}C and 21.0 ^{0}C, respectively. The extreme lowest temperature is 3.5^{0}C and annual sunshine time is 2,307.5 hours with annual total radiation of 137.9 Kcal.cm^{-2}. The mean annual precipitation is 966.5 mm. Annual frost day is 138-160 days. The general climatic characteristics can be summarized as no apparent seasonal variation, obvious drought and rainy season, rainy in summer and autumn, drought in winter and spring, cool in summer, warm in winter.

Hydrology

There are two river systems within the project county. Nujiang River flows 115 km from north to the south in the western part of the Longyang County, with a total watershed area of 4220.5 km^2, and merges into 萨尔温江 in Burma. Lanchangjiang River flows 61.6 km along eastern boundary of the Longyang County, with a total watershed area of 635 km^2, and joins into Menam River in Burma. Major branch streams of the two rivers include Donghe River, Wayaohe River, Pupiaohe River, Chongjianghe River, Wafanghe River, Dashahe River, Shunzhuhe River. The project lands are located in the upper reaches of these rivers.

Soils

Due to the high elevation difference and complex landform, there are 9 types of soils in the project county, including sub-alpine meadow, brown soil, yellow-brown earth, yellow earth, yellow-red earth, purple soil, dry red soil, paddy soil. The zonic soil from foot to the peak of mountains are latodsol (below 800m), cinnamon-red soil (800-1300m), red earth (1300-2000m), yellow-red earth (1500-2300 m), yellow earth and yellow-brown earth (2100-2600m), brown soil (2600-3000m), dark brown soil (3000-3400m) and subalpine shrub meadow. Soils of the project lands are dominated by yellow-red earth, as well as a few red earth, yellow earth and brown soil.

Ecosystems

Due to the complex landform and there is an apparent vertical vegetation spectrum. Main natural vegetation types include Savanna-shrub-grass in valley bottom, temperate coniferous forests, monsoon evergreen broadleaf forest, semi-moist evergreen broadleaf forest, temperate evergreen broadleaf forest, mid-temperate coniferous forest, moss bosquet, cold-temperate bamboo stand, cold-temperate shrub stand and meadow.

Currently there are two land uses, i.e., 827.6 ha of un-used barren land and 514.6 ha of grazing land (table A-3).

[1] Editorial Board of Baoshan City Annals. 1993. Baoshan City Annal. Kunming: Yunnan Ethic Press

Table A-3 Land use and land cover of the project lands

Town/ Townships	Villages	Land ID	Area (ha)	Land use	Vegetation	Causes of Deforestation
Wadu	Huangtian	LY0101	66.2	Barren land	dense Eupatorium, sporadic shrubs and trees	Agricultural cultivation in 1959 followed by abandonment
	Langba	LY0102	79.3			Deforestated due to land use contract in 1982
		LY0103	37.5			
	Shanping	LY0302	30.0	Grazing land	Eupatorium and grasses, no shrub, sporadic trees	1958-59 Steel and Iron Campaign, followed by wheat cultivation, and abandoned after 1982
		LY0303	5.6			
		LY0304	52.1			
		LY0305	4.3			
Wafang	Xiping	LY0202	26.1	Grazing land	Perennial grasses, no shrub, sporadic trees	Deforestated due to land use contract in 1982-83, followed by grazing
		LY0203	8.6			
		LY0204	59.0			
		LY0207	4.5			
		LY0209	34.1			
		LY0210	95.0			
	Shuigouwa	LY0211	11.9	Grazing land	Perennial grasses, no shrub, sporadic trees	Deforestated in 1958-59 Steel and Iron Campaign, followed by abandonment
		LY0212	13.0			
		LY0213	3.9			
		LY0214	99.9			
	Dangdong	LY0215	11.6	Grazing land		
		LY0216	23.5			
			23.8			
		LY0217	7.7			
Mangkuan	Damengkan	LY0110	134.9	Barren land	dense Eupatorium, sporadic shrubs and trees	Deforestated in 1958-59 Steel and Iron Campaign, followed by abandonment
		LY0111	116.1			
Pupiao	Huangni	LY0112	11.6	Barren land		
		LY0113	14.7			
Bingma	Taihe	LY0104	54.8	Barren land		
Longyang Forestry Farm		LY0105	13.8	Barren land	dense Eupatorium, sporadic shrubs and trees	Deforestated in 1958-59 Steel and Iron Campaign, followed by abandonment
		LY0106	32.8			
		LY0107	12.5			
		LY0108	26.4			
		LY0109	133.6			
Longyang Conservation Post		LY0114	82.2	Barren land	dense Eupatorium, sporadic shrubs	
		LY0115	11.2			

				and trees	
Total		1342.2			

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

>>In Longyang County, 34 species of plants are protected at state level and 45 species at provincial level. Among them, *Taiwania flousiana* Gaussen and *Cyathea spinulosa* are include in first category at state level. *A1cimandra cathcartii, Pseudotsuga forrestii* Craib, *Cephalotaxus lanceolata* K. M. Feng ex Cheng et L. K. Fu, *Tetracentron sinense* Oliv. in Hook. , Icon. Pl., *Coptis teeta* Wall, *Paeonia delavayi var. lutea* (Delavay ex Franch.) Finet et Gagnep, *Circaeaster agrestis* Maxim, *Camellia reticulata* Lindl., *Craigia yunnanensis* W. W. Smith et W. E. Evans, *Dipentodon sinicus* Dunn, *Eurycorymbus cavaleriei* (Levl.) Rehd. et H. – M, *Davidia involucrata var. vilmoriniana* (Dode) Wanger, *Rhododendron protistum var. giganteum* (Forrest ex Tagg) Chamberlian, *Sinopteris grevilleoides* (Christ) C. Chr. Et Ching and *Caryota urens* Linn are included in the second catetory. *Neocheiropteris palmatopedata* (Bak.) Christ, *Torreya yunnanensis* Cheng et L. K. Fu, *Mgnolia rastrata* W. W. Sm., *Manglietia insignis* (Wall.) Bl., *Euptelea pleiospermum* Hook. f. et Thoms, *Sinopodophyllum hexandrum* (Royle) Ying, *Helicia shweliensis* W. W. Smith, *Terminalia myriocarpa* Huerck et M. A., *Toona ciliata* Roem, *Panax zingiberensis* C. Y. Wu et Feng ex C. Chow et al., *Rhododendron sulfureum* Franch, *Rhododendron alutaceum* Balf. f. et W. W. Smith, *Picrorhiza scrophulariiflora* Pennell, *Trillium tschonoskii* Maxim, *Tacca chantrieri* André, *Dendrobium candidum* Wall and *Gastrodia elata* Blume are in the third category at state level.

There are 2389 species of wildlife, among which 82 species are protected at state level. There are 205 species of animals, belonging to 32 family of 10 orders, accounting for 52% and 30.9% of the total number in Yunnan Province and China, respectively. Precious animals include *Budorcas taxicolor*, *Hylobates hoolock*, *Macaca assamensis*, *Presbytis phayrei*, *Panthera tigris tigris*, *Panthera pardus*, *Neofelis nebulosa*, *Naemorhedus goral*, *Nycticebus coucang*, *Manis pentadactyla*, *Macaca mulatta*, *Macaca arctoides*, *Ursus thibetanus*, *Ailurus fulgens*, *Lutra lutra*, *Viverra zibetha*, *Moschus berezovskii*, *Moschus fuscus*, *Cervus unicolor*, *Capricornis sumatraensis*.

525 species of birds habitat in Longyang County, belonging to 58 family of 19 orders, accounting for 52.9% and 35.3% of the total number in Yunnan Province and China, respectively. Protected birds include *Lophophorus sclateri*, *Aquila chrysaetos*, *Sarcogyps calvus*, *Syrmaticus humiae*, *Ithaginis cruentus*, *Tragopan satyra*, *Pavo muticus*, *Ciconia nigra*, *Tragopan blythii*, *Grus antigone*, *Lophura nycthemera*, *Lophura* leuco*m*elanos, *Accipiter trivirgatus* and *Accipiter nisus*.

There are 133 species of amphibian and reptiles in Longyang, belonging to 17 family of 4 orders. 3 species are included in the first protected category at state level, 2 species in the state second protected category, and 3 species are protected at provincial level.

There are 49 species of fish in Longyang accounting for 12.3% of the total number of species in Yunnan Province. Precious fish include *Tor hemispinus*, *Barbodes margarianus*, *Epalzeorhynchus bicornis*, *Garra qiaojiensis*, *Schizothorax nukiangensis*, *Schizothorax myzostomus* and *Nemacheilus longus*.

Based on baseline survey, No protected or endangered species and IUCN species have been found on the proposed project lands. These lands currently have low biodiversity and Eupatorium is an invasive species in the region (Table A-3).

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

>>Based on the preference of local farmers that was collected through PRA approach, and the local site conditions through baseline survey, and taken into consideration of biodiversity conservation and soil erosion control, the proposed A/R CDM project activity will use following tree species:

- Armandi pine (*Pinus armandi* Franch)
- Yunnan pine (*Pinus yunnanensis* Franch)
- Szemao pine (*Pinus khasya* Royle et Gord)

All species are native to the project area. No GMO or invasive species will be used. These species will be intermixed in planting.

20-year-old Armandi pine plantation

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

>> No technology will be transferred to the host party. The following technical standards will be strictly followed:

- State Technical Regulations for Afforesation/Reforestation: GB/T 15776-2006;
- 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: GB/T 6001-1985;
- Technical Standard for Container Seedling Breeding: LY1000-1991.
- Seed Certification Regulations (GB2772-1999)

Site and Soil Preparation

To prevent soil erosion, reduce GHG emission and protect existing carbon stocks, site burning and overall tillage will not be employed during the site and soil preparation. Existing non-tree vegetation will be slashed manually along landform contour with a width 100 cm and piled on-site. Small holes (with diameter and depth 30 cm) will be dug for tree planting. Holes will be arranged in a triangle form on slope along contour. Site and soil preparation will be conducted in the spring (April-May) 2008.

Genetic Sources and Nursery Practices

All seedlings used in the proposed A/R CDM project activity will be produced on-sites beside the project lands, or purchased from central nursery of Longyang County. All seedlings will be bred from seed and there will be no clone offsprings.

Seeds of Yunnan pine will be collected from seed orchards in Longyang Forestry Farm. Seeds of Armandi pine will be collected from seed orchards in Longyang Forestry Farm or Shuizhai Township nearby. Seeds of Szemao pine will be collected from seed orchards at Pupao Township.

To increase survival rate and early growth of trees to be planted, seedlings will be bred in plastic tubes (5 cm in diameter and 15 cm length) that hold soils mixed with 20 percent of organic soil. The seedlings are qualified according to standard GB 6000-1999. Only the quality grade I and II can be used. Table A-4 lists the standard for seedling grading for tree species used in the proposed A/R CDM project activity.

Table A-4 Standard for seedling grading[2]

Species	Seedling age	Standard for grade I and II			
		Minimum diameter at base (cm)	Minimum height (cm)	Root	
				Minimum length of main root (cm)	Minimum number of lateral roots with length over 5cm
Yunnnan pine	3-4	0.15	6	15	5
Szemao pine	3-4	0.15	6	15	5
Armandi pine	3-4	0.15	6	15	5

Forest Establishment

Planting activities will be conducted in raining season (June-July) 2008, with spacing 2 m × 3 m for all species. Trees will be planted in by block mixture. Table A-5 lists the species and model arrangement and table A-6 lists model arrangement for each compartment/sub-compartment. Fig. A-8 presents a GIS example of species combination and planting model arrangement.

Table A-5 Species and model arrangement

Species/Model	Model No.	Species ratio	Area (ha)
Armandi pine +Yunnan pine	M1	8:2	922.9
Yunnan pine + Szemao pine	M2	5:5	29.1
Armandi pine	M3	10	168.3
Szemao pine	M4	10	221.9
Total			1342.2

[2] Data source: Standards for Seedling Qualification: GB 6000-1999

Table A-6 Reforestation model for each sub-compartment

Towns/Townships /Farm/Post	Villages	LAND ID	Sub-compartment ID	Model No	Area (ha)
Wadu	Sanping	LY0302	LY0302_1	M1	30.0
		LY0303	LY0303_1	M1	5.6
		LY0305	LY0305_1	M1	4.3
		LY0304	LY0304_1	M1	24.0
			LY0304_2	M1	28.1
	Langba	LY0102	LY0102_1	M1	33.0
			LY0102_2	M1	46.3
		LY0103	LY0103_1	M1	37.5
	Huangtian	LY0101	LY0101_2	M1	25.9
			LY0101_1	M1	40.3
Wafang	Xiping	LY0202	LY0202_1	M1	26.1
		LY0203	LY0203_1	M1	8.6
		LY0207	LY0207_1	M1	4.5
		LY0209	LY0209_1	M3	34.1
		LY0210	LY0210_1	M1	30.4
			LY0210_2	M1	40.4
			LY0210_3	M1	24.2
		LY0204	LY0204_1	M3	16.7
			LY0204_2	M3	42.3
	Shuigouwa	LY0211	LY0211_1	M3	11.9
		LY0212	LY0212_1	M3	13.0
		LY0213	LY0213_1	M3	3.9
		LY0214	LY0214_3	M1	22.2
			LY0214_2	M1	42.0
			LY0214_1	M1	35.7
	Dangdong	LY0215	LY0215_1	M1	11.6
		LY0217	LY0217_1	M1	7.7
		LY0216	LY0216_1	M1	23.5
			LY0216_2	M1	23.8
Mangkuan	Damengkan	LY0110	LY0110_3	M4	28.3
			LY0110_4	M4	22.5
			LY0110_1	M4	19.2
			LY0110_2	M4	28.6
			LY0110_5	M4	36.3
		LY0111	LY0111_4	M4	41.3
			LY0111_1	M4	20.9
			LY0111_3	M2	29.1
			LY0111_2	M4	24.8

Pupiao	Huangni	LY0112	LY0112_1	M1	11.6
		LY0113	LY0113_1	M1	14.7
Bingma	Taihe	LY0104	LY0104_1	M2	40.0
			LY0104_2	M2	14.8
Longyang Forestry Farm		LY0109	LY0109_1	M1	41.0
			LY0109_2	M3	20.1
			LY0109_3	M1	44.1
			LY0109_4	M1	28.4
		LY0108	LY0108_1	M1	26.4
		LY0107	LY0107_1	M3	12.5
		LY0106	LY0106_1	M1	32.8
		LY0105	LY0105_1	M3	13.8
Longyang Conservation Post		LY0114	LY0114_4	M1	18.4
			LY0114_2	M1	20.9
			LY0114_3	M1	16.7
			LY0114_1	M1	26.2
		LY0115	LY0115_1	M1	11.2
Total		32	55	4	1342.2

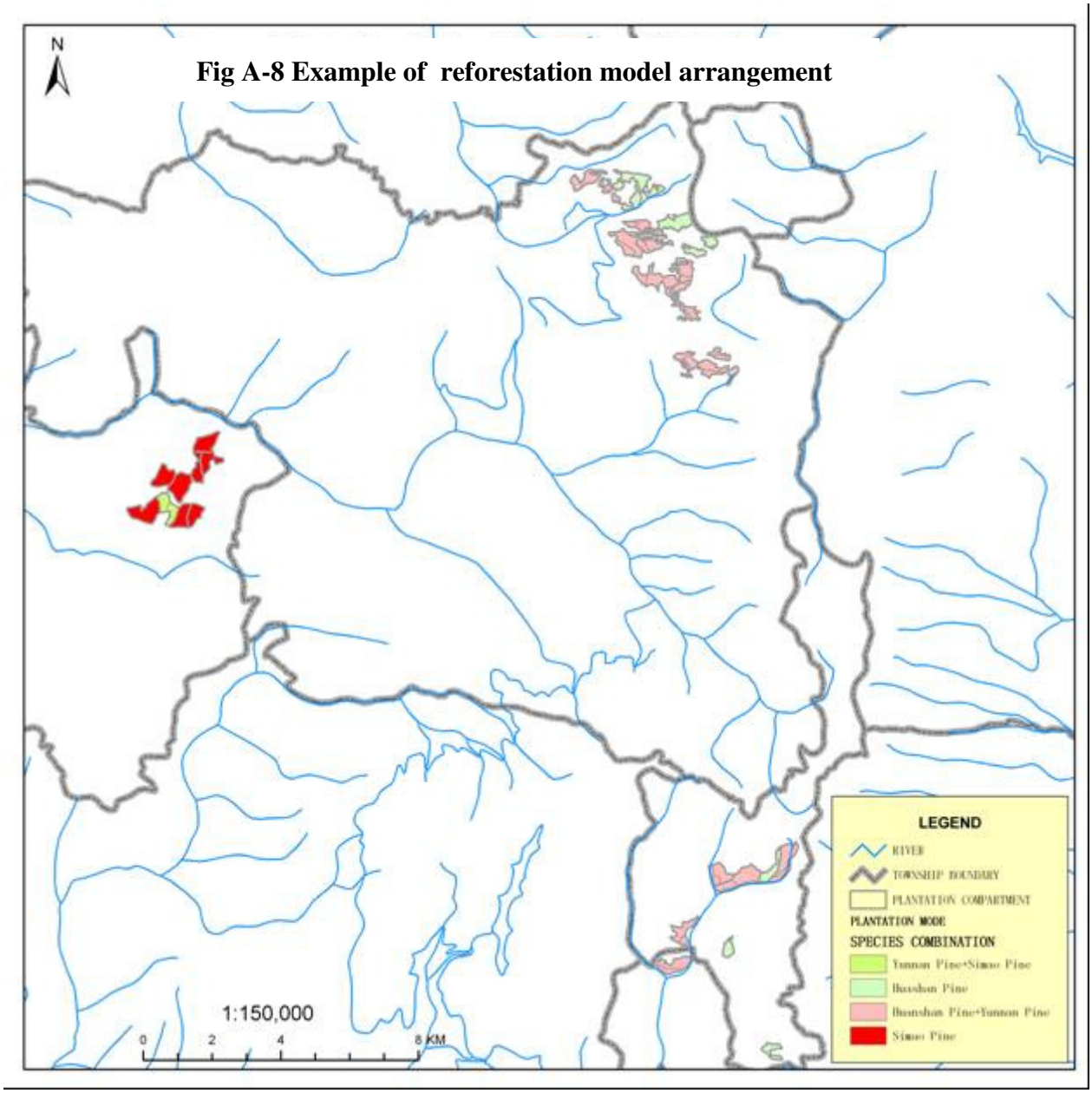


Fig A-8 Example of reforestation model arrangement

To ensure high survival rates and good growth in the early stages, weed will be slashed manually in May-June period everyyear in the first 2-4 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 in order to enhance the growth of young stands: 50g per tree at the time of planting, 100g per tree in the second year, 150g per tree in the third year, and 200g per tree in the fourth year.

Forest Management

The plantations of Szemao pine will be thinned manually at 16-year-old, and once again at 23-year-old. The Armandi pine plantation will be thinned manually once at 23-year-old. The plantation of Yunnan pine will not be thinned. All plantations will be harvest after 30-year-old. Thinning intensity for each thinning event is 30 percent of the standing volume.

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

>> No technology will be transferred to the host party.

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

>> Potential leakage associated with the proposed A/R CDM project activity may include the use of vehicles for the transportation of products, fertilizer and other production materials and the displacement of grazing activity, outside the project area. Although potential transportation leakage is relatively small, the proposed A/R CDM project activity will make effort for vehicles to be full-loaded on both to and return ways so as to minimize the leakage. The leakage due to the displacement of grazing are unlikely occur due to the governmental license control of tree logging, however, the proposed A/R CDM project activity will strictly enforce the Forest Laws and its related regulations, and avoid tree logging due to displacement of grazing by control license issuance.

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

>> There are two types of legal titles to lands, i.e., state owned and village collective owned. 219.1 ha of land in Longyang Forestry Farm and 93.4 ha of lands in Longyang Conservation Post are owned by the state, and land tenures of these lands belongs to respective farm and conservative post. Other 1029.7 ha of lands are collectively owned by local villages, among which land tenure of 275 ha of lands in Wadu Township and 128.7 ha of lands in Shuigou Village of Wafang Township belong to individual farmers, and other lands belong to villages. See Table A-7 for details.

Table A-7 Land title and land tenure

Town/ Townships	Villages	Land ID	Area (ha)	Legal title	Land tenure
Wadu	Huangtian	LY0101	66.2	Village	Individual Farmers
	Langba	LY0102	79.3	Village	Individual Farmers
		LY0103	37.5		
	Shanping	LY0302	30.0	Village	Individual Farmers
		LY0303	5.6		
		LY0304	52.1		
		LY0305	4.3		
Wafang	Xiping	LY0202	26.1	Village	Village
		LY0203	8.6		
		LY0204	59.0		

		LY0207	4.5		
		LY0209	34.1		
		LY0210	95.0		
	Shuigouwa	LY0211	11.9	Village	Individual Farmers
		LY0212	13.0		
		LY0213	3.9		
		LY0214	99.9		
	Dangdong	LY0215	11.6	Village	Village
		LY0216	23.5		
			23.8	Village	Individual Farmers
		LY0217	7.7	Village	Village
Mangkuan	Damengkan	LY0110	134.9	Village	Village
		LY0111	116.1		
Pupiao	Huangni	LY0112	11.6	Village	Village
		LY0113	14.7		
Bingma	Taihe	LY0104	54.8	Village	Village
Longyang Forestry Farm		LY0105	13.8	State-owned	Farm
		LY0106	32.8		
		LY0107	12.5		
		LY0108	26.4		
		LY0109	133.6		
Longyang Conservation Post		LY0114	82.2	State-owned	Nature Reserve
		LY0115	11.2		
Total			1342.2		

To effectively promote and govern CDM project activities in China, the Chinese government issued the *Measures for Operation and Management of Clean Development Mechanism Projects in China* on Oct 12, 2005, effective immediately. Based on the *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 *Measures*[3].

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

>> The Chinese Government defines forests as lands having growing trees with:

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

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

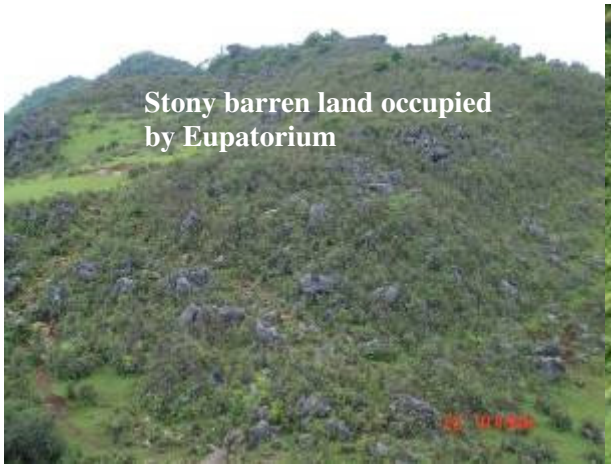
[3] http://cdm.ccchina.gov.cn/

The land eligibility is demonstrated using latest version of "Procedures to demonstrate the eligibility of lands for afforestation and reforestation project activities (Version 01)"[4], as bellow.

1. the land within the planned project boundary is eligible for the proposed A/R CDM project activity by following the steps outlined below.

(a) The land at the moment the project starts does not contain forests which can be demonstrated by:

(i) Field survey showed that the lands to be planted in the proposed A/R CDM project activity are currently stony barren lands occupied by invasive Eupatorium or grasses, with or without a few tiny shrubs and sporadic trees, rather than forests or young natural stands and plantations or temporarily unstocked lands that are expected to reach the minimum crown cover and minimum height chosen by China to define forest (see Table A-3 for current vegetation for different parcels of lands). Based on surveyed data from 97 sampling plots (20 m in diameter), there are 6.4 existing trees per hectare in average, with the crown cover at maturity only 1.26%. Even for the plot with the highest 5 existing trees, the crown cover at maturity is expected to be 7.8%, which is much lower than minimum crown cover chosen by China to define forest. See Annex 3 for details.



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

(ii) Most recent land use/cover maps showed in figures above (from Fig A-3 to Fig A-7) also demonstrates that the lands to be planted are not forested lands. The maps were derived from satellite image (landsat ETM+, Feb 9 2002).

(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 showed that the lands to be planted in the proposed A/R CDM project activity have been non-forested lands since at least 1989 (see also Table A-3 for the cause of deforestation).

(ii) Land use/cover maps showed in figures below (from Fig A-9 to Fig A-13) also demonstrate that the lands to be planted were not forested lands in 1989.

Note: The satellite images will be accessible to the DOE to confirm the eligibility of lands. The lands to be planted in the proposed A/R CDM project activity are marked with red lines in these figures.

Fig.A-9 Land use/cover maps in 1989 in Mangkuan Township

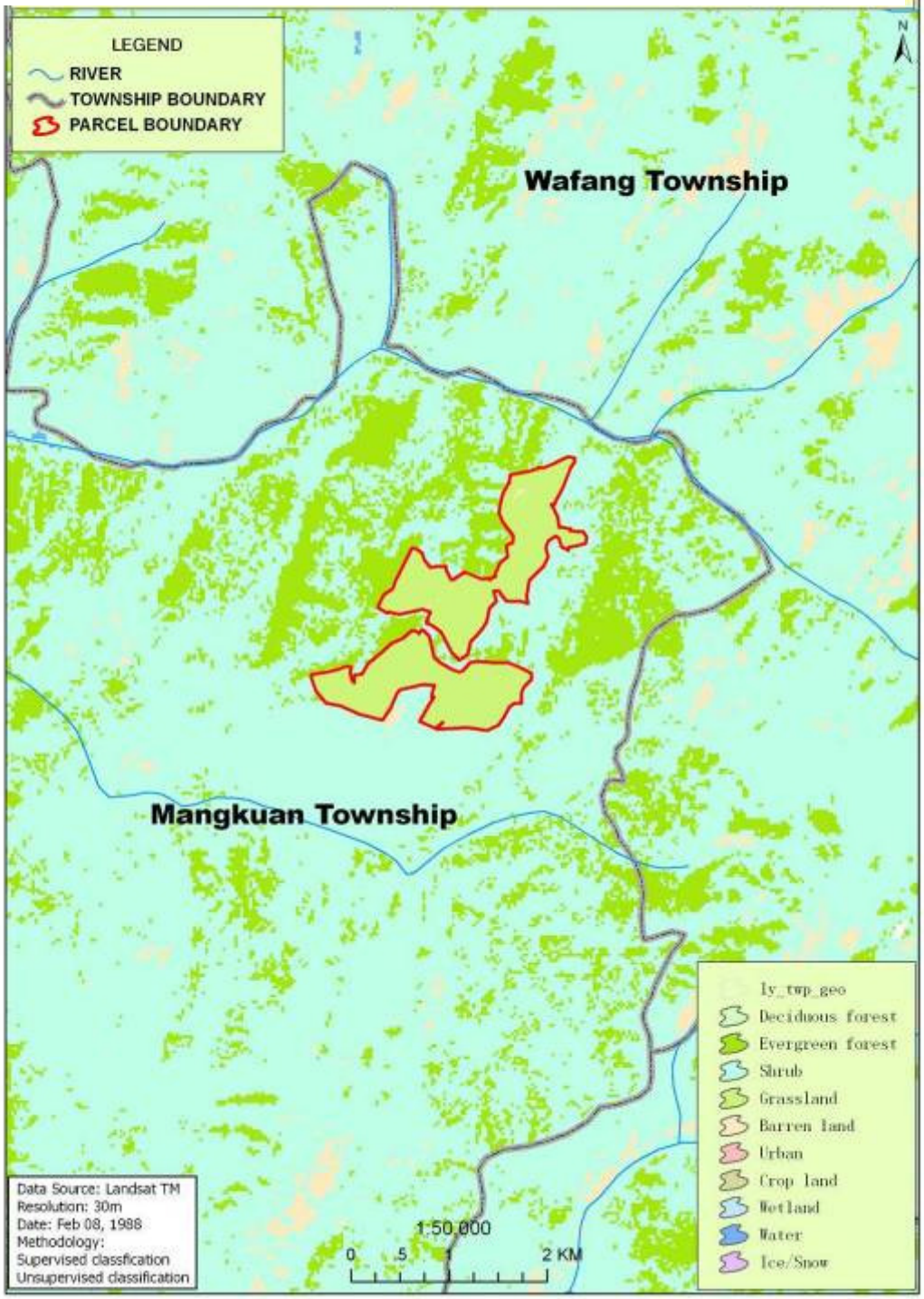


Fig.A-10 Land use/cover map in 1989 in Longyang Forestry Farm and Longyang Conservation Post

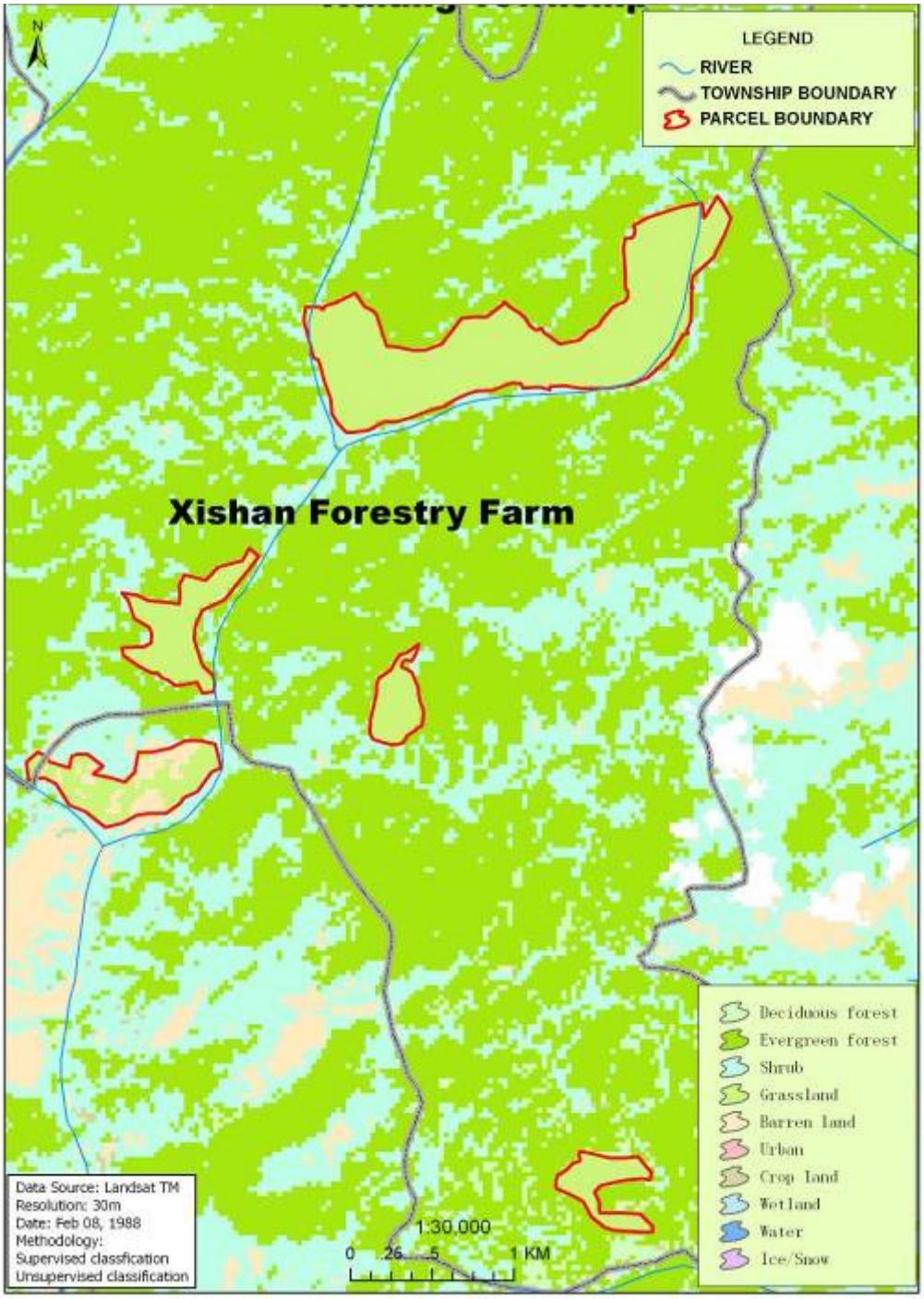


Fig.A-11 Land use/cover map in 1989 in Wafang Township

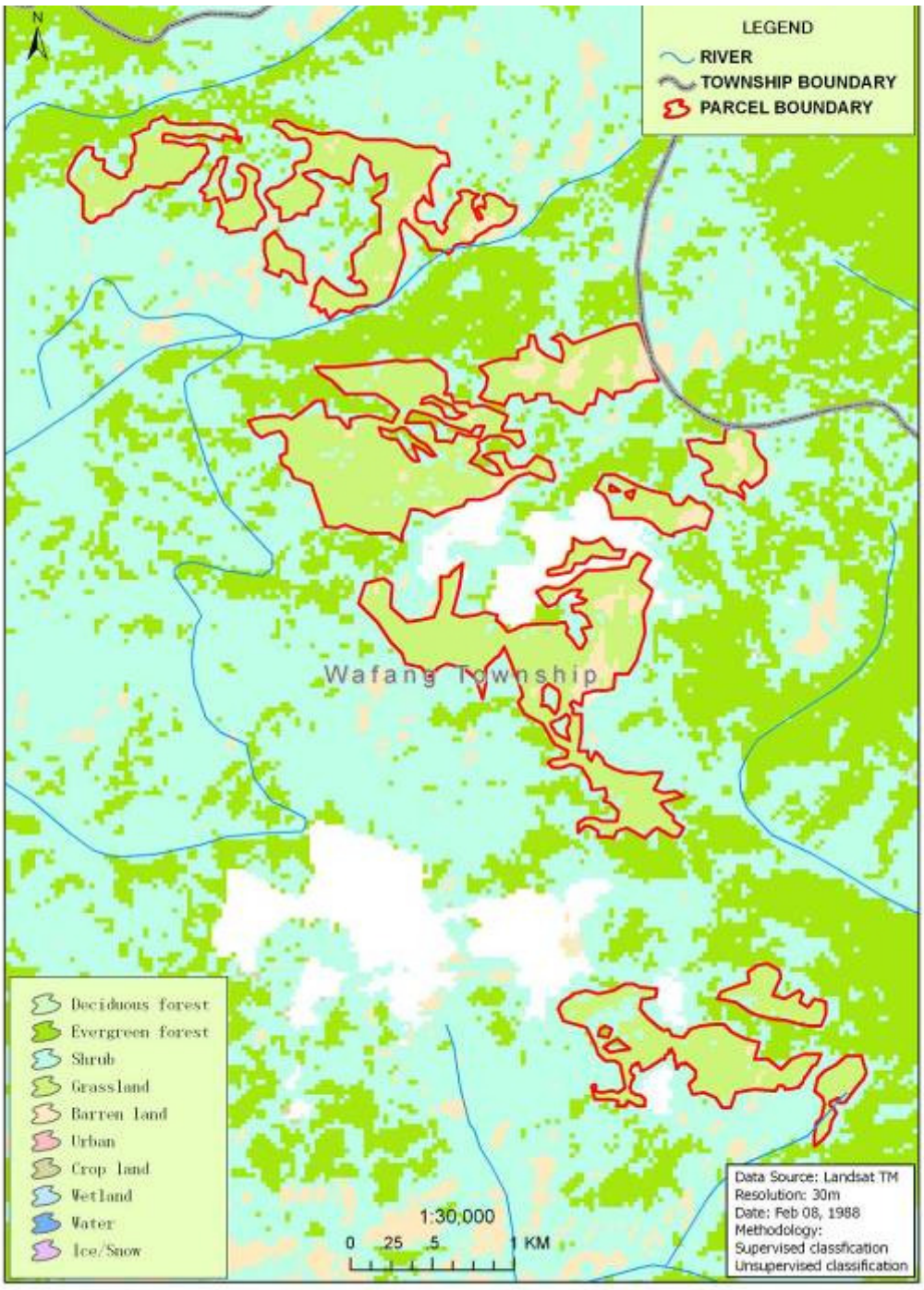


Fig.A-12 Land use/cover map in 1989 in Wadu and Bingma Townships

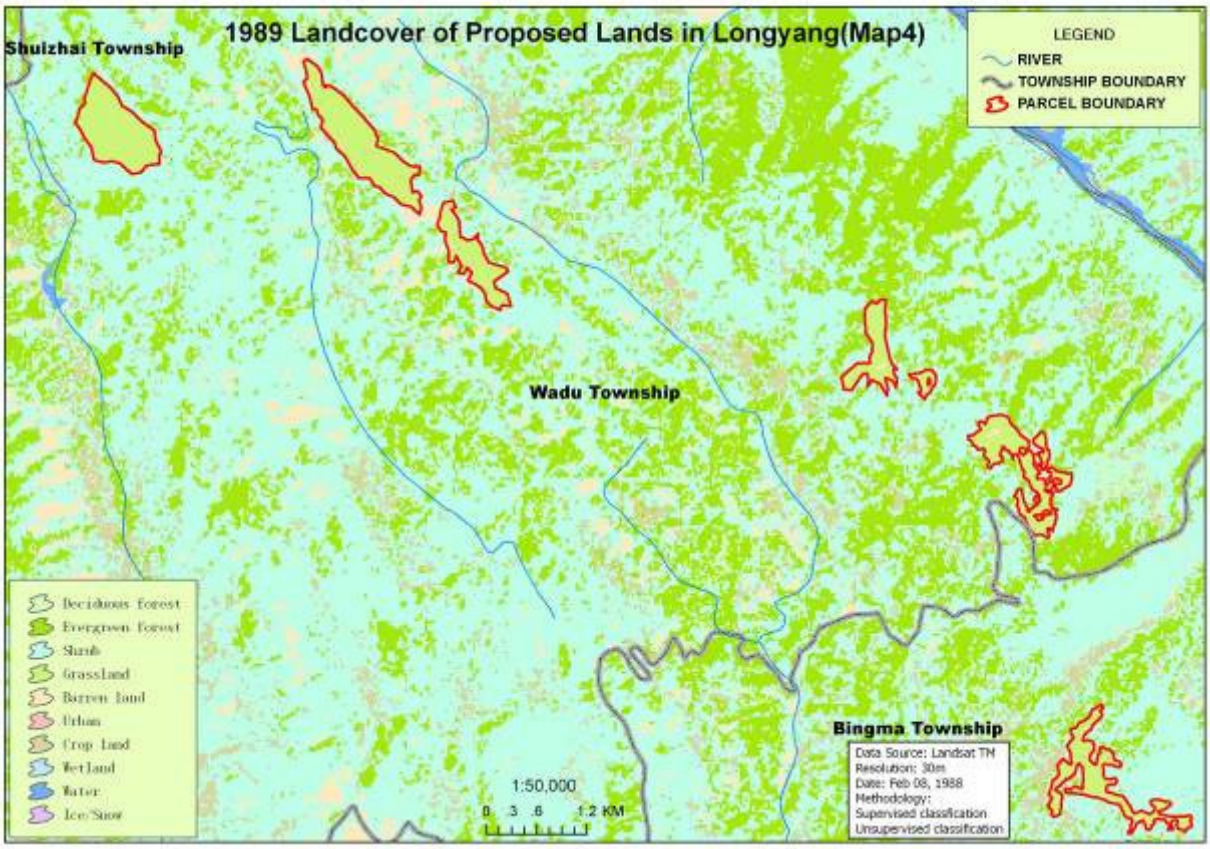
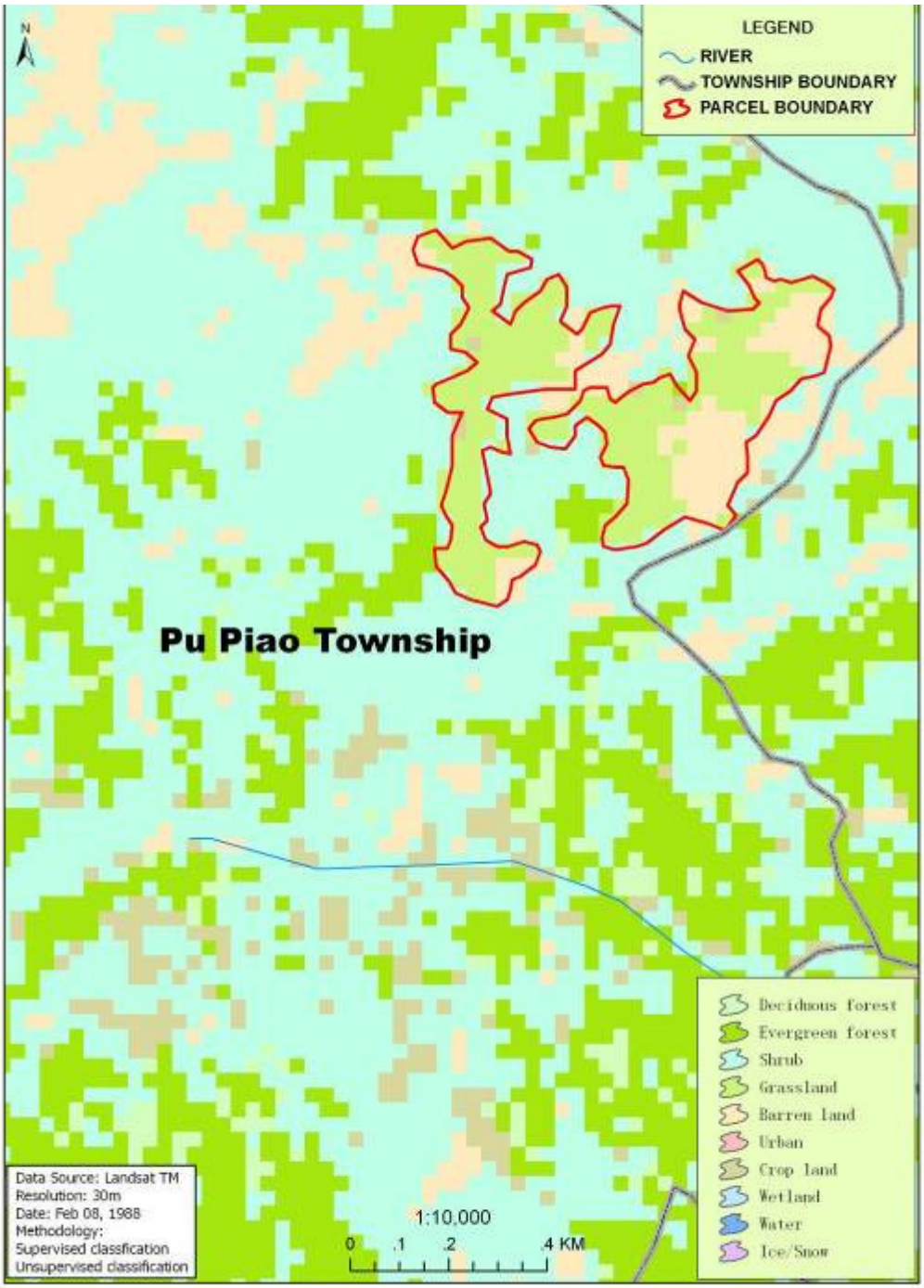


Fig.A-13 Land use/cover map in 1989 in Pupiao Town



A.8. 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.9. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

>>

Table A-7 Estimated amount of net anthropogenic GHG removals by sinks

Summary of results obtained in Sections C.5., D.1. and D.2.				
Year	**Estimation of baseline net GHG removals by sinks (tonnes of CO_2 e)**	**Estimation of actual net GHG removals by sinks (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of net anthropogenic GHG removals by sinks (tonnes of CO_2 e)**
2008	265	-15,265	1	-15,531
2009	290	-79	0	-370
2010	314	21	0	-293
2011	336	223	0	-113
2012	357	289	0	-68
2013	375	1,271	0	896
2014	391	1,918	0	1,527
2015	406	2,738	0	2,333
2016	418	3,735	0	3,317
2017	428	4,896	0	4,468
2018	436	6,201	0	5,764
2019	443	7,617	0	7,175
2020	447	9,112	0	8,665
2021	450	10,651	0	10,200
2022	452	12,199	0	11,747
2023	452	13,727	15	13,260
2024	451	8,726	0	8,276
2025	448	15,404	0	14,956
2026	445	16,600	0	16,155
2027	440	17,698	0	17,257
2028	435	18,692	0	18,256
2029	429	19,580	0	19,151
2030	423	20,365	137	19,805
2031	416	-30,020	0	-30,436
2032	408	15,983	0	15,575
2033	400	16,323	0	15,923

2034	392	16,606	0	16,214
2035	383	16,839	0	16,456
2036	374	17,029	0	16,654
2037	365	17,182	845	15,971
Total (tonnes of CO_2 e)	12,071	246,259	999	233,189

A.10. 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 loans from local commercial banks and participants. 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. Duration of the project activity / crediting period

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

>>01/04/2008

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

>>30 years

B.3 Choice of crediting period:

>> 30 years

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

>> N/A

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

>> 30 years 0 month.

SECTION C. Application of an approved baseline and monitoring methodology

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

>> The Consolidated afforestation and reforestation baseline and monitoring methodology "Afforestation and reforestation of degraded land" (AR-ACM0001/version 01)[5] is applied.

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

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

- Due to soil erosion and/or grazing the lands to be reforested are severely degraded and the lands are still degrading or remain in a low carbon steady state. Most lands are currently covered by herbaceous plants (including grasses and invasive Eupatorium), sparse tiny shrubs and a few spotted growing trees (see table A-3). But the tree crown cover is below the thresholds for defining a forest set by Chinese DNA that are consistent with decision 5/CMP.1 and 16/CMP.1, and would not reach the threshold under continuation of current management (see Annex 3 below). In particular, most of lands are steep rocky lands with thin soil depth and severe soil erosion.
- Unavailability of natural seed sources, poor site conditions and and/or anthropogenic pressures (e.g., grazing), in the absence of human assistance, do not permit the encroachment of natural tree vegetation that leads to the establishment of forests according to the threshold values of the national definition of forest for CDM purposes in China.
- The proposed A/R CDM project activity will not be implemented on organic soils
- There will be no irrigation activity in the proposed A/R CDM project activity.
- Species used in the proposed A/R CDM project activity are not nitrogen-fixing species, thus there will be no greenhouse gas emissions from denitrification.

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

>>

Table C-1 Selection of carbon pools

Carbon Pools	Selected (answer with yes or no)	Justification / Explanation
Above ground	Yes	Major carbon pool subjected to the project activity
Below ground	Yes	Major carbon pool subjected to the project activity
Dead wood	No	As there is only a few pre-project living trees and the lands to be

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

		planted are degraded and degrading or in a low-level steady state, carbon stocks in dead wood in the baseline scenario can be expected to decrease more or increase less, relative to the project scenario. Therefore based on applied methodology, this pool can be conservatively omitted.
Litter	No	As the lands to be planted are degraded and degrading or in a low-level steady state, carbon stocks in litter in the baseline scenario can be expected to decrease more or increase less, relative to the project scenario. Therefore based on applied methodology, this pool can be conservatively omitted.
Soil organic carbon	No	As the lands to be planted are degraded and degrading or in a low-level steady state, and comply to the applicability conditions set in A/R Methodological tool "Procedure to determine when accounting of the soil organic carbon pool may be conservatively neglected in CDM A/R project activities"[6] as follow: a) The lands to be planted are not organic soils (e.g., peat-lands), or wetlands; b) The rate of loss of carbon stocks in mineral soils due to erosion within the project boundary is not be permanently increased above baseline rates by the proposed CDM A/R project activity: As elaborated in Section A.5.4, trees will be planted with low density (1667 trees per hectare) and small hole site preparation (30 cm in diameter or 0.07 m^2). Therefore, the vegetation and surface soil disturbed by site preparation is estimated to be around 1.2% of the total land surface. In addition, the holes will be dug following land contour. c) Fine litter (woody twigs less than 2mm diameter, bark and leaves) will not be collected and removed. As a result, the soil organic carbon stocks in the baseline scenario can be expected to decrease more or increase less, relative to the project scenario. Therefore based on applied methodology, this pool can be conservatively omitted.

Table C-2 GHG emissions by sources other than those resulting from changes in carbon pools

Source	Gas	Included/ excluded	Justification / Explanation
Combustion of fossil fuels used for vehicles	CO_2	Included	Potential significant emission source due to transportation
	CH_4	Excluded	Potential emission is negligibly small as per the methodology applied
	N_2O	Excluded	Potential emission is negligibly small as per the methodology applied
Use of fertilizers	CO_2	Excluded	Not applicable
	CH_4	Excluded	Not applicable

[6] http://cdm.unfccc.int/EB/Meetings/033/eb33_repan15.pdf

Source	Gas	Included/ excluded	Justification / Explanation
	N_2O	Included	Potential significant emission source due to use of synthetic fertilizer in the proposed A/R CDM project activity

There will be no biomass burning either for site preparation or for forest management. Therefore, emissions due to biomass burning are not taken into account.

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

>> The ex ante stratification procedures in Section II.3 of the approved methodology applied have been followed as below.

1. Stratification according to pre-existing vegetation:

Based on field surveys on vegetation, the pre-project vegetations are grouped into three vegetation types. Therefore, 3 baseline strata were identified based on pre-existing vegetation (Table C-3). See also table A-3 and Table annex 3-4 for detail pre-project vegetation and for each baseline stratum and land parcel.

Table C-3 Baseline strata

Baseline strata ID	Area (ha)	Vegetation	Land use	Land ID
BLS-1	827.6	dense Eupatorium, sporadic shrubs and trees	Barren land	ly0101、ly0102、ly0103、ly0104、ly0105、ly0106、ly0107、ly0108、ly0109、ly0110、ly0111、ly0112、ly0113、ly0114、ly0115
BLS-2	422.6	Perennial grasses, no shrub, sporadic trees	Grazing	ly0202、ly0203、ly0204、ly0207、ly0209、ly0210、ly0211、ly0212、ly0213、ly0214、ly0215、ly0216、ly0217
BLS-3	92.0	Eupatorium and grasses, no shrub, sporadic trees	Grazing	ly0302、ly0303、ly0304、ly0305

2. Stratification according to the planned AR CDM project activity:

Since each sub-compartment has same species and time of planting, and each species have same management practices (see also Section A.5.4). Therefore in the project scenario, the lands are stratified into 4 strata based on stand models to be planted (Table C-4).

Table C-4 Project Strata

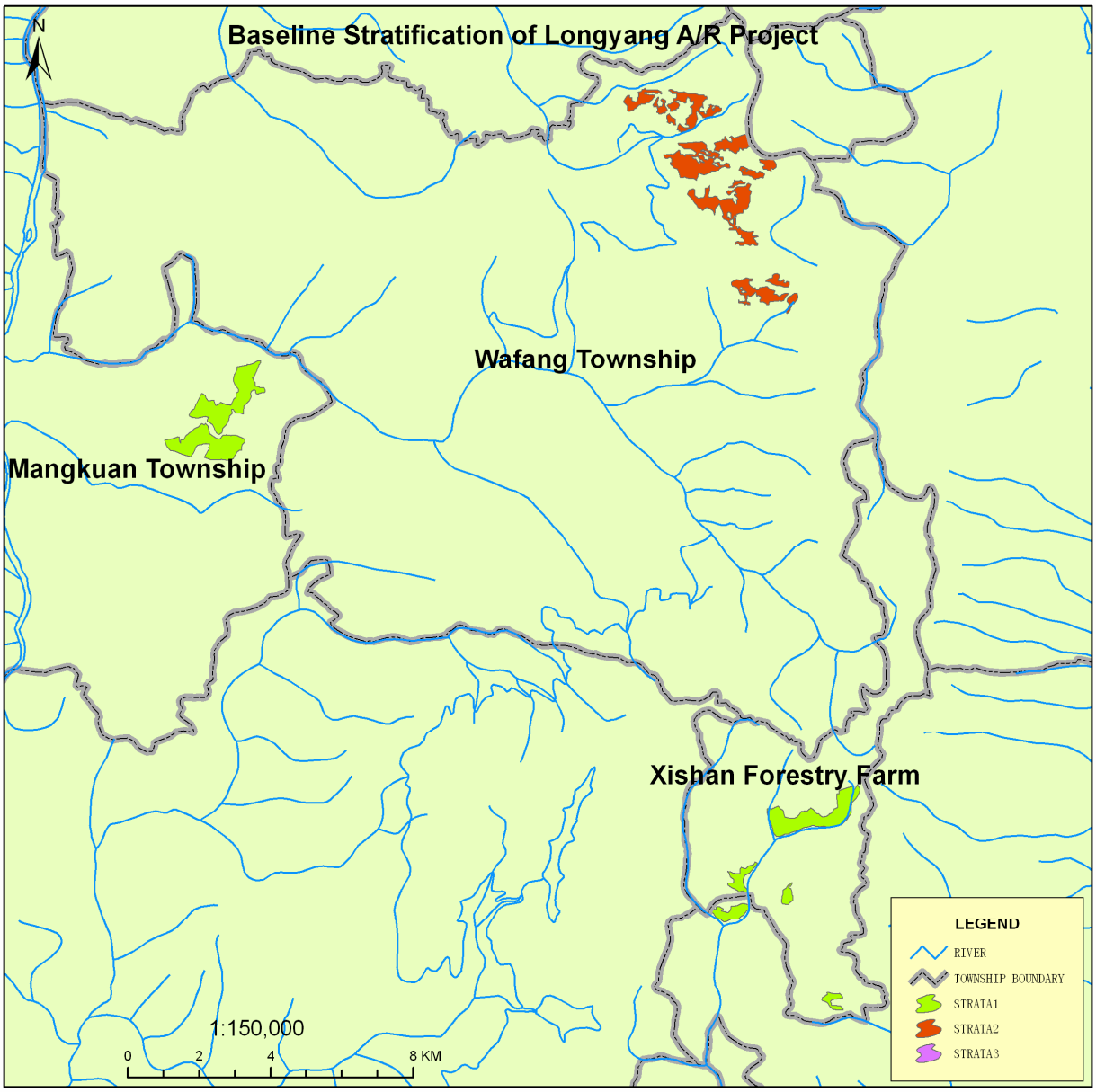
Strata ID	Stand model	Area (ha)
PS- I	Armandi pine + Yunnan pine	922.9
PS- II	Yunnan pine + Szemao pine	29.1
PS- III	Armandi pine	168.3

PS- IV	Szemao pine	221.9

3. Mapping stratification:

Both the baseline stratification and project stratification described above have been built into GIS platform and stratification maps have been produced (see Fig C-1 and Fig. A-8 for an example of baseline stratification map and project stratification map). Since the stratification is based on project maps, the strata boundary is well consistent with project boundary.

Fig. C-1 Example of baseline stratification map



C.5. Identification of the baseline scenario:

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

>> As requested by the applied methodology, the most plausible baseline scenario has been determined using A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities"[7].

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

>> Using A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities"[7], the baseline scenario for all strata is to maintain the current status (the abandoned barren lands or illegal grazing land), see Section C.6 for details. Under the baseline scenario, land cover will continue to decrease or, at best, remain constant, and the natural return of trees is unlikely to occur, because:

a） There are few if any seed source that can disperse onto the project sites due to the large size of the project lands and their far from adjacent forests.

b） Although there are spotted growing trees, the grass and shrub cover, particularly the invasive weed, prevents seeds from landing on mineral soil and competes with young seedlings. This is also supported by the fact that the lands to be reforested have been non-forested lands at least since mid 1980s

The project areas would remain degraded and would continue to degrade or remain in a steady state at low level in the absence of the project activity because:

a） The field surveys, interviews with stakeholders (Section H 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 (keeping barren status or illegal grazing) 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.

b） 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 6.94% which is much lower than the required rate of return (RRR) by Chinese government (see step 3 of Section C.6 for details). There are also apparent investment barriers and other barriers that prevent the implementation of the type of the project activity (see also step 2 of Section C.6 for detail).

Under the baseline scenario, the carbon stock in living biomass of non-tree vegetation will remain steady or decrease due to the continual degradation of the lands. Therefore, the baseline carbon stock changes can be estimated as the sum of carbon stock change in pre-project living biomass in the absence of the proposed A/R CDM project activity.

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

C.6. Assessment and demonstration of additionality:

>> The steps as outlined in the A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities"[7] are followed to demonstrate that the proposed A/R CDM project activity is additional and not the baseline scenario. Both barrier arguments and investment analysis (steps 2 and 3) are applied.

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

The proposed A/R CDM project started on 1 April 2008, and the proof that the lands to be planted are eligible for the A/R CDM project activity has been detailed in Section A.7 above based on the definition of forest per Chinese DNA, land use/cover maps of 1990 and 1999, field surveys and interviews with local communities.

The incentive of planned sale of GHG emission allowances is evidenced by the project implementation plan by the Conservation International (CI), baseline survey that was conducted in the summer 2006 and cooperative contracts signed by the operating entity and local communities. Without the GHG allowance sales, the project would not be economically attractive, and would face significant barriers.

STEP 1: Identification of alternative land use scenarios to the proposed A/R CDM project activity

Sub-step 1a: Identify credible alternative land use scenarios to the proposed CDM project activity

Using procedures below to identify credible alternative land use scenarios to the proposed CDM project activity:

a） **Analyzing the historical and existing land-use / land-cover changes, and identifying key factors that influence the land-use / land-cover changes over times:** As presented in table A-3, lands to be planted within the project boundary had historically been forested lands before 1950s-1980s. However, the areas suffered several large-scale events of deforestation since then, mainly caused by unreasonable policies. The first large scale of deforestation occurred during the "Steel and Iron Campaign" in 1958-1959, followed by continuous damage and/or agricultural cultivation during "Cultural Revolution" period (1966-1976). Some lands were deforestated in early 1980s due to an unsuccessful land tenure reform in which lands including remaining 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, the project lands had become non-forested lands by the mid 1980s. Nevertheless, human intervention did not halt on these lands, but continued as fuelwood and over-grazing. Due to the consecutive human interventions and severe soil erosion, the lands have severely degraded. Currently, the lands are degraded barren lands of low productivity or grazing lands, covered with some grasses, sparse tiny shrubs and spotted trees. Most of lands are occupied by invasive plant. Since all lands within the project boundary are legally forestry lands, the current grazing activities are illegal. The crown cover of the spotted trees is below 20% that is the threshold of forest definition in China, and will not exceed 20% with continuation of current management such as grazing, fuel wood collection, as well as soil erosion. Due to lack of seed sources and impacts of vegetation especially the invasive plant, natural encroachment of trees is unlikely to occur.

b） Interview with local farmers, forestry farm staff and nature reserve staff indicated that crown cover of both tree and non-tree vegetation have been decreasing in the last decades due to illegal grazing, and/or fuelwood collecting as well as soil erosion (see Section H). An invasive weed,

Eupatorium (Eupatorium adenophorum), occupies some of the project land. Under the current conditions, the land will continue to degrade and soil erosion will accelerate. This will result either in the continued decrease of the carbon stocks both in living biomass and soils, or at least, maintenance of these stocks at a low level.

c） National, local and sectoral land-use policies or regulations

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 reforestation. The villages owning lands were allowed to be contracted with farmers for forestry purposes, with 30-50 years 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) that subsidizes farmers to convert cropland on steep slope to forests, the Intensively Managed Commercial 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.

Although these programs had 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), none of the programs are targeted to degraded lands. The commercial timber plantation base program usually target to productive lands with high economic return. Moreover, 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 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 programmers. In addition, local farmers/communities are usually not able to fully finance forest establishment because it is difficult for them to get loans from local banks for the purpose of reforestation on remote degraded lands (loans for agricultural activities and reforestation on near and non-degraded economically attractive lands are much easier to obtain).

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

Since the lands to be planted are restricted to forestry purposes by governments, other land uses are impossible, therefore the above analysis comes to a conclusion that the plausible alternative land uses available to the project participants are::

- The proposed project not undertaken as an A/R CDM project;
- Continuation of current barren lands or illegal grazing lands.

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

Current laws and/or regulations allow the continuation of the current situation and the reforestation on the degraded lands. Therefore, the identified alternatives are entirely in compliance with applicable legal and regulatory requirements, currently and in the foreseeable future.

STEP 2: Barrier analysis

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

a) Investment barriers

- Lack of access to credit: No credit mechanisms are in place for farmers to make long term investment in plantation forestry. Agricultural are the main income sources for local communities in the project area. However, 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$ 143 with the lowest at US$ 74 in Sanping Village of Wadu Townahip (see Table G-1). Under this situation, local farmers are living far 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 in a shorter period following the start of the proposed A/R project activity.
- Debt funding not available for this project activity: The chance to get long-term commercial loans from banks for the purpose of reforestation is low in the project area due to high risk and the economical unattractiveness in the context of remote lands (loans for agricultural activities and a few short-term fast-growing species reforestation on non-degraded economically attractive lands nearby are a bit easier to obtain). With the proposed A/R CDM project activity, the loan from local commercial banks becomes easier.
- The forestry farm and the nature reserve are financially independent accounting enterprise. The existing forest resources that allow to be harvested annually and the harvest amount of license approved by government are quite limited. There is even no harvest for the nature reserve for the purpose of conservation. The revenue from timber harvest can only afford to the regeneration of forests and the operation of the forestry farm including the salary. In many cases the farm has to find other income sources for the forest regeneration on the slashed lands. In addition to the unavailable debt funding from banks, as elaborated above, it is difficult for the farm and the nature reserve to reforest on the remote degraded lands in the absence of the proposed A/R CDM project activity.

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. The forestry farms and the nature reserve are experienced for reforestation on lands nearby with good conditions but have no experiences on remote degraded lands as all of their previous reforestation activities occurred on lands that are easily accessible and have good site and soil conditions (planting and management are more easier).

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. The foresetry and nature reserve have less institutional barriers.

d) Market risks: Currently the risks of timber market, are perceived to be high by the project participants because the nature of remote degraded lands with low productivity and high transportation costs, which cause the high cost of the timber production, would largely reduce the marketing competitive capacity. As the price per unit of carbon credit is guaranteed in the proposed A/R CDM project activity by means of a contract with the credit buyers, this provides the certainty of future incomes. Although the market risks do exist for all other reforestation projects, the higher productivity of other projects in other areas tends to reduce the risks. Without the sale of carbon credit, the basic financial considerations and the risk awareness cited above would drive the decision not to go ahead with the project.

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

The alternative land use scenario "proposed project not undertaken as an A/R CDM project" identified in sub-step 1a above can be eliminated from land use scenarios due to barriers faced. The alternative land use (continued status as barren or grazing land use) does not face the above-mentioned barriers.

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

Is forestation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier?

→ no, then:

Does the list contain only one land use scenario?

→yes, the remaining land use is the baseline scenario.

STEP 3: Investment analysis

Sub-step 3a. Determine appropriate analysis method

The benchmark analysis method (Option III) is chosen. The PIN Financial Analysis spreadsheet developed by the World Bank BioCarbon Fund[8] is used to conduct the investment analysis in which Financial Internal Return Rate (FIRR) with and without the carbon benefit are the relevant indicators.

Sub-step 3b – Option III: Apply benchmark analysis

The required rate of return (RRR) on equity is 8% for investment projects based on the standard issued by the National Reform and Development Comission (NDRC) [9] which is applicable to forestry projects. This means projects can be approved by the government or adopted by forestry enterprises only when their FIRR is expected to be higher than this threshold value.

Sub-step 3c. Calculation and comparison of financial indicators.

[8] www.biocarfund.org

[9]NDRC et al. 2006. Economic analysis methods and parameter for construction project (version 3). China Planning Press

The FIRR of the proposed A/R CDM project activity was calculated below, both without and with carbon finance, and is 6.94% and 9.08% (at $8.00 per tonne of CO_2-e). When carbon benefit was included, the FIRR exceeded the benchmark so that the proposed A/R CDM project activity is financially attractive. When carbon benefit 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.

Detailed calculation is summarized as following:

The planting is proposed to be conducted in the year 2008. The cost for forest establishment (US$/ha) in the first 3 years after planting are listed in Table C-5 below. The cost is estimated based on budget standards for afforestation/reforestation in the National Natural Forestry Conservation Program and the Grain For Green Program, the standard for project budgeting in Yunnan Province, market information issued by Provincial and local governments in 2006, in combination of local social-economic and market profiles. Costs for weeding and fire and disease control will occur through 2008-2010.

Table C-5 Establishment costs in US$/ha

Items	Armandi pine	Yunnan pine	Szemao pine
1 Establishment	529	496	796
1.1 site preparation	86	86	86
1.2 seedlings	115	81	382
1.3 planting	171	171	171
1.4 weeding (3 years)	86	86	86
1.5 fertilization (3 years)	71	71	71
2 Equipment and infrastructure	25	25	25
2.1 road and protection	25	25	25
2.2 tools	0	0	0
3 Other costs (designing, training, technical demonstration and consultation, administration, supervision and, etc)	199	203	222
4 Total	753	724	1044

The operation costs include thinning and harvesting, timber 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 and non-wood product and carbon credits.

Table C-6 Parameters for operating costs and revenues

Items	Item	*Armandi pine*	*Yunnan pine*	*Szemao pine*
First thinning	Standing volume at thinning (m^3/ha)	24.7		16.8
	Timber output ratio (%)	65		65
	Thinning timber output (m^3/ha)	16.1		10.9
Second thinning	Standing volume at thinning (m^3/ha)			35.0
	Timber output ratio (%)			65

	Thinning timber output (m^3/ha)			22.8
Harvest	Standing volume at harvest (m^3/ha)	66.7	95.1	118.7
	Timber output ratio (%)	60	55	55
	Harvest timber output (m^3/ha)	40.0	52.3	65.3
Harvest cost	Timber (US$/$m^3$)	7.9	7.9	7.9
Transportation cost	Timber (US$/$m^3$)	0.3	0.3	0.3
Selling price	Timber (US$/$m^3$)	157.1	142.9	142.9
Maintenance and operation cost	(US$/ha)	79	79	79
Tax (% if grow income)		15%	15%	15%

Sup-step 3d: 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 21.8% of the total cost (0.48 versus 2.20 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 these most important factors show that the FIRR without carbon will be below RRR (8%) in the case of (Table C-7)

- 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 C-7 Sensitive analysis

Parameters	Variation	FIRR (%)
	Without carbon benefit	
Product price	+10%	7.54
	-10%	6.24
Product Output	+10%	7.54
	-10%	6.24
Operating cost	+10%	6.71
	-10%	7.16
	With carbon benefit	
Product price	+10%	9.56
	-10%	8.55

Product Output	+10%	9.56
	-10%	8.55
Operating cost	+10%	8.88
	-10%	9.29

STEP 4: Common practice analysis

There has been very limited reforestation in the project regions in the past. The reforestation was mainly established years ago by a small number of relatively wealthy communities and farmers at a time when there were not many alternative investment opportunities. As it was not profitable and there was little market incentive, the activities could not be extended by investors. As the cost of labour and planting materials including seedling and fertilizers has increased significantly in recent years, the farmers and forest farm are not willing to plant trees in remote, degraded land, which is not economically attractive. This is consistent with the above financial analysis results, which indicates that reforestation is economically unattractive in the absence of proposed A/R CDM project activity, due to slow tree growth, low land productivity and high transportation costs.

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.

- 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, which is secure and thus advantageous to add to the other products (such as wood products) that have an uncertain market price in the future. Income from carbon credit depends on reaching the growth objectives, whereas income from timber depends 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 carbon credits are the only income of the project that can be estimated and expected with a reasonably low market risk. Thus carbon credit can be seen as the means to ensure the proposed A/R CDM project activity, if timber has a lower market price in the future, at least does not incur a loss. With that, the local farmers/communities and operating entities are interested in it.
- As stated above, local farmers/communities usually cannot afford stand establishment and it is difficult for them to get loans from banks for the purpose of reforestation on remote degraded lands. The proposed A/R CDM project activity with its carbon benefits can make it easier for local farmers/communities and forestry farms to obtain loans from local commercial banks.
- The local forestry agencies as well as 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.

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

>>The baseline net removals by sinks are the sum of the carbon stock changes in carbon pools in the absence of the proposed A/R CDM project activity. As demonstrated above, the baseline scenario is the

continuation of current degraded/degrading or steady state, under which the carbon stock changes in dead wood, litter and soil organic matter are conservatively assumed to be zero based on the methodology applied. The baseline net removals by sinks are therefore estimated as the carbon stock changes in living biomass of pre-project trees. Please see Annex 3 for the detail calculation and Table annex 3-7 and Table annex 3-8 for the baseline carbon stock changes.

Table C-8 Numerical values and sources of all data used in the calculation of baseline net removals by sinks

ID number	Data variable	Data unit	Value applied	Data source	Comment
BS001	*Armandi pine growth curve*	*equation*	$SV = 0.228 * (1 - e^{(-0.07*A)})^{5.4474}$	*An,1995*	*e*
BS002	*Alnus growth curve*	*equation*	$SV_{(t)} = 0.880452 \cdot (1 - e^{(-0.039517 \cdot A)})^{2.912148}$	*Fitted using data from Forestry inventory in Yunnan Prov in1992,1997 and 2002*	*e*
BS003	*Armandi pine wood density*	*t.d.m.m^{-3}*	*0.396*	*National inventory*	*d*
BS004	*Alnus wood density*	*t.d.m.m^{-3}*	*0.443*	*National inventory*	*d*
BS005	*BEF for Armandi pine*	*Dimension-less*	*2.028*	*National inventory*	*d*
BS006	*BEF forAlnus and walnut*	*Dimension-less*	*1.423*	*National inventory*	*d*
BS007	*Root-shoot ration for Armandi pine*	*Dimension-less*	*0.171*	*National inventory*	*d*
BS008	*Root-shoot ration for Alnus and walnut*	*Dimension-less*	*0.313*	*National inventory*	*d*
BS009	*Carbon fraction*	*Dimension-less*	*0.5*	*IPCC*	*d*

Table C-9 Estimated baseline net removals by sinks

Year	Annual estimation of baseline net anthropogenic GHG removals by sinks in tonnes of CO_2 e
2008	265
2009	290

2010	314
2011	336
2012	357
2013	375
2014	391
2015	406
2016	418
2017	428
2018	436
2019	443
2020	447
2021	450
2022	452
2023	452
2024	451
2025	448
2026	445
2027	440
2028	435
2029	429
2030	423
2031	416
2032	408
2033	400
2034	392
2035	383
2036	374
2037	365
Total estimated baseline net GHG removals by sinks (tonnes of CO2 e)	12,071
Total number of crediting years	30
Annual average over the crediting period of estimated baseline net GHG removals by sinks (tonnes of CO2 e)	402

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

>> Date of completion of baseline study: June 15, 2007

Name of person/entity determining the baseline:

The Nature Conservancy China program: Jian Ma, jma@tnc.org.cn

Yunnan Forestry Department Carbon Sequestration Office:

Zeyuan Xia, **xia_zy1974@163.com**

Tao Liu, **ivanlt@163.com**

Tengwei Su, **ynfccb@163.com**

Baoshan Forestry Bureau Carbon sequestration office: Tianshuang Zheng, ylz212120856@126.com

Chinese Academy of Forestry: Xiaoquan Zhang, **xiaoquan@caf.ac.cn**

All of these persons or entities are not project participants.

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

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

>> The actual net greenhouse gas removals by sinks represent the sum of the changes in carbon stocks in the carbon pools within the project boundary, minus the increase in non-CO_2 GHG emissions measured in CO_2 equivalents by sources that are increased as a result of the implementation of the proposed A/R CDM project activity, while avoiding double counting, within the project boundary, attributable to the A/R CDM project activity. Based on the approved methodology applied, the aboveground biomass and belowground biomass are the pools to be accounted for.

a. Estimate of carbon stock changes in living biomass under the project scenario

Methods and procedures described in Section II.5 of the applied methodology have been followed below.

a.1 Loss of pre-project tree and non-tree vegetation

It is conservatively assumed that all pre-project tree and non-tree vegetation will be died out. Therefore, the carbon stock loss of pre-project tree and non-tree vegetation equals to the carbon stock at the start of the proposed A/R CDM project activity, which has been estimated using equation (1)-(4) in the A/R Methodological Tool "Estimation of emissions from clearing, burning and decay of existing vegetation due to implementation of a CDM A/R project activity"[10] (Table D-1, see Annex 3 for detail estimation). All carbon loss is accounted in the year 2008.

Table D-1 carbon loss of pre-project tree and non-tree vegetation

Baseline strata ID	Area (ha)	Carbon loss (tCO_2)								
		Non-tree vegetation			Trees			Total		
		AGB	BGB	Sub-total	AGB	BGB	Sub-total	AGB	BGB	Total
BLS -1	827.6	2,488	6,888	9,377	77	18	95	2,565	6,906	9,471
BLS -2	422.6	341	3,209	3,550	127	36	162	467	3,245	3,712
BLS -3	92.0	799	916	1,716	246	71	317	1,046	987	2,033
Total	1342.2	**3,629**	**11,014**	**14,642**	**449**	**124**	**574**	**4,078**	**11,138**	**15,216**

Note: AGB: aboveground biomass; BGB: belowground biomass

a.2 Estimates of carbon stock changes in living biomass of planted trees

BEF method as presented in Section II.5.1.1 and formula (15) and (16) of the approved methodology applied is used.. As presented in table C-4, the only difference among project strata is tree species and the management model for each species is identical. Therefore, in applying the equations of the approved methodology, stand model is neglected.

Local growth curves are used for projecting growth of planted trees:

[10] http://cdm.unfccc.int/EB/Meetings/036/eb36_repan20.pdf

Yunnan pine[11]: $V_{(t)} = NT_{(t)} 0.200346 \cdot (1 - e^{(-0.054764 \cdot A)})^{2.978562}$

Armandi pine[12]: $V_{(t)} = NT_{(t)} \cdot 0.228 * (1 - e^{(-0.07 \cdot A)})^{5.4474}$

Szemao pine[13]: $V_{(t)} = NT_{(t)} \cdot 0.0000166068 \cdot A^{2.85001}$

Where

$V_{(t)}$	stem volume at time *t* for the project scenario, m^3 ha^{-1}
$NT_{(t)}$	Number of trees at time *t*, tree ha^{-1}
A	Stand age, year

These curves were used to estimate the average merchantable volume per tree and per hectare of each species of plantation. Taken into account natural mortality, the number of trees is assumed to be 80% of initial planting density (the survival rate in third year after planting usually reaches to 85-90% in the project area). There will be no fuelwood gathering of living trees. Thinning will also be accounted based on forest management plan for each project stratum (Table C-4). The average merchantable volume is then converted into carbon stock and carbon stock changes in aboveground biomass and belowground biomass via wood density (WD) and Biomass Expansion Factors (BEF) and root-shoot ratio (R) (Table D-2) based on equation (15)-(18) presented in the approved methodology applied, using LULUCFSequestrationInput Tools developed by the World Bank BioCarbon Fund (www.biocarfund.org). The carbon stock and carbon stock changes of the planted trees are summarized in Table D-3 and Table D-4 respectively. Please see attached spreadsheet for the detail calculation.

Table D-2 Wood density, BEF and Root-shoot ratio for species used[14]

Tree species	Wood Density (tonnes d.m.m^{-3})	BEF	Root-shoot ratio
Armandi pine	0.396 (14,0.017)	2.028 (19, 0.076)	0.171 (24, 0.006)
Yunnan pine	0.482 (17, 0.009)	2.085 (6, 0.833)	0.195 (7, 0.033)
Szemao pine	0.454 (33, 0.034)	1.583 (6, 0.080)	0.159 (6, 0.011)

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

[11] Derived using data from forestry inventory that have been conducted once every 5 years

[12] An, Heping. 1988. Growth curves for plantation of Masson pine, Chinese fir and Armandi pine. Central South Forest Investory and Planning, (2):13-19

[13] Wang Jingchang. 1990. Analysis on growth of Szemao pine plantation. Forest Inventory and Planning, 1990, (3):1-6

[14] Institute of Forest Ecology, Environment and Protection, CAF, Updated Database for China GHG Inventory in Forestry Sector.

Table D-3 Estimated carbon stock changes in living biomass of planted trees

	Carbon stock (t C)			Carbon stock changes (t CO_2/yr)		
	Aboveground	belowground	total	Aboveground	belowground	total
2008	0	0	0	0	0	0
2009	4	1	5	16	3	19
2010	43	8	51	142	26	168
2011	140	26	165	354	65	419
2012	319	59	378	659	120	780
2013	613	112	725	1,076	195	1,271
2014	1,056	191	1,248	1,626	292	1,918
2015	1,690	304	1,994	2,324	415	2,738
2016	2,555	458	3,013	3,173	562	3,735
2017	3,691	658	4,348	4,163	734	4,896
2018	5,129	910	6,039	5,275	925	6,201
2019	6,898	1,219	8,117	6,485	1,133	7,617
2020	9,015	1,587	10,602	7,762	1,351	9,112
2021	11,490	2,017	13,507	9,076	1,575	10,651
2022	14,326	2,508	16,834	10,399	1,800	12,199
2023	17,518	3,059	20,578	11,706	2,021	13,727
2024	19,531	3,426	22,957	7,381	1,346	8,726
2025	23,113	4,046	27,159	13,132	2,272	15,404
2026	26,973	4,712	31,686	14,156	2,444	16,600
2027	31,090	5,422	36,512	15,096	2,602	17,698
2028	35,440	6,170	41,610	15,948	2,744	18,692
2029	39,997	6,953	46,950	16,710	2,871	19,580
2030	44,738	7,766	52,504	17,384	2,981	20,365
2031	37,714	6,602	44,317	-25,753	-4,267	-30,020
2032	41,433	7,243	48,676	13,635	2,348	15,983
2033	45,232	7,896	53,128	13,929	2,394	16,323
2034	49,098	8,559	57,656	14,174	2,432	16,606

2035	53,019	9,230	62,249	14,377	2,462	16,839
2036	56,985	9,908	66,893	14,543	2,485	17,029
2037	60,988	10,591	71,579	14,678	2,504	17,182

Table D-4 Carbon stock changes in living biomass of planted trees for project strata

	Carbon stock (t C)				Carbon stock changes (t C/yr)			
	PS-1	PS-2	PS-3	PS-4	PS-1	PS-2	PS-3	PS-4
2008	0	0	0	0	0	0	0	0
2009	5	0	0	0	17	1	0	0
2010	35	4	0	13	110	12	0	47
2011	109	11	0	45	272	29	1	118
2012	246	25	3	105	502	51	9	219
2013	468	46	11	199	817	77	31	347
2014	806	75	31	337	1,237	105	74	503
2015	1,290	111	71	523	1,775	135	144	685
2016	1,953	157	137	767	2,433	166	244	892
2017	2,827	211	239	1,073	3,203	198	372	1,124
2018	3,936	273	382	1,450	4,066	230	525	1,381
2019	5,299	345	572	1,903	4,997	262	697	1,661
2020	6,926	425	813	2,439	5,969	294	884	1,966
2021	8,823	513	1,107	3,064	6,953	326	1,078	2,293
2022	10,983	611	1,454	3,786	7,923	358	1,273	2,644
2023	13,398	717	1,854	4,609	8,854	389	1,464	3,018
2024	16,051	723	2,303	3,877	9,727	22	1,646	-2,682
2025	18,921	826	2,798	4,609	10,524	378	1,815	2,683
2026	21,985	936	3,334	5,424	11,235	401	1,968	2,991
2027	25,218	1,052	3,908	6,329	11,851	425	2,103	3,315
2028	28,591	1,174	4,513	7,325	12,368	448	2,218	3,654
2029	32,078	1,302	5,144	8,418	12,785	471	2,313	4,008
2030	35,651	1,437	5,795	9,612	13,102	494	2,388	4,377
2031	30,787	1,364	4,523	7,637	-17,835	-268	-4,664	-7,243

2032	33,567	1,484	4,996	8,622	10,193	440	1,736	3,612
2033	36,352	1,608	5,474	9,686	10,214	456	1,750	3,901
2034	39,129	1,736	5,952	10,831	10,180	472	1,753	4,201
2035	41,882	1,870	6,428	12,062	10,095	488	1,745	4,511
2036	44,600	2,007	6,899	13,379	9,966	505	1,728	4,831
2037	47,272	2,149	7,363	14,787	9,798	522	1,703	5,161

b. Estimates of the increase in GHG emissions by sources

The direct N_2O emission caused by fertilizer application is expected to be the only GHG emissions by sources within the project boundary increased as a result of the implementation of the A/R CDM project activity. There will be no other GHG emissions by sources because:

- The site preparation, planting, fertilization, thinning as well as the logging in the proposed A/R CDM project activity will be conducted manually, without using machinery tools that consume fossil fuel, i.e., $E_{FuelBurn}$=0;
- There will be no biomass burning during site preparation thus GHG emissions from slash and burn activity are nil, i.e., $E_{BiomassBurn}$=0;
- No irrigation will be used in the proposed A/R CDM project activity.

Therefore, $GHG_E = N_2O_{direct-Nfertilizer}$

At the first 4 years of after planting, compound synthetic fertilizer, with a nitrogen content of 10%, will be applied. The amount of fertilizer to be applied is 50g per tree at the time of planting, 100g per tree in the second year, 150g per tree in the third year, and 200g per tree in the fourth year. The total amount of nitrogen to be applied per year was calculated based on the amount per tree, planting density and planting area. Using formula (1) and (3) in A/R Methodological tool "Estimation of direct nitrous oxide emission from nitrogen fertilization"[15], the direct N_2O emissions were then estimated to be 490 tCO_2 e, including 49 tCO_2 e in 2008, 98 tCO_2 e in 2009, 147 tCO_2 e in 2010 and 196 tCO_2 e in 2011. During the estimation, default values 0.01 and 0.1 from 2006 IPCC Guidelines were used for emission factor for emissions from N inputs (EF_1) and fraction that volatilises as NH3 and NOx for synthetic fertilizers, respectively.

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

>> Based on the approved baseline and monitoring methodology applied, there are three potential sources of the leakage (LK):

- GHGs emissions caused by vehicle fossil fuel combustion due to transportation of seedling, labours, staff and harvest products to or from project sites, $LK_{Vehicle}$;

[15] http://cdm.unfccc.int/EB/Meetings/033/eb33_repan16.pdf

- Carbon stock decreases caused by displacement of pre-project grazing and fuelwood collection activities, $LK_{ActivityDisplacement}$;
- Carbon stock decreases caused by the increased use of wood posts for fencing, $LK_{fencing}$.

a. Estimation of $LK_{Vehicle}$

Labors used for the proposed A/R CDM project activity are from local villages, hence transportation for labors is not needed. All seedlings used in the proposed A/R CDM project activity will be bred either in local nuseries or bought from nurseries nearby and tranported to the project lands. There is also a need for transporting thinned or harvested timber. A medium size track, heavy track, livestock and manpower will be used, depending on the location of the project lands. Based on the amount of seedlings and seed needed for reforestation and the expected output of thinned or harvested timber, the leakage caused by vehicle use is estimated using equation (2) and (3a) in A/R Methodological Tool "Estimation of GHG emissions related to fossil fuel combustion in A/R CDM project activities"[16] and equation (35) in Section II.6.1 of the approved methodology AR-ACM0001/version 01 applied for each parcel of land and each species. The emission factor is 2.6353 kg CO_2 litre^{-1} for diesel and 2.49 kg CO_2 litre^{-1} for gasoline for all vehicle (from China's national initial national communication). The expected leakage is 999 t CO_2-e by the end of the crediting period (Table D-5 below).

Table D-5 Estimateed leakage from transportation

Year No.	Year	Annual Leakage (t CO_2-e yr^{-1})	Cumulative Leakage (t CO_2-e)
1	2008	1	1
2	2009	0	1
3	2010	0	1
4	2011	0	1
5	2012	0	1
6	2013	0	1
7	2014	0	1
8	2015	0	1
9	2016	0	1
10	2017	0	1
11	2018	0	1
12	2019	0	1
13	2020	0	1
14	2021	0	1
15	2022	0	1
16	2023	15	16
17	2024	0	16
18	2025	0	16
19	2026	0	16
20	2027	0	16
21	2028	0	16
22	2029	0	16
23	2030	137	153
24	2031	0	153

[16] http://cdm.unfccc.int/EB/Meetings/033/eb33_repan14.pdf

25	2032	0	153
26	2033	0	153
27	2034	0	153
28	2035	0	153
29	2036	0	153
30	2037	845	999

b. Estimation of $LK_{ActivityDisplacement}$

Some lands to be planted in the proposed A/R CDM project activity are subjected to fuelwood collection, and some parcels of lands have grazing animals although this is illegal. Thus, as the result of the project activity, grazing and fuelwood collection may be temporarily or permanently displaced from the project sites to other locations. The displacement may result in leakage if the new grazing areas are obtained by converting stocked areas, particularly forests, to grazing land, and if the displaced fuelwood collection results in degradation or deforestation of forests and devegetaion of other lands.

b.1. Estimation of $LK_{Conversion}$ (Leakage due to conversion of land to grazing land)

The pre-project animal population and the number of grazing month from different livestock groups on lands within the project boundary and outside the project boundary that are under the control of the project participants have been surveyed using Participatory Rural Appraisal (PRA), with a result summarized in Table D-6 below. The annual biomass intake of the animals over the project lands and existing grasslands is estimated using equation (3) in the A/R methodological tool "Estimation of GHG emissions related to displacement of grazing activities in A/R CDM project activity"[17] and the required area to accept displaced animals is estimated using equation (4) of the methodological tool. DMI_g is from Table 3 in methodological tool. The total annual net primary production (*ANPP*) is estimated based on land area and ANNP per hectare which is default values from Table 3.4.2 of IPCC good practice guidance LULUCF.

Table D-6 indicates that there are sufficient existing grazing lands under the control of the project participants that can adopt displaced animals, i.e. even if all pre-project animals are displaced to existing grasslands outside the project boundary but under the control of the project participants, the existing grazing lands are still under the grazing capacity. Therefore, $LK_{Conversion} = 0$.

b.2. Estimation of $LK_{fuelwood}$ (Leakage due to displacement of fuelwood collection)

Trees can be harvested only when the local government issues a harvest licence. Such a licence is usually not issued to allow tress to be harvested for fuel. This harvest regulation has been well enforced over China. Therefore, local villages usually harvest herbaceous and shrub biomass for fuel because of the unavailability of other cheap fuel materials. Moreover, 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 by gathering dead wood and branches and shrubs growing between the trees during

[17] http://cdm.unfccc.int/EB/Meetings/036/eb36_repan19.pdf

the early stages of succession. Therefore, as the result of the proposed A/R CDM project activity, leakage from the displacement of wood as collection for fuel is nil, i.e., $LK_{fuelwood} = 0$.

c. Estimation of $LK_{fencing}$

No wood post will be used in the proposed A/R CDM project activity. Therefore, there will be no leakage induced by the use of wood post, i.e. $LK_{fencing} = 0$.

Table D-6 Pre-project animal populations and land available for adopting displaced animals

Towns	Villages	Villager group	Land ID	Area (ha)	Number of animals (head)			Biomass consumption (t d.m/yr)				Existing grazing land outside the project boundary under the control of the animal owners								ANPP (t d.m /ha/yr)	Required area (ha)
													Current number of animals (head)			Biomass consumption (t d.m/yr)					
					Cattle	Horse	goat	Cattle	Horse	goat	total	Area (ha)	Cattle	Horse	goat	Cattle	Horse	goat	total		
Wadu	Sanping	Aguanshan	LY0302	30.0	10	0	30	80	0	50	130	113	22	0	120	176	0	201	377	8.2	62
		Dayanzhi	LY0303	5.6	3	0	12	24	0	20	44	65	34	0	80	272	0	134	406	8.2	55
			LY0305	4.3	4	0	14	32	0	24	55	69	20	0	20	160	0	34	193	8.2	30
		Jingxiangzhai	LY0304	52.1	16	0	80	128	0	134	262	92	24	0	180	192	0	302	494	8.2	92
	Langba				0																
	Huangtian				0																
Wafang	Xiping	Shangpingzhi	LY0202	26.1																	
		Xijia	LY0203	8.6																	
			LY0207	4.5	12	10	52	96	80	87	263	220	20	20	200	160	160	336	656	8.2	112
		Louzhiwopu	LY0209	34.1	5	4	12	40	32	20	92	120	12	6	62	96	48	104	248	8.2	41
		Taozhiwa	LY0210	95	4	3	8	32	24	13	69	160	10	3	46	80	24	77	181	8.2	31
		Shanglishu	LY0204	59	12	7	44	96	56	74	226	200	24	22	240	192	176	403	771	8.2	122
	Shuigouwa	Group 1	LY0211	11.9	30	14	130	240	112	218	570	320	30	24	140	240	192	235	667	8.2	151
			LY0212	13	20	10	62	160	80	104	344	240	20	15	132	160	120	222	501	8.2	103
			LY0213	3.9	10	0	0	80	0	0	80	340	10	10	40	80	80	67	227	8.2	37
			LY0214	99.9	5	0	0	40	0	0	40	230	12	3	20	96	24	34	153	8.2	24
	ngd	Group4	LY0215	11.6	3	0	0	24	0	0	24	240	12	3	20	96	24	34	153	8.2	22
			LY0217	7.7	50	20	0	400	160	0	560	278	16	12	20	128	96	34	257	8.2	100

	Group 8	LY0216	23.5	8	3	10	64	24	17	105	120	6	12	60	48	96	101	245	8.2	43
	Group 9	LY0216	23.8	4	1	12	32	8	20	60	140	8	14	40	64	112	67	243	8.2	37
Mangkuan	Damengkan			0	0	0	0	0	0											
Pupiao	Huangni			0	0	0	0	0	0											
Bingma	Taihe			0	0	0	0	0	0											

SECTION E. Monitoring plan

E.1. Monitoring of the project implementation:

E.1.1. Monitoring of forest establishment and management:

>>

a. Monitoring of forest establishment

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

- To confirm that site and soil preparations are implemented based on practice documented in PDD, e.g., no slash and burn, no overall plough. If slash and burn of pre-existing vegetation occur, emissions associated shall be accounted for based on monitoring methodology applied:
  - ✓ Site burning upon occurring: the date, location, area, biomass removed and burnt shall be recorded and measured;
  - ✓ Disturbance of soil surface: Checking the ensuring small hole preparation with the disturbance on soil surface less than 10%.
- Planting: date, location, area, tree species (including mixture models);
- Fertilization: date, location, area, tree species, amount and type of fertilizer applied, nitrogen content, etc, in the first 3 years;
- Survival checking:
  - ✓ The initial survival rate of planted trees shall be counted three months after the planting, and re-planting shall be conducted if the survival rate is lower than 90 percent of the final planting density;
  - ✓ Final checking three years after the planting;
  - ✓ The checking of the survival rate using sampling methods.
- Weeding: check and confirm that the weeding practice is implemented as described in the PDD;
- Survey and check that species and planting for each stratum are in line with the PDD;
- Document and justify any deviation from the planned forest establishment.

b. Monitoring of forest management

Forest management practices to be monitored include:

- Fertilization: date, location, area, tree species, amount and type of fertilizer applied, nitrogen content, etc, in the first 3 years;
- Thinning: date, location, area, tree species, thinning intensity, volumes or biomass removed;
- Harvesting: date, location, area, tree species, volumes or biomass removed;
- Coppicing: date, location, area, tree species, volumes or biomass removed;
- Fuel wood collection: date, location, area, tree species, volumes or biomass removed;
- Monitoring of disturbances: date, location, area (GPS coordinates and remote sensing, as applicable), tree species, type of disturbance, biomass lost, implemented corrective measures, change in the boundary of strata and stands.

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of data points / Other measure of number of collected data	Comment
1.1.2.01	*Area of slash and burn*	*ha*	*m*	*Once before planting*	*All strata*	*To confirm there is no slash and burn*
1.1.2.02	*proportion of soil disturbance*	*%*	*c*	*Once before planting*	*All strata*	*To confirm there is no overall plough and the area disturbed by soil preparation less than 10% of total surface area.*
1.1.2.03	*Amount of fertilizer applied*	*t*	*m*	*annually*	*All strata*	
1.1.2.04	*N content in fertilizer applied*	*dimensionless* $^{-1}$	*m*	*annually*	*All types of fertilizer applied*	

1.1.2.05	*Survival rate*	*dimensionless*	*m*	*3 months and 3 years after planting*	*All species and strata*	using permanent or temporary sample plots
1.1.2.06	*Area thinned*	*ha*	*m*	*annually*	*All strata and species*	*Record location, species and area*
1.1.2.07	*Thinning intensity*	*m^3/ha*	*m*	*annually*	*All strata and species*	*Thinned volume*
1.1.2.08	*Harvest area*	*ha*	*m*	*annually*	*All strata and species*	*Record location, species and area*
1.1.2.09	*Harvest volume*	*m^3/ha*	*m*	*annually*	*All strata and species*	
1.1.2.10	*disturbance*	*area*	*m*	*annually*	*All strata and species*	*Location, area, species and type of disturbance, volume or biomass loss, changes strata/project boundary due to the disturbance*

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

>> 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, including:

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 monitoring report. 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:

- 15% of randomly selected plots will be re-measured by another 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 deviation between measurement and re-measurement below 5% will be considered tolerable and error above 5%. 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.

c) Verification of data entry and analysis

Reliable estimation of carbon stock in pools requires proper entry of data into the data analyses spreadsheets. To minimize the possible errors in the process of data entry, the entry of both field data and laboratory data will be reviewed using expert judgement and, where necessary, 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 chosen pools and non-CO_2 GHG and corresponding calculation spreadsheets;
- GIS products;
- Copies of the measuring and monitoring reports.

E.2. Sampling design and stratification:

>> The number and boundaries of the strata defined ex-ante in Section C.4 may change during the crediting period (ex-post). Therefore, strata should be monitored periodically. If a change in the number and area of the project strata occurs, the sampling framework should be adjusted accordingly..

a. Monitoring of strata

The ex ante project stratification presented in Section C.4 will be used as a basis for monitoring. However, since there is, usually some extent, a diversion of planned forest establishment and management practice as well as unexpected disturbance, this ex ante stratification shall be updated regularly based on (ex post stratification):

- Unexpected disturbances occurring during the crediting period (e.g. due to fire, pests or disease outbreaks), affecting differently different parts of an originally homogeneous stratum or stand;
- Forest establishment and management (clearing, planting, thinning, harvesting, coppicing, re-replanting) may be implemented at different intensities, dates and spatial locations than originally planned in the PDD;
- Two different strata may be similar enough to allow their merging into one stratum. If one of the above occurs, ex-post stratification may be required. The possible need for ex-post stratification will be evaluated at each monitoring event and changes in the strata will be reported to the DOE for verification.

b. Sampling size

Permanent sampling plot will be established and measured periodically for monitoring purposes. Assuming the cost for establishing a sample plot for each stratum is constant, equations (1), (2) and (4) in methodological tool "Calculation of the number of sample plots for measurements within A/R CDM project activities"[18] have been used to calculate the number of plots for each stratum (Table E-1 below.. The average standing volume (Q, $m^3.ha^{-1}$) of plantations have been calculated based on growth curves presented in Section D.1.a.2 above. The standard deviation of each stratum (st_i) is set as the 20% of the standing volume. The precision level was set as 10%. To ensure statistically independence for each stratum, minimum 3 plots are set for each stratum.

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

Table E-1 Number of monitoring plots for each stratum

Strata ID	Species	Area (ha)	Number of sampling plots
PS -I	Yunnan pine	184.6	3
	Armandi pine	738.3	16
PS -II	Yunnan pine	14.6	3

[18] http://cdm.unfccc.int/EB/Meetings/031/eb31_repan15.pdf

	Szemao pine	14.5	3
PS -III	Armandi pine	168.3	4
PS-IV	Szemao pine	221.9	3
Total		**1342. 2**	32

c. Sampling plot size

The stands to be established are relative dense (1667 trees per hectare). The size of plots is hence set as 20 m × 20 m = 400 m^2 (including 6 trees within each sampling plot).

d. 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. It is to be ensured that the sampling plots evenly spread as possible.

e. Monitoring frequency

The planting activity started in 2008. Szemao pine will be thinned at age 16 and 23. The Armandi pine will be thinned at age 23. There will be no harvesting during the crediting period. To avoid the coincidence with peaks in carbon stocks, the first monitoring will be conducted in the year 2012, with a subsequent monitoring interval of 5 years, i.e., in 2017, 2022, and 2027 respectively. Verification will be conducted in 2012, 2017, 2022, 2027 (Table E-2).

Table E-2 Monitoring times versus harvest and thinning time

Year No	Year	Monitoring	Verification	Thinning
1	2008			
2	2009			
3	2010			
4	2011			
5	2012	X	X	
6	2013			
7	2014			
8	2015			

9	2016				
10	2017	X	X		
11	2018				
12	2019				
13	2020				
14	2021				
15	2022	X	X		
16	2023				X
17	2024				
18	2025				
19	2026				
20	2027	X	X		
21	2028				
22	2029				
23	2030				X
24	2031				
25	2032	X	X		
26	2033				
27	2034				
28	2035				
29	2036				
30	2037	X	X		

f. Measuring and estimating carbon stock changes over time

The growth of individual trees on plots will be measured at each monitoring event. Pre-existing trees will not be measured and accounted for as a conservative manner. Non-tree vegetation such as herbaceous plants, grasses, and shrubs will not be measured and accounted as per methodology applied. The carbon stock changes in living biomass of trees on each plot are then estimated through Biomass Expansion Factors (BEF) method.

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

There will be no slash and burn site preparation, overall ploughing and flood irrigation as well as no machinery tools to be used within the project boundary. However, additional N_2O emissions will occur due to fertilization within the project boundary and CO_2 emissions from transportation outside the project boundary, hence these emissions will be monitored using methods described in sections below.

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

>> Monitoring of the baseline net GHG removals by sinks is not needed as per the revised approved methodology AR-ACM0001/version 01 applied.

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

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

>>Step-wise procedures for BEF method and equation (14)-(18) in Section II.5.1.1 of the approved baseline and monitoring methodology (AR-ACM0001/version 01) will be followed to monitor the verifiable carbon stock changes in the above-ground and below-ground living biomass within the project boundary.

Diameter at breast height (DBH, at 1.3 m above ground) and height of all the trees within each permanent sample plot above a minimum DBH (2 cm) will be measured. The merchantable volume of trees ($V_{l,j,I,sp,t}$) in equation (15) of the methodology will be estimated using locally derived equations[19]:

- *Yunnan Pine:* $V = 0.00005829011 \cdot DBH^{1.9796344} \cdot H^{0.90715154}$
- *Szemao pine:* $V = 0.0000515777\ 14 \cdot DBH^{1.985218} \cdot H^{0.92035096}$
- *Armandi pine :* $V = 0.000059973839 \cdot DBH^{1.8334312} \cdot H^{1.0295315}$

Where

V	standing volume of trees, $m^3.tree^{-1}$
DBH	diameter at breast height, cm
H	tree height, m

The merchantable volume of trees will be then converted to carbon stock in aboveground and belowground biomass using Equation (15) and (16) of the applied methodology and species-specific biomass expansion factor for conversion of biomass of tree volume to above-ground biomass ($BEF_{2,j}$), wood

[19] Chinese Ministry of Forestry. 1978. volume table for trees. Beijing, China Standard Press

density (D_j) and root-shoot ratio (R_j) that are listed in Table D-2 above. These parameters are estimated from published data. However, the average value of $BEF_{2,j}$ may result in significant errors because BEF usually decreases with the increase of plantation age. Therefore, an effort will be made to analyze the data so as to derive age-dependent equations for $BEF_{2,j}$. IPCC default value (0.5) for the carbon fraction (CF) will be used. These values shall be updated every five years if the values from the national inventory are updated in the future.

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

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of sample plots at which the data will be monitored	Comment
2.1.1.01	*Project stratum ID*	*Alpha numeric*	*defined*	*At stand establishment*	*100%*	*Each stand has a particular year to be planted under each stratum*
2.1.1.02	*Stand ID*	*Alpha numeric*	*defined*	*At stand establishment*	*100%*	*Each stand has a particular year to be planted under each stratum*
2.1.1.04	*Desired level of precision (p)*	*%*	*defined*	*Before the start of the project*	*100%*	*10% will be used for the purpose of QA/QC and measuring and monitoring precision control*
2.1.1.05	Standard deviation for each stratum i (st_i)		*e*	*At each monitoring event*	*100%*	*Used for estimating numbers of sample plots of each stratum*
2.1.1.07	Sample plot ID	*Alpha numeric*	*defined*	*Before the first monitoring event*	*100%*	*Numeric series ID will be assigned to each permanent sample plot* (e.g., 1, 2, 3, … pl, …)
	Ration of molecular weights of carbon	*Dimensionless*	*Universal*			*=44/12*

	and CO_2		*constant*			
	Total number of plots in stratum i	*Dimensionless*	*m*	*5 years*	*100%*	
	Sample plot area (AP)	*m^2*	*m*	*5 years*	*100%*	
	Allowable error		*c*	*5 years*	*100%*	
	Confidence level	*%*	*defined*	*Before the first monitoring event*	*100%*	*=95%*
	Total size of all strata (A), e.g. the total project area	*hectare*	*m*	*Before the start of the project and adjusted thereafter every 5-year*	*100%*	
	Area of stratum i (A_i)	*hectare*	*m*	*Before the start of the project and adjusted thereafter every 5-year*	*100%*	
	Maximum possible number of sample plots in the project area (N)	*Dimensionless*	*c*	*5 years*	*100%*	
	Sample size (total number of sample plots required) in the project area (n)	*Dimensionless*	*c*	*5 years*	*100%*	
	Maximum possible number of sample plots in stratum i (N_i)	*Dimensionless*	*c*	*5 years*	*100%*	
	Sample size for stratum i (n_i)	*Dimensionless*	*c*	*5 years*	*100%*	*Equation (63)*
2.1.1.08	*Plot location (latitude/longitude)*		*m*	*5 years*	*100% sample plots*	*Using GPS to locate before start of each field measurement*
2.1.1.09	*Tree species (j)*		*m*	*5 years*	*100%*	
2.1.1.10	*Age of plantation*	*year*	*m*	*5 years*	*100%*	*Counted since the planted year*
2.1.1.12	*Diameter at breast height of living trees (DBH)*	*cm*	*m*	*5 years*	*100% trees in plots*	*Measuring at each monitoring time per sampling method*
2.1.1.13	*Tree height*	*m*	*m*	*5 years*	*100% trees in plots*	*Measuring at each monitoring time per*

						sampling method
2.1.1.16	*merchantable volume per tree*	*$m^3.tree^{-1}$*	*c*	*5 years*	*100% trees in plots*	
2.1.1.17	*Wood density of species j (D_j)*	*t d.m.m^{-3}*	*e*	*5 years*	*100% of species*	*Species-derived from China national GHG inventory in LUCF sector*
2.1.1.18	*Biomass expansion factor ($BEF_{2,j}$)*	*Dimensionless*	*e*	*5 years*	*100% of species*	*Species-derived from China national GHG inventory in LUCF sector*
2.1.1.19	*Carbon fraction of species j (CF_j)*	*dimensionless*	*e*	*Once per species*	*100% of species*	*IPCC default (0.5) is used*
2.1.1.20	*Root-shoot ratio(R_j)*	*Dimensionless*	*e*	*5 years*	*100% of species*	*Species-derived from China national GHG inventory in LUCF sector*
2.1.1.21	*Carbon stock in above-ground biomass of tree*	*tonnes $C.tree^{-1}$*	*c*	*5 years*	*100%*	
2.1.1.22	*Carbon stock in below-ground biomass of trees*	*tonnes $C.tree^{-1}$*	*c*	*5 years*	*100%*	
2.1.1.23	*Mean carbon stock in aboveground biomass per unit area for stratum i, species j, time t*	*tonnes $C.ha^{-1}$*	*c*	*5 years*	*100%*	
2.1.1.24	*Mean carbon stock in belowground biomass per unit area for stratum i, species j, time t*	*tonnes $C.ha^{-1}$*	*c*	*5 years*	*100%*	
2.1.1.25	*Area of stratum i, species j, at time t*	*hectare*	*m*	*yearly*	*100%*	*Measured for different strata and stands*
2.1.1.28	*Annual carbon stock change in above-ground biomass for stratum i, species j, time t*	*tonnes $C.yr^{-1}$*	*c*	*5 years*	*100%*	*Equation (72)*
2.1.1.29	*Annual carbon stock change in below-ground biomass for stratum i, species j,*	*tonnes $C.yr^{-1}$*	*c*	*5 years*	*100%*	

	time t					
2.1.1.30	*Annual carbon stock change in living biomass in the project scenario for stratum i, species j, time t*	*tonnes CO_2-e.yr^{-1}*	*c*	*5 years*	*100%*	
2.1.1.31	*Sum of the changes in living biomass carbon stocks in the project scenario (above- and below-ground)*	*tonnes CO_2-e*	*c*	*5 years*	*100%*	

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

>> In terms of the approved methodology applied by the proposed A/R CDM project activity, there are four emissions by sources potentially as a result of the proposed A/R CDM project activity, i.e., fossil fuel burning, biomass burning, flood irrigation and N fertilization. However, the site preparation, planting, fertilization, thinning as well as the logging in the proposed A/R CDM project activity will be conducted manually, without using machinery tools that consume fossil fuel, and there will be no biomass burning during site preparation thus GHG emissions from slash and burn activity are nil, and further more no irrigation will be used in the proposed A/R CDM project activity. Therefore, the direct N_2O emission caused by fertilizer application is the only GHG emissions by sources within the project boundary increased as a result of the implementation of the A/R CDM project activity.

Procedures and formula presented in A/R Methodological tool "Estimation of direct nitrous oxide emission from nitrogen fertilization"[15] will be strictly followed to measure and estimate ex post the direct N_2O emissions due to use of N-fertilizer application during the crediting period. Due to the lack of national or local data, IPCC default emission factors and parameters will be used.

Data to be collected in order to monitor the GHG emissions by the sources

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of sample plots at which the data will be monitored	Comment
2.1.2.1	*Use of synthetic fertilizer per unit area for stratum i, species j, at time t*	*kg N ha^{-1} yr^{-1}*	*m*	*annually*	*100%*	*For different N fertilizer types*

2.1.2.2	*Use of organic fertilizer per unit area for stratum i, species j, at time t*	*kg N ha^{-1} yr^{-1}*	*m*	*annually*	*100%*	*For different N fertilizer types*
2.1.2.3	*Area of with N applied in stratum i, species j, at time t*	*ha yr^{-1}*	*m*	*annually*	*100%*	*For different N fertilizer types*
2.1.2.4	*Total mass of synthetic fertilizer used within the project boundary*	*t N*	*c*	*5-years*	*100%*	
2.1.2.5	*Total mass of organic fertilizer used within the project boundary*	*t N*	*c*	*5-years*	*100%*	
2.1.2.6	*Fraction that volatilises as NH3 and NO_X for synthetic fertilizers*	*dimensionless*	*e*	*Once per fertilizer type used*	*100%*	*IPCC default value (0.1) is used if no more appropriate data*
2.1.2.7	*Fraction that volatilises as NH3 and NO_X for organic fertilizers*	*dimensionless*	*e*	*Once per fertilizer type used*	*100%*	*IPCC default value (0.2) is used if no more appropriate data*
2.1.2.8	*Emission factor for emission from N input*	*t N_2O-N (t N-input)$^{-1}$*	*e*	*Before start of monitoring, once in the crediting period*	*100%*	*IPCC default value (1%) is used if no more appropriate data*
2.1.2.9	*Increase in N2O emission as a result of direct nitrogen application within the project boundary*	*t CO_2-e*	*c*	*5-years*	*100%*	*Calculated using equation (1) in the tool*

E.5. Leakage:

>> As per the approved methodology applied, there are four potential sources of leakages in the proposed A/R CDM project activity. These are; fossil fuel combustion by vehicles, displacement of grazing, collection of wood for fuel, and the use of wood posts for fencing. However, as elaborated in Section D-2 above, the leakage from the displacement of grazing and fuelwood collection and the use of wood post for fencing is nil. Therefore, the leakage source to be monitored in the proposed A/R CDM project activity is the fossil fuel combustion due to vehicle use. The step-wise procedures and formula (3a) in indirect method in the A/R Methodological Tool "Estimation of GHG emissions related to fossil fuel combustion in A/R CDM project activities"[16] will be followed to monitor and estimate the leakage.

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

>> National default values from national GHG inventory will be used for GHG emission from use of vehicles, e.g., 2.6353kg CO2 per litre of diesel and 2.49 kg CO2 per litre of gasoline, for vehicles that commonly used by local farmers. The consumption is 0.1-0.2 litre per km dependent on type of vehicles.

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of data points	Comment
	Vehicle type (j)	*Dimension-less*	*m*	*yearly*	*100%*	
	Fuel type (i)	*Dimension-less*	*m*	*yearly*	*100%*	
3.1.01	*Total mass transported by vehicle type j*	*tonnes*	*m*	*yearly*	*100%*	*For different material / product type*
3.1.02	*Load capacity of vehicle type j*	*tonnes*	*m*	*yearly*	*100%*	*For different material / product type*
3.1.03	*Average single-trip distance for vehicle type j*	*km*	*m*	*yearly*	*100%*	
3.1.04	*Specific energy consumption of vehicle type*	*quantity of fuel / km*	*e*	*At the start of the project*	*100%*	

	j for fuel i during year y					
3.1.05	*CO2 emission factor of the fuel type i combusted*	*t-CO2 / GJ*	*e*	*At the start of the project*	*100%*	*China national GHG inventory in transportation sector*
3.1.06	*Net calorific value of fuel i*	*GJ/mass or volume unit*	*e*	*At the start of the project*	*100%*	*China national GHG inventory in transportation sector*
3.1.07	*Indicator of return load*	*Dimension-less*	*e*	*yearly*	*100%*	
3.1.08	*Total GHG emissions due to fossil fuel combustion from vehicles ($LK_{vehicle}$)*	*tonnes CO2-e*	*c*	*yearly*	*100%*	*Equation (3a) in the tool*

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

>> Following procedures for periodic review of the implementation of measures to minimize leakage will be conducted:

a) Periodic review of return-load status of vehicles used by the proposed A/R CDM project activity, based on daily collected data of vehicle use;

b) Periodic review illegal logging, in particular, those relevant to the implementation of the proposed A/R CDM project activity, based on relevant data of forest administration from local forestry sector;

c) Periodic review of awareness training courses for forest protection and their effectiveness.

E.6. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored not included in section E.1.2:

	j for fuel i during year y	

2.1.1.08 Plot location (latitude /longitude)	*low*	*Random plot verification using GPS to ensure the consistent measuring and monitoring of the carbon stock change over time*
2.1.1.09 Tree species (j)	*low*	*Random Verification over the project area to ensure the area of each tree species is correctly measured*
2.1.1.10 Age of plantation	*low*	*Random Verification over the project area to ensure the area in terms of plantation age is correctly measured*
2.1.1.12 Diameter at breast height of living trees (DBH)	*low*	*Random plot verification*
2.1.1.13 Tree height	*low*	*Random plot verification*
2.1.1.16 merchantable volume of trees	*low*	*All equations used to calculate this data shall be verified*
2.1.1.17 Wood density of species j (D_j)	*low*	*Data that divert significantly from IPCC default value shall be verified*
2.1.1.18 Biomass expansion factor (BEF)	*low*	*Data that divert significantly from IPCC default value shall be verified*
2.1.1.19 Carbon fraction of species j (CF_j)	*low*	*Data that divert significantly from IPCC default value shall be verified*
2.1.1.20 Root-shoot ratio	*low*	*Data that divert significantly from IPCC default value shall be verified*

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

>> The proposed A/R CDM project activity will be implemented under the following operational and management structure:

The proposed A/R project activity will be implemented under the framework of the FCCB project which is a jointly-implemented project by CI (Conservation International) and TNC(The Nature Conservancy) and Yunnan Forestry Department Under the authorization of the project participants, the provincial and county carbon sequestration office have been established and will be responsible for the administrating and coordinating the project participants, facilitating and supervising the implementation of the proposed A/R CDM project activities, organizing technical training and consultation, and organizing and coordinating the measuring and monitoring of the actual net GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity. Any activity data and monitoring and measuring data will be reported to and archived in the county carbon sequestration office as well be imported to the new developed GIS based information management system installed in Provincial carbon sequestration office.

Longyang Forestry Bureau, under the guidance and coordination of provincial carbon sequestration office, will provide instruction of reforestation and forest management, and conduct the specific supervision of the implementation of the proposed A/R CDM project activity, and collect specific activity data at routine basis.

Carbon Sequestration office of Longyang Forestry Bureau, under the guidance and coordination of provincial Carbon Sequestration office, will conduct the measurement of the actual net GHG removal by sinks and leakage generated by the proposed A/R CDM project activity, and will be responsible for drafting monitoring report with the consultant of expert group.

TNC China program conservation and climate change group, under the coordination of the provincial carbon sequestration office, will provide technical consultation and training in the measuring and monitoring of the actual net GHG removal by sinks and leakage generated by the proposed A/R CDM project activity, and will be responsible for helping the Carbon Sequestration Office of Longyang Forestry Bureau in drafting of the monitoring report.

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

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

>> Name of person/entity applying the monitoring plan:

The Nature Conservancy China program: Jian Ma, **jma@tnc.org.cn**

Yunnan Forestry Department Carbon Sequestration Office:

Zeyuan Xia, **xia_zy1974@163.com**

Tao Liu, **ivanlt@163.com**

Tengwei Su, **ynfccb@163.com**

Baoshan Forestry Bureau Carbon sequestration office: Tianshuang Zheng, **ylz212120856@126.com**

Chinese Academy of Forestry: Xiaoquan Zhang, **xiaoquan@caf.ac.cn**

All of these persons or entities are not project participants.

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

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

>> Through establishing 467.7 ha of multiple-use plantations using native species, the proposed A/R CDM project activity will provide the following environmental benefits.

- **Biodiversity conservation**

The project area is one of critical areas of global biodiversity conservation, which provides habitats for important rare and endangered wildlife, making the proposed A/R CDM project activity significant positive biodiversity benefits:

- Suppressing invasive weed (Eupatorium) currently occupied the lands, and as a result, preventing its further invading toward/within the nature reserve.
- Providing firewood to the local communities, thus reducing the pressure of fuelwood collection on the nature reserves and strengthening the biodiversity conservation.
- 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 and illegal logging and NTFP collection in the nature reserve.
- Small hole site and soil preparation ensure least removal of pre-existing vegetation, which is advantageous for biodiversity conservation.

- **Controlling soil erosion**

The soils in the project area are developed from granite or granite gneiss. With high sand and silt content in soils the lands are subjected to soil erosion. Therefore the forest restoration will improve soil conservation.

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

>> 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.

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

>>N/A

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

>>

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

>> Agricultural are the main income sources for local communities in the project area. However, 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$ 143 with the lowest at US$ 74 in Sanping Village of Wadu Townahip (see Table G-1).

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 H below). Farmers decided the final contractual production arrangements as they liked, such as shareholding arrangement between local farmers/communities and forestry farm (see Section H.2). It is expected that 3,656 villagers will benefit from the proposed project. The main socio-economic benefits of the project include:

(1) Income generation: According to the contractual arrangement between local communities and the forestry farm, Farmers/villages will obtain all incomes from wood and non-wood product by offering their lands and labors for forest establishment. About 3,656 local farmers of 856 households will benefit from the project.

(2) Sustainable fuel wood supply: The local communities depend on fuel wood for living to a certain extent, especially for minority villagers. The proposed A/R CDM activity will provide more sustainable fuel sources for local farmers.

(3) Strengthening social cohesion: 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, forestry farm and local government, with intensified communication among them and supporting networks for social and productive services, especially for the ethnic minorities.

(4) 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 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 and planting.

Table G-1 Socio-economic profile in the project area

Town/ township	Villages	Number of household	Population		Ethnic minority		Mean annual income per capita (US$/yr)			
			total	female	name	population	food	husbandry	others	total
Wadu	Sanping	89	398	167			35	20	19	74
	Langba	187	782	373			38	19	40	97
	Huangtian	86	381	187			75	15	45	135
Wafang	Xiping	234	1,051	518			39	42	81	161
	Shuigouwa	76	312	149			52	19	25	96
	Dangdong	161	636	328			101	49	87	237
Mangkuan	Damengkan	30	124	56	Yi	124	97	42	80	219
Pupiao	Huangni	46	209	100	Bai	3	79	18	35	132
Bingma	Taihe	59	240	109			49	22	49	120
Total	11	968	4,133	1,987	2	127	57	30	56	143

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

>> Since the proposed A/R CDM project activity has applied PRA method in the project design which ensure the proposed project activity can reflect the desire of the local farmers to the greatest extent, there is no negative socio-economic impact that is considered significant by the project participants or the host party.

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

>>N/A

SECTION H. Stakeholders' comments:

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

>> Comments by stakeholders have been invited using PRA methodology. All villages involved 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 CDM A/R project activities. The leaflet was distributed to the proposed project communities before the PRA process, and was explained during the PRA process.

(2) **Seminar of farmers**. 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 farmers was held in each village. Main topic include, inter alia:

- Introduction of the project objective, main activities, benefits and potential risk, as well as the modalities and procedures of the CDM A/R project activity;
- Introduction of the survey team, objective, task, methods and main activities of the survey, and how the local communities to involve in the investigation;
- Question and discussion;
- Election of farmers' representatives who will directly participate in the survey. The representatives shall include same proportion of women and ethic minority people;

(3) Participating survey: 5-10 farmers' representatives from each villager to assist the survey including at least 2 females.

- Mapping of resources: land use, land cover, land tenure, land ownership, land use right, and their boundary shall be mapped under the assistance of farmers' representatives;
- Current social-economic information, including population, income and sources, fuel wood collection, grazing activities, etc.

- Important events: Important historic events related to community development, resource management, in particular the changes of land use and land cover, by interviewing with elders and past and current village leaders. These information shall be verified
- Favorable tree species by scoring;
- Favorable collaboration arrangement.

(4) **Questionnaire**. Questionnaire forms were developed and distributed among different stakeholders, including farmer households, villages, township governments, forest farm, local forest stations and forestry bureau, nature reserve and NGOs. 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.

(5) **Semi-structure interview:**

- Group interview on seminar of farmers described above
- VIP interview to village leaders, elder villagers, head of ethnic minorities and other important peoples.
- Special group interview including interviewing of women, rich farmer household, poor household and households immigrated from outside. 10-15 households were interviewed in each village.

H.2. Summary of the comments received:

>> Comments from local farmers, villages and 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 project activity they can obtain the following benefits:

- ✓ Income generation by selling wood and non-wood products: 50-80% of income from wood and non-wood forest products will belong to farmers who offer lands;
- ✓ Income generation by selling carbon credits: 20% of income from carbon trading will be allocated to local farmers;
- ✓ Income generation from increased employment: Local farmers can get additional income by participating site preparation, planting and forest management, etc.
- ✓ Greening their grasslands/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 all farmer households willing to participate the proposed A/R CDM project activity. All households interviewed prefer to cooperate with forest farm by contractual arrangements rather than simply lease lands to the forestry farm. Local farmers/communities indicated that without the

proposed A/R CDM project activity it is impossible for them to plant trees on the project area due to the huge pre-investment, lack of technical unknown how, organizational barriers and low economic return in terms of the degraded remote lands.

During the PRA process, the scoring assessment on tree species also indicates that local farmers/communities prefer tree species in following order: Nepal alder, armandi pine, yunnan pine, birch, etc.

(2) Longyang Forestry Farm and Longyang Conservation Post

Both the forestry farm and the conservation post that mainly focuses on reforestation, forest management and conservation are very interested in participating in the proposed A/R CDM project activity. They would like to invest in the reforestation because:

- ✓ It can get income from sale of CERs that have no market risk
- ✓ It can get income from wood and non-wood forest products produced on lands owned by them;
- ✓ The commercial loan and carbon fund can alleviate their financial pressure from pre-investment, without the proposed A/R CDM project activity such fund sources are difficult to obtain.
- ✓ Without the proposed A/R CDM project activity, they would be unwilling to invest in the reforestation on both the communities' lands and their own lands due to the unacceptably low economic revenues.

With regard to the financing arrangements, the farm prefers 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. With regard to the tree species, the farm would like to Armandi pine, Yunnan pine and Szemao pine based on the site conditions and the economic value.

2. Secondary stakeholders

(1) Local forestry departments: Forestry Bureaus and forestry stations of Longyang county and Yunnan Province view that the proposed A/R CDM project activity will increase forest resources, improve the local environment and increase income of local farmers/communities. They would provide technical training and consultation to farmers/communities and planting entity, and supervise the implementation of the proposed A/R CDM project activity.

(2) Local Governments: County and township/town governments in Longyang County 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 soil erosion control.

(3) Gaoligongshan Nature Reserve: The reserve believe that the proposed A/R CDM project activity will benefit to the biodiversity conservation by suppressing invasive pest pant, establishing buffer zone outside of the reserve, enhancing forest connectivity, reducing pressure on the nature resources by providing sustainable fuel wood to the local communities. The reserves also propose to use native species as much as possible, establish mixed forests, avoid a large area of pure plantation, be cautious to use pesticide and fertilizer, avoid site burning.

H.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 farms/conservation post is on a voluntarily basis.
- ✓ Choice of stakeholder arrangements was based on the preference of local farmers/communities.
- ✓ Preferences of local farmers/communities were taken into account in the selection of tree species;
- ✓ Tree species used are native to local, and a mixed species arrangements will be used;
- ✓ Although local farmers like Nepal alder, the site condition is not suitable for the species;
- ✓ Compound and/or organic fertilizers will be applied through small holes rather than overall dispersion to minimize its environmental impact;
- ✓ 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 will not be used.

Annex 1

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

Organization:	Longyang Forestry Farm
Street/P.O.Box:	Shengyang Road, Longyang County
Building:	/
City:	Baoshan City
State/Region:	Yunnan Province
Postfix/ZIP:	678000
Country:	China
Telephone:	+86-0875-2209266
FAX:	+86-0875-2209266
E-Mail:	lyqlczzh@163.com
URL:	/
Represented by:	Zhenhua Zhao
Title:	Farm Director
Salutation:	Mr.
Last Name:	Zhao
Middle Name:	/
First Name:	Zhenhua
Department:	Longyang Forestry Farm
Mobile:	13987580887
Direct FAX:	+86-0875-2209266
Direct tel:	+86-0875-2209266
Personal E-Mail:	lyqlczzh@163.com

Organization:	National Development and Reform Commission
Street/P.O.Box:	
Building:	38 South Yuetan Street
City:	Beijing
State/Region:	
Postfix/ZIP:	100824
Country:	P.R.China
Telephone:	+86-10-68501715/2957
FAX:	+86-10-68501876/2873
E-Mail:	su_wei@mfa.gov.cn, lily@ccchina.gov.cn
URL:	http://cdm.unfccc.int/DNA
Represented by:	
Title:	Director General
Salutation:	Mr
Last Name:	Su
Middle Name:	
First Name:	Wei
Department:	Office to National Climate Change Coordination Committee
Mobile:	
Direct FAX:	+86-10-68501876/2873
Direct tel:	+86-10-68501715/2957
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no available public funding that will result in a diversion of official development assistance and financial obligations of any Parties under UNFCCC.

Annex 3

BASELINE INFORMATION

To provide transparent information for the project boundary, baseline stratification, determination of baseline scenario and the ex ante estimation of baseline net removals by sinks and leakage. Baseline survey was conducted in the summer and autumn 2007. The survey includes:

- Delineation of project boundary;
- Baseline stratification;
- Pre-project carbon stock in living biomass of non-tree vegetation
- Pre-project growing trees;
- Grazing activity within and outside the project boundary.

For the purposed of baseline survey, operation procedure has been developed based on methodological manual for measuring terrestrial carbon pool by Winrock International and the approved methodology (AR-ACM0001/version 01) applied. The methods and results are summarized below.

1. Delineation of the project boundary

The project boundary has been delineated based on satellite image in combination with field check and interviewing. The satellite image (Landsat-5, 30 m resolution) on Dec 31 1989 and satellite image (Landsat-7, 15 m resolution) in March 2002 have been decoded and overlapped to produce non-forested lands at the two time points. The overlapped maps were further checked using Spot-5 satellite image in 2006. Furthermore, on-site check using GPS and interviewing with local farmers and staff from the forestry farm and conservation post were conducted to ensure the land eligibility and confirm the project boundary.

2. Baseline stratification

Step 1: Field study tours on each parcel of land to inspect the existing vegetation, soil condition and erosion status;

Step 2: 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, etc), see table A-3 for details;

Step 3: Based on current vegetation and grazing activity collected from field survey and interviewing,. The project lands were stratified into 3 baseline strata (Table C-3).

Step 4: The baseline strata have been built into GIS platform to produce baseline strata map (see Fig C-1 for an example of baseline strata map).

3. Sampling schemes

Temporary plots have been randomly selected for the purpose of measuring pre-project carbon stock in living biomass of non-tree vegetation, for each baseline stratum, following the procedures in Annex 1 of the A/R Methodological Tool "Estimation of emissions from clearing, burning and decay of existing vegetation due to implementation of a CDM A/R project activity"[10]. The number of plots for each baseline stratum depends on pre-project vegetation types and the area of stratum. To achieve 95% precision level at 95% confidence interval, two steps of sampling have been implemented. The first step is so called initial investigation, in which 11-20 temporary plots for each baseline stratum have been sampled and surveyed, and the variation of biomass stock was estimated. The number of sampling plots for each baseline stratum required to achieve 95% precision at 95% confidence level was estimated based on the variation from initial survey. Then the second step of sampling survey, so called complementary survey, was conducted to achieve required number of plots. See Table Annex 3-1 for the number of sampling plots.

Table Annex 3-1 Number of plots for each baseline stratum

Baseline strata ID	Land ID	Area (ha)	Number of sampling plots
BLS-1	LY0101	66.2	3
	LY0102	79.3	3
	LY0103	37.5	2
	LY0104	54.8	3
	LY0105	13.8	1
	LY0106	32.8	3
	LY0107	12.5	0
	LY0108	26.4	2
	LY0109	133.6	4
	LY0110	134.9	6
	LY0111	116.1	5
	LY0112	11.6	0
	LY0113	14.7	1
	LY0114	82.2	4
	LY0115	11.2	2
	Sub-total	**827.6**	**39**
BLS-2	LY0202	26.1	4
	LY0203	8.6	2
	LY0204	59.0	5
	LY0207	4.5	2
	LY0209	34.1	4
	LY0210	95.0	2
	LY0211	11.9	2
	LY0212	13.0	2
	LY0213	3.9	2
	LY0214	99.9	3
	LY0215	11.6	0
	LY0216	47.3	2
	LY0217	7.7	2
	Sub-total	**422.6**	**32**
BLS-3	LY0302	30.0	10

	LY0303	5.6	2
	LY0304	52.1	13
	LY0305	4.3	1
	Sub-total	**92.0**	**26**
Total		**1342.2**	**97**

The plots are circular with a radius of 20 meter. All spotted growing trees within the plots were recorded and measured (diameter at breast height (DBH), height, crown diameter and age). For the purpose of measuring biomass of herbaceous plants, four sub-plots were randomly selected within each circular plot. The size of the sub-plots was 1 m × 1 m (square) for aboveground biomass, and 25 cm × 25 cm for belowground biomass. All living material of the herbaceous plants inside the sub-plots was harvested to ground level and weighed, and the underground part was also dug and weighed. Well-mixed samples (80-120 g) 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. The number of shrubs inside the circular plots was also counted and 2-3 mean-size shrubs were sampled. Destructive harvesting techniques were also used to measure the living biomass of the sampled shrubs.

To understand the natural regeneration of trees on the project lands, the appearance of natural regenerated trees have been counted respectively for

seedlings: with height < 30 cm

Young trees:: with height 30 cm- 130 cm

small trees: with height >130 cm and DBH < 5 cm

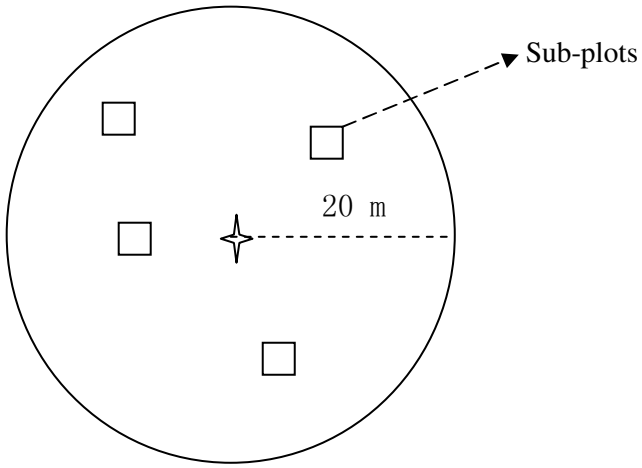


Fig Annex 3-1 sketch map of sampling measurement

4. Biomass in living biomass of non-tree vegetation

Based on the sampling measurement, the carbon stock in the living biomass of herbaceous plants and shrubs on land prior to the start of the proposed A/R CDM project activity were estimated as shown in Table annex 3-2 and Table annex 3-3.

Table annex 3-2 Carbon stock in living biomass of pre-project herbaceous plants

Baseline strata ID	Area (ha)	Carbon stock (tC/ha)			Carbon stock (tC/ha)		
		Above-ground	Below-ground	Total	Above-ground	Below-ground	Total
BLS -1	827.6	0.74	2.26	3.00	612	1,870	2,483
BLS -2	422.6	0.17	2.07	2.24	72	875	947
BLS -3	92.0	2.29	2.71	3.00	211	249	460
Total	1342.2				895	2,994	3,889

Table annex 3-3 Carbon stock in living biomass of pre-project shrubs

Baseline strata ID	Area (ha)	Carbon stock (tC/ha)			Carbon stock (tC/ha)		
		Above-ground	Below-ground	Total	Above-ground	Below-ground	Total
BLS -1	827.6	0.080	0.010	0.090	66	8	74
BLS -2	422.6	0.050	0.001	0.051	21	0	22
BLS -3	92.0	0.080	0.006	0.086	7	1	8
Total	1342.2				95	9	104

5. Pre-project spotted trees

Based on survey on 97 temporary circular plots, the pre-project living trees are summarized in table annex 3-4. The table annex 3-4 indicates that the crown cover of pre-project living trees at maturity is much lower than 20%, the threshold defining forests in China. Even for the plot with 68 pre-project living trees per hectare, the crown cover at maturity is only 13.36%., which is below the threshold of 20% for defining as a forest.

Table Annex 3-4 Pre-project living trees

Baseline strata ID	Area (ha)	Dominant tree species	Number of trees per ha		Mean age	Mean DBH (cm)	Mean height (m)	Mean crown diameter (m)	Estimated crown diameter at maturity (m)	Crown cover at maturity (%)	
			Max	Mean						Max	Mean
BLS -1	827.6	Alnus	42	2	8	7.9	4.9	3	5	8.25	0.39
		Armandi pine	26	3	10	7.2	4.0	3	5	5.11	0.59
BLS -2	422.6	Alnus & walnut	32	8	12	9.6	5.1	3	5	6.28	1.57

		Armandi pine	16	1	16	14.3	3.9	3	5	3.14	0.20
BLS -3	92.0	Alnus & walnut	34	11	15	20.8	7.8	3	5	6.68	2.16
		Armandi pine	25	1	25	23.7	11.7	3	5	4.91	0.20

The mean stem volume of pre-project living trees was estimated by equations[20]:

Armandi pine: $SV=0.000059973839\ DBH^{1.8334312} H^{1.0295315}$

Alnus and walnut: $SV = 0.000052750716 \cdot DBH^{1.9450324} \cdot H^{0.93885330}$

Where

SV: stem volume（m^3 $tree^{-1}$）

DBH: diameter at breast height (cm)

H: tree height (m)

The stem volume of trees was then converted into carbon stock in aboveground biomass and belowground biomass through wood density (D), biomass expansion factor (BEF), root-shoot ratio (R) and carbon fraction (CF) using equations:

$$C_{AB} = V \cdot D \cdot BEF \cdot CF$$

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

Where

C_{AB}: carbon stock aboveground biomass, t C. $tree^{-1}$

C_{BB}: carbon stock in belowground biomass, t C. $tree^{1}$

V: stem volume, m^3 $tree^{-1}$

D: wood density, t d.m.m^{-3}

BEF: biomass expansion factor from stem bioimass to aboveground biomass, dimensionless

CF: carbon fraction, t C （t d.m)$^{-1}$, IPCC default = 0.5

R: Root-shoot ratio, dimensionless

The D, BEF and R used for different species are listed in Table annex 3-5. BEF for spotted trees growing on open land is likely larger than forests and there is no BEF for the spotted trees. To make our estimation conservative, we assumed that BEF for single trees is 30% larger than those for forests from Table annex 3-5. IPCC default value (0.5) is used for the carbon fraction. The carbon stock in living biomass of pre-project trees for each baseline stratum was then estimated via the number of pre-project living trees per hectare and the area (Table annex 3-6).

Table annex 3-5 wood density, biomass expansion factor and root-shoot ratio[11]

[20]Ministry of Agriculture and Forestry. 1978. Volume table of standing trees. Beijing, China Standard Press

Tree species	Wood density (t. d.m.m^{-3})	Biomass expansion factors	Root-shoot ratio
Armandi pine	0.396 (14,0.017)	2.028 (19, 0.076)	0.171 (24, 0.006)
Alnus and walnut[12]	0.443 (189,0.013)	1.423 (10,0.245)	0.313 (13, 0.071)

Note: data in brackets represent the number of samples and standard errors

Table annex 3-6 Carbon stock in living biomass of pre-project trees

Baseline strata ID	Area (ha)	Carbon stock (tC/ha)			Carbon stock (tC/ha)		
		Above-ground	Below-ground	Total	Above-ground	Below-ground	Total
BLS -1	827.6	0.03	0.01	0.03	21	5	26
BLS -2	422.6	0.08	0.02	0.10	35	10	44
BLS -3	92.0	0.73	0.21	0.94	67	19	86
Total	1342.2				123	34	157

6. Baseline carbon stock changes

The carbon stock in living biomass of pre-project growing trees is expected to increase in the absence of the proposed A/R CDM project activity, due to continuous growth of the living trees. The carbon stock in the living biomass of pre-project trees has been predicted using carbon stock change method (refer to Equation (7)-(10) in Section II.4.1 of the applied methodology AR-ACM0001/version 01:.

$$C_{it} = \sum_{j=1}^{J} (C_{AB,ijt} + C_{BB,ijt})$$

$$C_{AB,ijt} = A_{it} \cdot V_{ijt} \cdot D_j \cdot BEF_{2,j} \cdot CF$$

$$C_{BB,ijt} = C_{AB,ijt} \cdot R_j$$

$$V_{ijt} = V_{ijt,s} \cdot N_j$$

Where

C_{it} carbon stock in living biomass for stratum i, time t; tonnes C.

A_{it} area of stratum i, at time t; hectare (ha)

$C_{AB,ijt}$ carbon stock in above-ground biomass for stratum *i,* species *j*, at time *t;* tones C

$C_{BB,ijt}$ carbon stock in below-ground biomass for stratum *i,* species *j*, at time *t;* tones C

V_{ijt} average standing volume of stratum *i,* species *j*, at time *t;* m^3 ha^{-1}

[11] Institute of Forest Ecology, Environment and Protection, CAF, Updated Database for China GHG Inventory in Forestry Sector.

[12] mean values for softwood.

D_j	wood density for species j; tonnes d.m. m^{-3} standing volume, from Table annex 3-5
$BEF_{2,j}$	biomass expansion factor for conversion of standing volume to aboveground tree biomass for species j; dimensionless, from Table annex 3-5
CF	Carbon fraction, dimensionless, CF=0.5 (IPCC default)
R_j	root-shoot ratio for species j; dimensionless , from Table annex 3-5
$V_{ijt,s}$	average standing volume per tree in stratum *i,* species *j*, at time *t;* m^3 $tree^{-1}$
N_j	Number of pre-project living trees for species j; trees ha^{-1}

As mentioned above, BEF for single trees was assumed to be 30% larger than those for forests from Table annex 3-5. $V_{ijt,s}$ is estimated by growth curve of trees as following:

Armandi pine [错误！未定义书签。]：　$SV_{(t)} = 0.228 * (1 - e^{(-0.07 \cdot A)})^{5.4474}$

Alnus and walnut [14]：　$SV_{(t)} = 0.880452 \cdot (1 - e^{(-0.039517 \cdot A)})^{2.912148}$

Where

SV: stem volume（m^3 $tree^{-1}$）

A: age of trees

The estimated baseline carbon stock changes in the crediting period are the sum of the carbon stock change in above- and below-ground biomass. Detail information are listed in Table annex 3-7 and Table annex 3-8 below.

Table annex 3-7 Estimated baseline carbon stock changes in living biomass of pre-project trees

Year No	Years	Carbon stock (tC)			Carbon stock changes (tC/yr)		
		Above-ground	Below-ground	Total	Above-ground	Below-ground	Total
0	2007	272	81	353			
1	2008	328	97	425	206	60	265
2	2009	390	115	504	225	65	290
3	2010	456	134	590	244	70	314
4	2011	528	154	682	261	75	336
5	2012	603	176	779	277	79	357
6	2013	683	199	881	292	83	375
7	2014	766	222	988	305	87	391

[14] 依据云南省 1992、1997、2002 年森林资源清查资料拟合。.

8	2015	852	247	1,099	316	90	406
9	2016	941	272	1,213	325	92	418
10	2017	1,032	298	1,330	333	95	428
11	2018	1,124	324	1,449	340	96	436
12	2019	1,219	351	1,569	345	98	443
13	2020	1,314	378	1,691	349	99	447
14	2021	1,409	405	1,814	351	100	450
15	2022	1,505	432	1,937	352	100	452
16	2023	1,601	459	2,061	352	100	452
17	2024	1,697	487	2,184	351	100	451
18	2025	1,792	514	2,306	349	99	448
19	2026	1,887	541	2,427	346	99	445
20	2027	1,980	567	2,547	343	98	440
21	2028	2,072	594	2,666	338	97	435
22	2029	2,163	620	2,783	334	96	429
23	2030	2,253	645	2,898	328	94	423
24	2031	2,341	671	3,012	323	93	416
25	2032	2,427	696	3,123	317	91	408
26	2033	2,512	720	3,232	310	90	400
27	2034	2,595	744	3,339	304	88	392
28	2035	2,676	768	3,443	297	86	383
29	2036	2,755	790	3,545	290	84	374
30	2037	2,832	813	3,645	283	82	365
Total					**9,385**	**2,685**	**12,071**

Table annex 3-8 Carbon stock changes in living biomass of pre-project trees for each baseline stratum

Year No	Year	Carbon stock (tC)			Carbon stock changes (tC/yr)		
		BLS-1	BSL-2	BSL-3	BLS-1	BSL-2	BSL-3
1	2008	51	202	100			
2	2009	70	241	114	19	40	14
3	2010	92	284	129	22	43	15

4	2011	117	329	144	25	45	15
5	2012	145	377	159	28	48	16
6	2013	176	428	175	31	50	16
7	2014	210	480	192	34	52	16
8	2015	246	534	209	36	54	17
9	2016	284	589	225	38	55	17
10	2017	325	645	243	40	57	17
11	2018	367	703	260	42	58	17
12	2019	410	761	277	43	58	17
13	2020	455	820	294	45	59	17
14	2021	500	880	312	45	59	17
15	2022	546	939	329	46	60	17
16	2023	593	999	346	47	60	17
17	2024	640	1,058	363	47	60	17
18	2025	686	1,118	380	47	59	17
19	2026	733	1,177	396	47	59	17
20	2027	779	1,235	413	46	59	16
21	2028	825	1,293	429	46	58	16
22	2029	871	1,350	445	45	57	16
23	2030	916	1,407	461	45	57	16
24	2031	960	1,463	476	44	56	15
25	2032	1,003	1,518	491	43	55	15
26	2033	1,045	1,572	506	42	54	15
27	2034	1,087	1,625	521	41	53	15
28	2035	1,127	1,677	535	40	52	14
29	2036	1,167	1,728	549	39	51	14
30	2037	1,205	1,778	562	38	50	14

7. Natural regeneration on project lands

No natural regenerated sapling or young trees have been found during the sampling survey.

Annex 4

MONITORING PLAN

All information has been included in Section E above. Therefore Annex 4 here is left intentionally blank.

- - - - -