Monitoring report form for CDM project activity
(Version 06.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Niger Acacia Senegal Plantation Project	
UNFCCC reference number of the project activity	9708	
Version number of the PDD applicable to this monitoring report	06.0	
Version number of this monitoring report	01	
Completion date of this monitoring report	07/02/2018	
Monitoring period number	01	
Duration of this monitoring period	21/12/2005 to 18/01/2018	
Monitoring report number for this monitoring report	01	
Project participants	International Bank of Reconstruction and Development (IBRD) as Trustee of the Bio Carbon Fund	
Host Party	Republic of Niger	
Sectoral scopes	14 (Afforestation / Reforestation)	
Applied methodologies and standardized baselines	AR-ACM0003 (Afforestation and reforestation of lands except wetlands version 1.0.0)	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	45,888.5 (tCO_2e)	32,777.5 (tCO_2e)
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	313,008 (tCO_2e)	

SECTION A. Description of project activity

A.1. General description of project activity

>> The **Niger Acacia Senegal Plantation Project** concerns the restoration of deforested and very degraded lands in the Sudano-Sahelian zone of Niger by enabling rural communities to adopt sustainable agroforestry practices with the establishment of Acacia Senegal Plantations. 26 rural communities, spread across six separate administrative regions in Niger, participate in the project, which covers a total area of 7,225.46 hectares. A Project Management and Monitoring Unit (Unité de Gestion et de Suivi du Projet – UGSP) at Achats Services International SA (hereinafter referred to as ASI) is tasked with overseeing the implementation and monitoring of the project.

The main aims of the project are: (i) the production of Arabic gum; (ii) carbon sequestration, and (iii) the development of intercropping at the project sites.

The participants and their respective roles are as follows:

- **ASI** is a limited liability company established in 1986. ASI aggregates the sale of Arabic gum and emission reductions for the duration of the programme to assist the communities involved in the project. ASI signed an agreement with the World Bank's BioCarbon Fund on 18 December 2006 for the purchase of emission reductions generated by the project. The UGSP is tasked with coordinating all activities linked to planting, notably: (i) monitoring the communities' planting programmes; (ii) providing technical assistance on the ground in partnership with other government structures; (iii) monitoring carbon stocks; (iv) capacity building; and (v) overseeing the communication strategy and external representation of the project.

- **The Community Action Program (CAP) of the Ministry of Agriculture and Livestock (MAG/EL)** provides: (i) funding for the activities of the UGSP; (ii) technical support for the project at the regional coordination level; (iii) monitoring how financing agreements are applied to implement planting and monitoring activities; and (iv) ensuring that funds are transferred to the communities.

- **Ministry of Environment and Sustainable Development (ME/DD)[1], through the General Directorate of Water and Forestry (DGEF)**, is responsible for the implementation of the project's planting activities, by ensuring that annual plantation programmes are initiated in a timely manner and that the plantations are given the adequate care and protection to guarantee the successful growth of individual trees. It also provides agents (hereinafter referred to as Biocarbon agents) offering close supervision of the project on the ground, assists the UGSP in collecting data on the plantations, builds capacity of the communities and supports the communities in their monitoring of activities.

- **National Council of the Environment for a Sustainable Development (CNEDD)** issued the project's Letter of Approval (LoA) and participates in capacity building and training activities.

- **Rural communities** are organized in management committees (Comités de Gestion – COGES) that work in partnership with the local communities and other actors of the project. The communities are involved in the: (i) execution of the project, as per the plan of operations (establishment and maintenance of plant matter, protection of sites, adherence to site boundaries, etc.); (ii) ensuring the availability of carbon stocks within the scope of the project until the end of the crediting period; (iii) transferring the emission reductions to ASI,

[1] Previously the Ministry of Water, the Environment and the Fight against Desertification (ME/E/LCD) as referred to in the PDD.

in accordance with the terms of their contract; (iv) delivering to ASI the amount of Arabic gum at the agreed time and location.

The project has produced significant results on the ground, including:

- The recovery of hardened land;
- The establishment of plantations;
- Significant income generated from the recovery of degraded land and the production of plants and plantations since the start of the project;
- The creation of temporary jobs, mainly for young people and women;
- Significant environmental effects, including the creation of microclimates, the reconstitution of wildlife habitat, the protection of natural flora and the appearance of new plant and animal species;
- The development of food intercrops (cowpea, groundnut, millet, sesame, voandzou, sorrel, etc.);
- The production of biomass fodder.

Through plantations established in 7,225.46 hectares, the project has sequestered 78,666 (tCO_2e) since the start of project activities.

A.2. Location of project activity

>> The project is situated in 26 georeferenced sites in six (6) regions of Niger.

The coordinates of a point taken within these sites are displayed in the Table 1 below to show the geographical location of each site. Figure 1 displays the sites on a map.

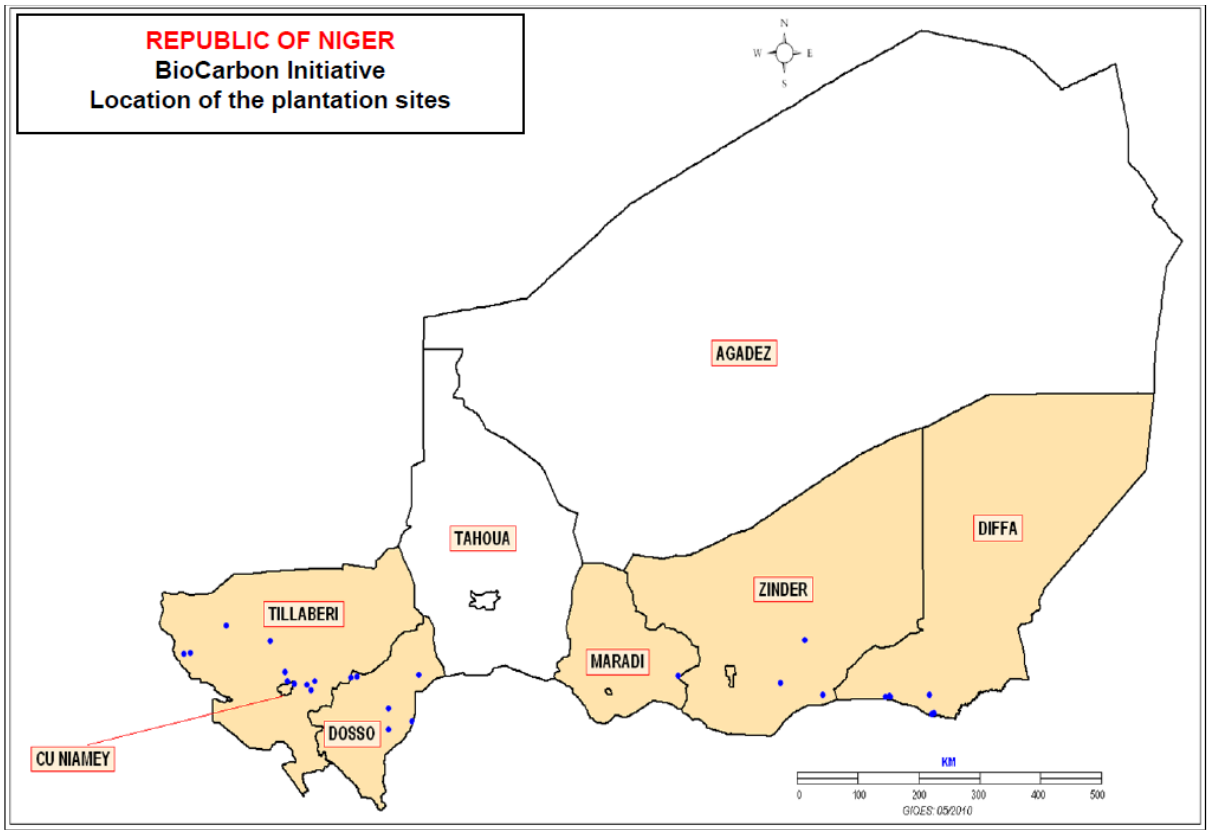
At the end of each year, the new areas that have been planted in the different sites are georeferenced, and plantation polygons are produced by the UGSP's monitoring and evaluation expert (GIS database is available at the moment of verification).

Table 1. Location of project sites

Region	Department	Municipality	Site	Longitude	Latitude
DIFFA	**Mainé Soréa**	**Mainé Soréa**	Tam	12° 7' 58" E	13° 8' 18" N
			Grémadi	12° 9' 32" E	13° 8' 51" N
			Tchikatkadoua	12° 5' 27" E	13° 25' 44" N
			Chéri	11° 24' 34" E	13° 23' 47" N
			Kayatawa	11° 28' 51" E	13° 23' 49" N
			Bringuidjiram	11° 28' 14" E	13° 24' 57" N
DOSSO	**Tibiri**	**Doumega**	Birni Fala	4° 4' 34" E	13° 1' 38" N
		Guecheme	Lido	3° 42' 58" E	12° 54' 30" N
	Doutchi	**Dankassari**	Goubey	4° 10' 45" E	13° 43' 37" N
	Loga	**loga**	Boukki	3° 13' 30" E	13° 41' 59" N
			Kogorou	3° 7' 59" E	13° 41' 46" N
	Dosso	**Maoureydey**	Maourey	3° 42' 43" E	13° 12' 55" N
MARADI	**Tessaoua**	**Maizirgui**	Chabaré	8° 12' 11" E	13° 43' 30" N
TILLABERI	**Tillabery**	**Anzourou**	Goulbal	1° 11' 55" E	14° 28' 38" N
	Tera	**Tera**	Bégorou Tondo	0° 38' 40" E	14° 3' 59" N
			Gourouabon	0° 32' 44" E	14° 2' 37" N
	Ouallam	**Ouallam**	Dabarey	1° 52' 31" E	14° 15' 41" N
		Simiri	Simiri	2° 8' 37" E	13° 38' 11" N

Region	Department	Municipality	Site	Longitude	Latitude
	Kollo	**Dantchandou**	Tchida	2° 34' 24" E	13° 38' 8" N
		Hamdallah	Béri Koira	2° 26' 43" E	13° 34' 27" N
		Kouré	Guassan Gourgné	2° 30' 46" E	13° 29' 28" N
		Karma	Koné Béri	2° 6' 50" E	13° 46' 34" N
ZINDER	**Gouré**	**Guidiguir**	Yacoubari	9° 47' 14" E	13° 36' 37" N
		Bouné	Kalgeri	9° 47' 14" E	13° 36' 37" N
			Kafourka	9° 47' 14" E	13° 36' 37" N
NIAMEY	**Niamey 4th district**	**Niamey 4th district**	Kongou Gonga	2° 15' 43" E	13° 36' 2" N

Figure 1. Location of project sites (map).



A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Niger	Achats Services International (ASI)	No

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Kingdom of Spain	• International Bank of Reconstruction and Development (IBRD) as Trustee of the Bio Carbon Fund • Ministry of Agriculture, Fisheries, Food and Environment • Ministry of Economy, Industry and Competiveness	Yes
Japan	• Suntory Holdings Limited • Tokyo Electric Power Company Holdings, Inc • Sumitomo Joint Electric Power Co., Ltd • Japan Petroleum Exploration Co., Ltd • The Okinawa Electric Power Co., Inc • Japan Iron and Steel Federation • Idemitsu Kosan Co., Ltd • Sumitomo Chemical, Limited	Yes

A.4. Reference to applied methodologies and standardized baselines

>> Methodology: AR - ACM0003 (Afforestation and reforestation of lands except wetlands), version 1.0.0.

Tools:

- Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, version 01.
- Procedures to demonstrate the eligibility of lands for Afforestation and reforestation CDM project activities, version 01.
- Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, version 03.0.0.
- Calculation of the number of sample plots for measurements within A/R CDM project activities, version 02.1.0.
- Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities, version 01.0.0.

A.5. Crediting period type and duration

>> Fixed crediting period of 30 years, from 21/12/2005 until 20/12/2035.

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

>> **Annual surface area planted and re-planted:** the annual level of plantation refers to all trees planted on eligible land, the sum of which represents the total project area. Table 2 illustrates the progress of the plantations on year-by-year basis. In 2017, the total surface area of the plantations across all the project's sites stands at 7,225.46 ha. Detailed information is available in GIS file at the moment of verification.

The areas re-planted concern land that has been cleared at the different sites to replace dead plants, thereby increasing the density of plant coverage.

Stocking density: two levels of stocking density were employed as outlined in the PDD, depending on the region where the plantation is located:

- In the western (Tillabéry, Niamey and Dosso) and central (Maradi) regions where the soil is hard, the plantations cannot succeed without the soil first undergoing preliminary treatment. In these areas, the trees are planted in semi-circular structures at a density of 313 trees/ha. To maximise the survival chances of at least one tree per semi-circular structure, each of them contains two or three plants. On some occasions, all three trees survive in the same structure (one tree on each wing of the structure and a third at the centre).
- In the eastern regions (Zinder and Diffa), where the soil is sandier, no such planting structures are used. Instead, the trees are planted in holes (30 cm wide and 30 cm deep). These are spaced at a density of 400 trees/ha.

Calendar and choice of sylvicultural activities:

Preparation of sites and creation of semi-circular water retention structures: the water retention structures are produced in the western (Tillabéry, Niamey and Dosso) and central (Maradi) regions, where water retention structures (generally semi-circular in shape) are required owing to the hardened nature of the soil. This activity is carried out by local residents during the dry season. A total area of 2,787.87 ha has been prepared with this kind of structure over the course of the project. In the eastern regions of the country (Zinder and Diffa), on the other hand, the trees are planted in simple holes as described above.

Purchase of seeds and production of plants: during the early years, the seeds were purchased in partnership with ICRISAT, which first certified their quality before sending them to the private nurseries locally tasked with planting them. This task was subsequently transferred to the Tree Seed Centre, which sends the amount of seeds required – in accordance with the foreseen level of plant production – to private producers chosen by the participating communities. The number of trees planted by the private nurseries depends on the level of demand and on their own land resources. The quality and variety of the seeds that they are sent is decided by the UGSP.

Planting: planting is carried out during the wet season, once the aggregate total rainfall has reached 70 mm. It takes place following a downpour, while the soil is still humid. Participating communities are organised into groups tasked with (i) depositing the trees where the planting holes should be; and (ii) digging the holes and planting the trees. Before proceeding, a demonstration is provided to remind participating communities about the techniques required for good planting. Below is a year-by-year record of the surface area covered by the plantations:

Table 2. Areas planted per stratum

Stratum	Year	Area (ha)
Stratum 01	2006	1,941.96
Stratum 02	2007	778.20
Stratum 03	2008	400.98
Stratum 04	2009	415.45
Stratum 05	2010	1,185.74
Stratum 06	2011	614.67
Stratum 07	2012	1,787.76
Stratum 08	2013	100.70
Total		**7,225.46**

Plantation maintenance and protection activities: to allow the plantations to grow normally, certain activities are carried out on site to ensure the maintenance and protection of the plants. The

table below provides a summary of these activities. Further details can be found in an Excel spreadsheet, to be made available during verification.

Site	Maintenance operations carried out
Diffa (6 sites)	
Tam	Pruning; bleeding; guarding; recovery of land; planting; fencing.
Gremadi	Guarding; recovery of land; planting; pruning; bleeding; fencing.
Chikatkadoua	Guarding; recovery of land; planting; pruning; bleeding; fencing.
Chéri	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum; collection of fodder; weeding.
Kayetéwa	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of fodder.
Bringuidjiran	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum; collection of fodder.
Dosso (6 sites)	
Birnin Falla	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum; collection of fodder; weeding.
Lido	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum; collection of fodder; collection of seeds.
Goubey	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Boukhi	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Kogorou	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Maourey Dey Moussa	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Maradi (1 site)	
Chabaré	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum; collection of fodder; creation of firebreak; weeding.
Tillabery (9 sites)	
Goulbal	Guarding; recovery of land; planting; pruning; bleeding; fencing.
Bégorou	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Gouryabon	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Dabarey	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum; collection of fodder; weeding.
Simiri	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Tchida	Guarding; recovery of land; planting; pruning; bleeding; fencing.
Béri Koira	Guarding; recovery of land; planting; pruning; bleeding; fencing.
Guassan Gourgné	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum.
Koné Béri	Guarding; recovery of land; planting; pruning; bleeding; fencing; collection of gum; collection of fodder.
Zinder (3 sites)	
Yacoubari	Guarding; planting; pruning; bleeding; fencing.
Kargueri	Guarding; planting; pruning; bleeding; fencing; collection of fodder.
Kafourka	Guarding; planting; pruning; bleeding; fencing; collection of gum; collection of fodder.
Niamey (1 site)	
Kongou Gonga	Guarding; recovery of land; planting; pruning; bleeding; fencing.

The different plantation maintenance and protection activities referenced in the table above are described below:

- **Recovery of land:** this consists of constructing the semi-circular water retention structures in the western (Tillabery, Niamey and Dosso) and central (Maradi) regions, where the land reserved for the plantations presents hardened soil. These structures trap run-off water at

the bottom of the plants, thus retaining sufficient water to meet the needs of the plants for several days following rainfall.

- **Bleeding:** bleeding is an operation designed to stimulate the natural exudation of trees. Bled trees can produce up to 5 or 6 times more Arabic gum. The technique comprises the removal of a length of bark (or cork) of around 2 cm x 10 cm from the branches, without cutting into the wood (secondary phloem). This length is taken from the bole (trunk) of the tree and/or from one of its main branches (with a diameter of at least 5-8 cm). During a planting programme, two periods are considered to be the most favourable times to carry out bleeding. The first is at the start of the dry season, when the trees have lost half of or all their leaves (the start of the cold season, around the month of November). The second is during the month of March, at the midpoint between the end of the cold weather and the start of the extreme heat of summer.

- **Collection of gum:** gum exudation starts a few days, sometimes only a few hours, after the bleeding. However, the tree must be left for two or three weeks (often more) before the first collection. The subsequent collections take place every one to two weeks. The collection consists of gathering/removing the gum when it develops the appropriate qualities to be sold at a good price. In other words, at the moment when its biochemical properties are closest to the standards demanded. The gum is collected in the cold of the morning or the afternoon, to prevent it from agglutinating.

- **Fencing:** sites are enclosed with three or four rows of barbed wire to avoid animals trampling on the young trees. In cases when the fences fall down due to adverse weather conditions, these are repaired on an annual basis by participating communities. Sometimes this task is carried out by the plantation guardians. This is only done when the trees are young, after which the fencing is removed.

- **Guarding:** this is done to complement the mechanical protection provided by the fencing. The technical standards agreed on with the DGEF are of one guardian per 25 ha of plantation.

- **Pruning:** this is carried out to enable the trees to grow. Lateral branches are trimmed with a knife or sharp pruning shears, with care taken not to harm the tree itself. The most conducive moment for pruning is prior to the rainy season. However, participating communities prefer to carry it out during the cold season (December) to combine the activity with the bleeding. It should be noted that gum is also produced where the tree has been pruned.

- **Weeding:** this is carried out to reduce competition for nutrients and water between the grass cover and the Acacia senegal plants. It is done early in the winter season with the development of the grass cover.

- **Firebreaks:** following the rainy season, when fodder biomass levels are high and the threat of bush fires is increased, firebreaks are erected to protect the trees and the fodder. This operation is carried out as early as possible before the onset of the Harmattan winds.

- **Collection of non-timber forest products:**
    - **Collection of fodder:** certain sites produce enough fodder for it either to be gathered up for livestock or to allow the local animals to graze on it.
    - **Collection of gum:** bleeding works are identified and carried out during the month of December, when the leaves have fallen because of lack of water. At this time, the plant is stressed and may respond favourably to the bleeding by producing gum within 15 days. The collection automatically follows, as and when the product starts to appear.

Technical training: participating communities receive training on the techniques required to carry out the following operations: growing plants, creating semi-circular water-retention structures, pruning, bleeding and gum collection.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

>> According to the PDD's monitoring plan, systematic stratified sampling based on density and age of plantations should be applied. However, the dispersal, small size and variability of actual density of plantations following replanting activities support the use of stratified random sampling based solely on tree age.

In view of the low growth of the Acacia senegal species in difficult soil and climatic conditions, and the operations of replanting and protecting sites for at least the first 3 years after planting, the threshold of 2.5 cm in minimum diameter as specified in the PDD was not retained. All trees planted, regardless of their diameter, were therefore measured.

As per the "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents" (Version 02.0) (Annex 24, EB 66) initially adopted on 29 September 2011 and revised on 2 March 2012, these changes are minor in nature and are to be confirmed by the designated operational entity at the verification without the need for submitting a notification or a request for approval.

B.2.2. Corrections

>> N/A

B.2.3. Changes to the start date of the crediting period

>> N/A

B.2.4. Inclusion of monitoring plan

>> N/A

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

>> N/A

B.2.6. Changes to project design

>> The project presents changes in the year-wise areas planted. As per the "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents" (Version 02.0) (Annex 24, EB 66) initially adopted on 29 September 2011 and revised on 2 March 2012, this change is minor in nature and is to be confirmed by the designated operational entity at the verification without the need for submitting a notification or a request for approval.

Changes to the year-wise areas planted: all the plantations established have respected the areas initially approved by participating communities and identified as having appropriate documentation on land tenure security. However, challenges encountered during implementation have resulted in changes to the year-wise areas planted because plants have died and have

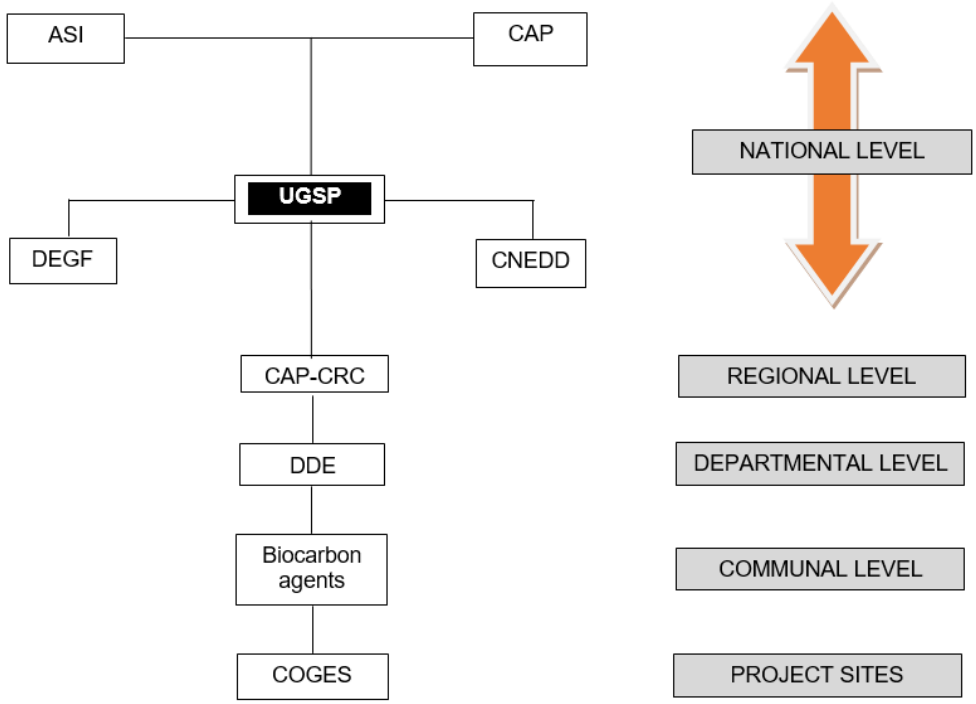
needed to be re-planted. These has been mostly due to periods of drought and attacks by hares to young trees. Other challenges that have led to some changes in year-wise areas planted include delays in making the necessary preparations on the ground and the dry weather, which resulted in some trees not being planted in time.

Table 3. Area planted over the course of the project.

Year	2006	2007	2008	2009	2010	2011	2012	2013	Total
Planted area (ha)	1941.96	778.2	400.98	443.74	1157.45	614.67	1787.76	100.7	7225.46
Expected in PDD) (ha)	1300	1992	305	456	1204	1310	1905		8472
Difference (%)	49%	-61%	31%	-3%	-4%	-53%	-6%		-15%

SECTION C. Description of monitoring system

>> The different actors involved in the monitoring of the project can be summarized through the organigram below:



The **UGSP** is responsible for the monitoring of the project, namely: (i) the monitoring of project boundaries; (ii) the monitoring of forest establishment; (iii) the monitoring of plantation maintenance activities; and (iv) the monitoring of carbon stocks. It is under the authority of **ASI** and the **CAP**, which is largely responsible for co-financing the UGSP's activities. The **UGSP** is made up of a coordinator, a monitoring and evaluation expert, and a technical assistant. The coordinator is responsible for overall coordination of activities, supports the other two members of the team when needed and supervises all activities on the ground, making sure that the results match up with the PDD. Supervision assignments are conducted jointly with the **DGEF** [2] representative. The monitoring and evaluation expert and the technical assistant jointly carry out monitoring operations

[2] General Directorate of Water and Forestry (DGEF) of the Ministry of Environment and Sustainable Development (ME/DD).

on the ground during all project activities, including site preparation, plant production, planting, evaluation of each planting programme, etc.

The UGSP works in partnership with other institutions for project implementation and monitoring of the sites:

- At the national level, the **DGEF** works alongside the UGSP to evaluate plant production and the planting carried out at the end of each year. The **CNEDD**[3] also plays a part in monitoring the condition of the sites.
- The **Regional Coordination Cell of the CAP (CAP-CRC)** supports the participating communities in the development and implementation of microprojects for financing by the CAP and undertakes monitoring missions during implementation.
- The **Departmental Environment Directorate (DDE),** which represents the DGEF at the departmental level, regularly monitors progress and receives reports from the Biocarbon agents from the respective project sites.
- The **Biocarbon agents** support the participating communities in all technical aspects of the implementation of their microprojects, including the maintenance of project sites and undertaking monitoring activities as described in this section.
- Finally, the **COGES**, which participates in various operations, also monitors the activities conducted by groups of villages and ensures that the quality of the work meets the standards of the training received.

Monitoring activities were carried out following the methodological process described in the PDD (Monitoring Plan) as follows:

The monitoring of project boundaries refers to the geo-referencing of the points of delimitation of the surfaces of the project. This is done in two phases by the respective **Biocarbon agents** on an annual basis:

1. the planning of areas to be planted for the year, which is carried out by the representatives of the **COGES** of the site, representatives of the **UGSP** and representatives of the **DGEF**;
2. the evaluation of the areas actually planted for the current year with geo-referencing, carried out at the end of each winter season.

The monitoring of the project boundary is carried out in three main stages:

1. the geo-referencing of plantation areas boundaries;
2. the registration of coordinates;
3. the transfer of GPS data to the computer via the "MAPSOURCE" transfer software. The files and sketches are thus sent to the **UGSP**. The data is then converted to an "Excel" file before being processed through the MAPINFO mapping software to create maps.

The information is managed and stored in a GIS database which is consolidated in two MAPINFO files: (i) project area file (polygons); and (ii) plantations (polygons). The stored data are those resulting from the joint end-of-campaign evaluation carried out by the **UGSP** and the **DGEF**.

The detailed procedures for monitoring the project boundaries are found in the Procedures Manual, a document that will be made available at the moment of the verification.

The monitoring of plantation maintenance activities comprises two aspects:

1. Re-planting: activity during which mortality rates are determined per unit area. This activity was carried out by an ICRISAT team at the end of the 2008 campaign. It continued each year thereafter by the **UGSP** and from 2010 onwards jointly by the **UGSP** and **DGEF**. This activity is carried out at the fourth quarter of each calendar year by the **Biocarbon agents**. In this way, the need per site is determined. The re-plantings are carried out at the same time as the plantations new plantations blocks.

[3] National Council of the Environment for a Sustainable Development.

2. The maintenance of plantations comprises a set of activities that promote the development of the plants. This is carried out by the **COGES** and includes:
    - Weeding, which is done early in the winter season with the development of the grass cover. Weed control reduces competition for nutrients and water between the grass cover and the Acacia senegal plants.
    - Pruning, which is done during the winter campaign where the plants have enough water in the water table to support this treatment. It improves the growth in height and size of the Acacia senegal stems.
    - Bleeding which is done at the beginning of the dry season or during the dry season. It promotes the production of gum by exudation. The bleeding is done under the responsibility of the respective COGES with the supervision of the respective Biocarbon agents.

The detailed procedures for monitoring of plantation maintenance activities are found in the Procedures Manual, a document that will be available at the moment of the verification.

Monitoring of carbon stocks: the forest inventory which produced carbon stock data for this monitoring period was conducted by two teams under the aegis of given the large number of sample plots and sites to be visited. It started in September 2017 and ended in January 2018. To reduce bias and possible errors in the data to be collected, inventory methods were harmonized through collective fieldwork of all the members of the two teams on the same site for two days. In this way, the two teams had to work with the same tools and the same measurement techniques and acquired a good understanding of the tasks to be performed. This allowed everyone to carry out their tasks quickly and efficiently.

Each team was made up of 7 to 8 people, including research professors, a water and forest engineer, the respective Biocarbon agent, the respective member of the COGES, assistants, and a driver. Each team counted with a head of mission who ensured the progress of activities. In addition, the two teams worked under the supervision and in collaboration with the head of the forest inventory. The following equipment was used by each field team:

- GPS, Garmin
- Caliper 150mm (to measure the base diameter of trees)
- 100m shearing rope
- 100m metric metal tape
- Graduated stake
- Clinometer
- Paint
- Brush
- Clamp
- Numbered metal plates
- Protection gloves

The detailed procedures for monitoring carbon stocks are found in the PDD's Monitoring Plan and the forest inventory report for this monitoring period[4].

[4] Mahamane (2018). Evaluation of sequestered carbon at the sites of the bio-carbon project.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	***44/12***
Unit	Dimensionless
Description	Ratio of molecular weights of carbon and CO2
Source of data	
Value(s) applied	44/12
Choice of data or measurement methods and procedures	Universal constant
Purpose of data/parameter	Calculation of actual net GHG removals by sinks
Additional comments	See ARACM0003V1 Excel tool, sheet “References” cell C13

Data/Parameter	**Confidence level**
Unit	%
Description	Statistic parameter
Source of data	Fixed
Value(s) applied	90%
Choice of data or measurement methods and procedures	Is the most used in statistical inference applied to forest inventory
Purpose of data/parameter	Calculation of actual net GHG removals by sinks
Additional comments	See Winrock sample plot calculator tool, sheet “BiomassStocks-Plots” cell: C10

Data/Parameter	**CF**
Unit	(t C(t d.m.)-1)
Description	Carbon fraction
Source of data	GPG-LULUCF
Value(s) applied	0.5
Choice of data or measurement methods and procedures	There is not local-derived and species- specific-values, then default value is used.
Purpose of data/parameter	Calculation of actual net GHG removals by sinks;
Additional comments	See ARACM0003V1 tool, sheet “References” cell C7

Data/Parameter	$Z_{\alpha/2}$
Unit	Dimensionless
Description	Value of the statistic z (normal probability density function), for α = 0.1 (implying a 90% confidence level).
Source of data	Statistic book
Value(s) applied	1.645
Choice of data or measurement methods and procedures	
Purpose of data/parameter	Calculation of actual net GHG removals by sinks
Additional comments	See ARACM0003V1 tool, sheet “Error” cell I15.

D.2. Data and parameters monitored

Data/Parameter	***BD***
Unit	cm
Description	Diameter at base of living trees
Measured/calculated/ default	Measured
Source of data	
Value(s) of monitored parameter	See ARACM0003V1 tool, sheet “Trees Data”.
Monitoring equipment	Caliper
Measuring/reading/recording frequency	5 years
Calculation method (if applicable)	NA
QA/QC procedures	Data cross checking is done in the sample plots.
Purpose of data/parameter	Applied in the allometric equations
Additional comments	Measuring at each monitoring time per sampling method

Data/Parameter	PL_{ik}
Unit	cm
Description	Total number of plots in stratum *i*, stand model *k*
Measured/calculated/ default	dimensionless
Source of data	Determined before forest inventory and adjusted during the monitoring event
Value(s) of monitored parameter	NA
Monitoring equipment	NA
Measuring/reading/recording frequency	5 years
Calculation method (if applicable)	NA
QA/QC procedures	The Project Management and Monitoring Unit (USGP) verifies the calculation of the number of sample plots by using equation 7 as described in section B.8.2 of the PDD.
Purpose of data/parameter	Calculation of actual net GHG removals by sinks
Additional comments	Number of plots (sampling size) is determined by using Winrock’s CDM A/R Sample Plot Calculator Spreadsheet tool

Data/Parameter	***Aikt***
Unit	ha
Description	Area of stratum *i*, stand model *k*, at time *t*;
Measured/calculated/ default	Measured
Source of data	Measured with GPS and upload into GIS database

Value(s) of monitored parameter	<table><tr><td>Strata</td><td>Area</td></tr><tr><td>Stratum 01</td><td>1,941.96</td></tr><tr><td>Stratum 02</td><td>778.20</td></tr><tr><td>Stratum 03</td><td>400.98</td></tr><tr><td>Stratum 04</td><td>415.45</td></tr><tr><td>Stratum 05</td><td>1,185.74</td></tr><tr><td>Stratum 06</td><td>614.67</td></tr><tr><td>Stratum 07</td><td>1,787.76</td></tr><tr><td>Stratum 08</td><td>100.70</td></tr></table>
Monitoring equipment	GPS
Measuring/reading/recording frequency	5 years
Calculation method (if applicable)	NA
QA/QC procedures	Areas are measured with GPS after plantation. This is done for every discrete area and date of plantation. Then, information is processed in GIS by the Project Management and Monitoring Unit (USGP)
Purpose of data/parameter	Calculation of actual net GHG removals by sinks
Additional comments	

Data/Parameter	***AP***
Unit	m^2
Description	Sample plot area
Measured/calculated/ default	Measured
Source of data	To monitor carbon stocks, a forest inventory is carried out and circular permanent sample plots with 17.84 m of radius are stablished. Sample plot area is registered in inventory forms and then upload into the ARACM0003V1 Excel calculation tool
Value(s) of monitored parameter	1000
Monitoring equipment	Metric tape
Measuring/reading/recording frequency	5 years
Calculation method (if applicable)	NA
QA/QC procedures	10% of the permanent sample plots are to be verified in each monitoring event by the USGP
Purpose of data/parameter	Calculation of actual net GHG removals by sinks
Additional comments	

Data/Parameter	***H***
Unit	m
Description	Total tree height
Measured/calculated/ default	Measured
Source of data	
Value(s) of monitored parameter	

Monitoring equipment	Graduated pole
Measuring/reading/recording frequency	5 years
Calculation method (if applicable)	NA
QA/QC procedures	Data cross checking is done in the sample plots.
Purpose of data/parameter	
Additional comments	This parameter was measured but is not required in the allometric equation used.

Data/Parameter	***fj(BD,H)***
Unit	dimensionless
Description	Allometric equation for species *j* linking above-ground tree biomass (kg tree^{-1}) to diameter at base (BD) measured in plots for stratum *i*
Measured/calculated/ default	calculated
Source of data	Allometric equation fitted with local data (Ichaou, A, 2010)
Value(s) of monitored parameter	Y = 4.502 C + 14.379; where: Y: total biomass in Kg (ABG+BGB), and C: circumference to the base in cm.
Monitoring equipment	NA
Measuring/reading/recording frequency	5 years
Calculation method (if applicable)	Equation used in the Excel calculation tool ARACM0003V1
QA/QC procedures	The following tool is used to demonstrate appropriateness of this equation: "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities"
Purpose of data/parameter	Calculation of actual net GHG removals by sinks.
Additional comments	

Justification of the allometric equation used for tree biomass estimation:

As specified in the PDD's monitoring plan, the most relevant allometric equation available for the region and species should be selected. For the estimation of tree biomass in this monitoring period, the project uses Ichaou's (2010)[5] biomass equation which was developed through a study on natural and planted stands of Acacia senegal over the territory of Niger. According to the A/R methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (version 03.0.0.), for ex-post estimation, the allometric equation used must be demonstrated to be appropriate for the purpose of estimation of tree biomass by applying the tool "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities" (version 01.0.0).

Appropriateness of Ichaou's biomass equation is addressed as follows:

1. A species-specific or group-of-species-specific allometric equation derived from trees growing in edapho-climatic conditions similar to those in the project area is considered

[5] Ichaou, A, 2010. Allometric models for the evaluation of aerial and underground phytomass and carbon deduction sequestered by the main populations of gum trees in the 3 geological basins of Niger. ASI/UGSP.

appropriate, and hence can be used for ex-post estimation of tree biomass, if at least one of the following conditions is satisfied:

a) The equation is used in the national forest inventory, or the national GHG inventory, of the host Party;

b) The equation has been used in commercial forestry sector of the host Party for ten years or more;

c) The equation was derived from a data set of at least 30 sample trees, and the value of coefficient of determination (R2) obtained was not less than 0.85.

Ichaou's equation was adjusted in the framework of the project by using local data. The data set was composed by 120 sample trees, the parameters of the equation were statistically significant (P < 0.005) and coefficient of codetermination (R^2) is 0,78. Although the model does not reach a coefficient of determination of 85%, a coefficient of determination of 78% can be considered acceptable since the equation incorporates both the aboveground and belowground biomass, thus reducing the error associated with the use of an additional parameter as the root-shoot ratio It means that the project uses a Tier 3 approach which is more accurate than using a default value from IPCC for root-shoot ratio. Additionally, the use of a total biomass equation does not result in a decrease in precision of the estimate of tree biomass.

D.3. Implementation of sampling plan

>> **Choice and number of sample plots:**

The project has 26 plantation sites covering a total area of 8,417.2 ha in 18 communes of Niger, of which 7,225.46 ha of plantations are standing at the time of the verification.

To estimate the amount of carbon sequestered by all plantation sites, circular permanent plots of 1000 m^2 (approximate radius of 17.83 m or diameter of 35.84 m) as specified in the PDD's Monitoring Plan were identified and delineated in the sites applying a stratified random sampling scheme based on the age of the plantations. According to the PDD's monitoring plan, systematic stratified sampling based on density and age of plantations should be applied. However, the dispersal, small size and variability of actual density of plantations following replanting activities support the use of stratified random sampling based solely on tree age. Thus, 7 sampling levels (strata) based on the age of the plantation blocks (from 2006 to 2013) were identified and a total of 131 plots were selected from the 26 sites of the project[6].

The total number of survey plots was determined with a margin of error of 10% (90% confidence level) according to the A/R Methodological tool "Calculation of the number of sample plots for measurements within A/R CDM project activities" (version 02.1.0) based on the area of the strata and the approximate value of the biomass stock variance in each stratum estimated from a preliminary sample of existing data related to the project area (2015 forest inventory report). Each stratum consists of plantation blocks of different sizes, depending on the number of plots to be surveyed per stratum. The QGIS 2.18 random sampling tool was used to determine the exact location (geographic coordinates) of the permanent plots in the selected blocks. These coordinates were then entered into a Garmin eTrex® 30x GPS receiver for field identification.

Three (3) sites were not prospected for security reasons. These are the Tam, Grémadi and Tchikatkadoua sites of the commune of Mainé Soroa (Diffa Region). For these inaccessible sites, the plots provided for sampling (12 plots; 2 in Grémadi and 5 for each site in Tam and Tchikatkadoua) were transferred to secure sites of the same stratum (planting age). The biomass

[6] Mahamane (2018). Evaluation of sequestered carbon at the sites of the bio-carbon project.

and carbon sequestered in the three sites were then estimated from the data collected on the sites of the same stratum with similar conditions.

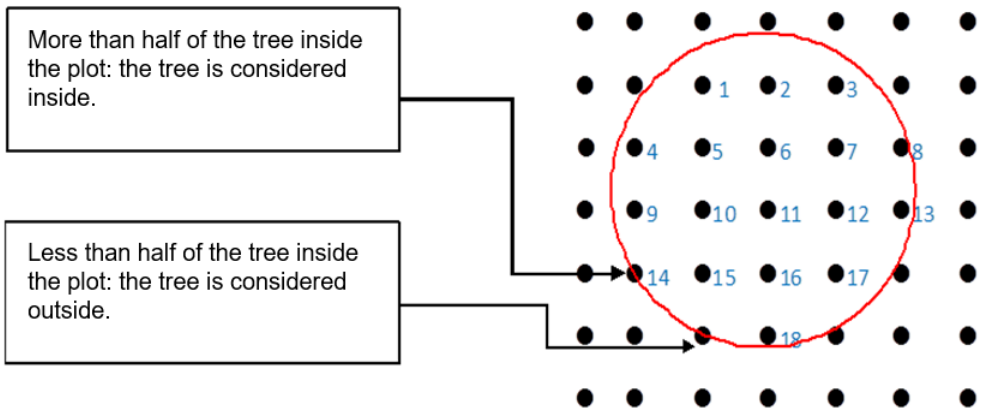
Delimitation of sample plots:

In the absence of the Pardé stake of 8 cm in diameter, a straight wooden stake of 2.5 m, a rope of 20 m, and a clinometer Suunto Tandem 360 were used for the final delimitation of the plots, the orientation and the measurement of slopes. In fact, with the geographic coordinates (in decimal degree), the operator searched for the point of the plot in the block to be surveyed and placed a 20 cm PVC pipe to mark the center of the plot. Then, with the help of the post marked at ground level (height of the ground in the eyes of the operator), the assistant is placed in the direction of greater slope (noted thanks to the clinometer) at a certain distance from the operator who uses the Suunto clinometer to aim for the mark on the stake to determine the slope of the plot. Using the Slope Correction Table from the Monitoring Plan, he moves the assistant to get the horizontal distance from the desired radius of the plot (17.83 m). The closest tree to the assistant, corresponding to the outermost tree inside the plot, is then marked with paint.

The operator and assistant turn around the center of the plot, placing themselves each time as necessary at the same distance of 17.83 m, and mark at each stop the trees included within the plot. Once at the starting point, the plot has an area of 1000 m² and all the trees inside are marked with paint and numbered with metal plates.

During this delimitation, a tree could be located on the boundary of the plot. To make it clear whether the tree is inside or outside the plot, the assistant makes sure that the center of the tree is at the right distance. For a good demarcation of the plot and to mark the trees, the following conditions have been respected (Figure 2):

Figure 2. Technique of counting trees in a circular plot.



Collected data:

Parameters measured

All standing Acacia senegal individuals within a given plot were measured for dendrometric parameters. This refers to the density of trees by counting, the total height of the tree using a graduated pole placed at the foot of the tree, and the diameter at the base (DB) of the trunk (0, 20 m from the ground) whose measurement level is determined by a graduated ruler, and marked with paint.

An electronic vernier caliper was used to measure the DB by orienting the tail of the caliper at each measurement towards the marked center of the plot in order to respect the uniformity of the

measurements and to reduce the effect of the heterogeneity of the trunk's shape (Figure 3A). Diameter measurements also take into account tree morphology (Figure 3B).

In view of the low growth of the Acacia senegal species in difficult soil and climatic conditions, and the operations of replanting and protecting sites for at least the first 3 years after planting, the threshold of 2.5 cm in minimum diameter as specified in the PDD was not retained. All trees planted, regardless of their diameter, were therefore measured. The trunks of the multi-stemmed trees have also all been measured (without order numbers, unlike the trees).

Of the 131 plots surveyed, thirteen (13) plots, about 10% of the total, were randomly selected for a second measurement of Height and DB of the trees, performed by another independent measurement team, for quality control. This operation was conducted to correct any observed measurement errors. The absolute value of the measurement error (%) on each measured tree was then calculated according to the formula:

$$\%\ Error = \left|\frac{(d_1 - d_2)}{d_1} x100\right|$$

with d_1 the first measurement of DB of tree *i* and d_2 the second measure of DB of that same tree *i*.

The average error (%) calculated at the scale of each of the 13 plots considered was calculated according to the formula:

$$\%\ Avg.\ Error = \frac{\sum_i^n (E_i N_i)}{\sum_i^n N_i}$$

with E_i the measurement error of all the trees in the plot *i* ; N_i the number of trees in the plot *i* ; and *n* the number of plots considered.

Figure 3A. Arrangement of calipers when measuring the diameter. The tail is always directed towards the center (P) of the circular plot.

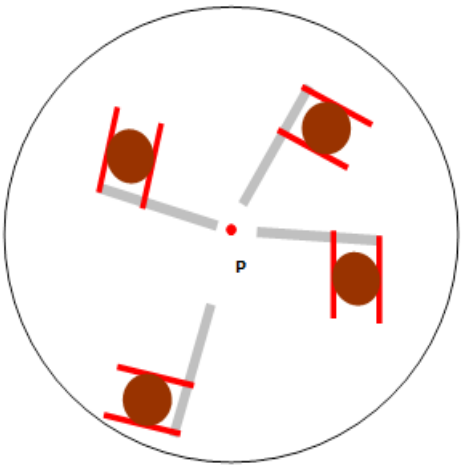
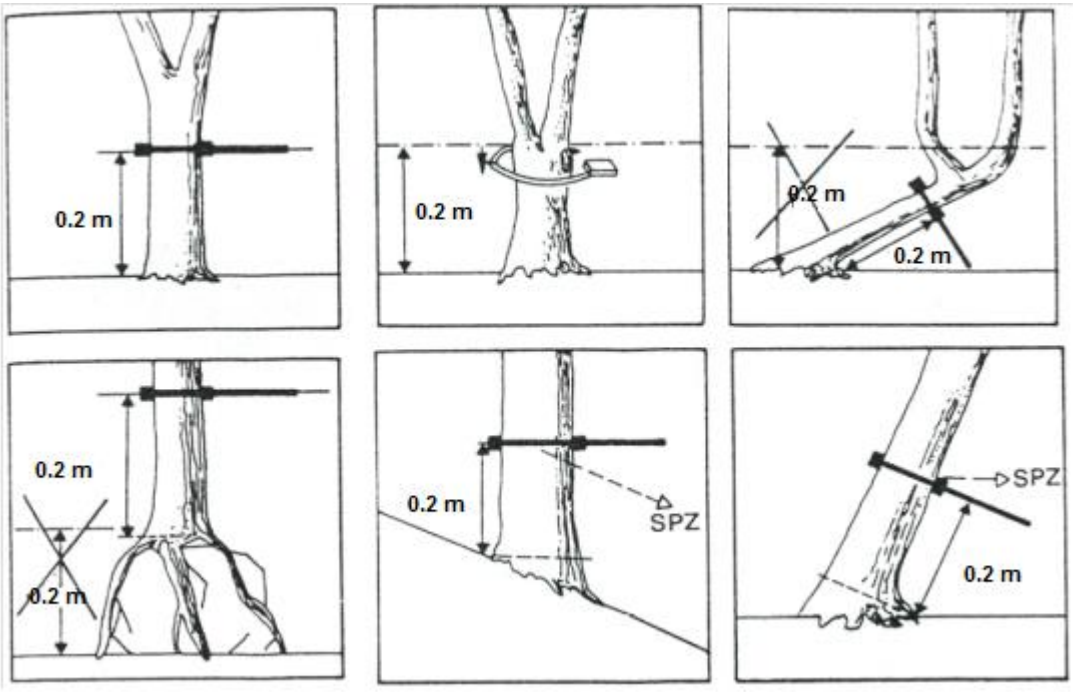


Figure 3B. Techniques for measuring diameters at the base according to the morphology of the tree.



Precision of forest inventory: The ARACM0003V1 Excel tool allows to estimate the error of forest Inventory (sheet "Error") and the result for this verification is 7.1%, which is lower than the maximum allowed error (10%).

Detailed information about the procedures and the result of forest inventory are provided in the report: "Evaluation of sequestered carbon at the sites of the bio-carbon project" available at the moment of verification.

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

>> As per the PDD, baseline emissions / net removals are zero.

E.2. Calculation of project emissions or actual net removals

>> The actual net greenhouse gas removals by sinks is estimated according to section 5.5 of the applied methodology AR-ACM0003 Version 01.0 and by using the ARACM0003V1 Excel tool in order to systematize the procedures and calculation; therefore, some steps and equations of the methodology were grouped in this tool, but without altering the results. These procedures and calculations are detailed below; equations are numbered as in the methodology.

In accordance with the PDD, the actual net greenhouse gas removals by sinks represent the sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the increase in greenhouse emissions by sources measured in CO_2 equivalents within the project boundary that are a result of the implementation of the A/R CDM project activity. Therefore, it is estimated according to the following equation of the methodology AR-ACM0003 Version 01.0:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \qquad \text{Equation (2)}$$

Where:

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e

$GHG_{E,t}$ = Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e.

Non-CO2 emissions are not expected as burning biomass is not allowed in the project area, then equation 2 can be expressed as follows:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t}$$

Then, the change in the carbon stocks in project, occurring in the selected carbon pools in year t are calculated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t} \quad \text{Equation (3)}$$

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e

$\Delta C_{TREE\ PROJ,t}$ = Change in carbon stock in tree biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$\Delta C_{SHRUB\ PROJ,t}$ = Change in carbon stock in shrub biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e, shrubs are not considered in this project.

$\Delta C_{DW\ PROJ,t}$ = Change in carbon stock in dead wood in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e. Dead wood is not considered in this project.

$\Delta C_{LI\ PROJ,t}$ = Change in carbon stock in litter in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e. Litter is not considered in this project.

$\Delta SOC_{AL,t}$ = Change in carbon stock in SOC in project, in year *t*, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO_2-e. SOC is not considered in this project.

Taking into account the carbon pools considered in this project, change in the carbon stocks in project is estimated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t}$$

Change in carbon stock in tree biomass is estimated according to the tool: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities". Section 8 of this tool has been chosen to estimate carbon stock in trees at a point of time as follows:

$$C_{TREE\_PROJ,t} = \frac{44}{12} \times CF_{TREE} \times B_{TREE} \quad \text{(Equation 12)}$$

$$B_{TREE} = A \times b_{TREE} \quad \text{(Equation 13)}$$

$$b_{TREE} = \sum_{i=1}^{M} w_i \times b_{TREE,i} \quad \text{(Equation 14)}$$

Where:

$C_{TREE\_PROJ,t}$	=	Carbon stock in trees in the tree biomass estimation strata; t CO_2e
CF_{TREE}	=	Carbon fraction of tree biomass; t C (t d.m.)$^{-1}$
B_{TREE}	=	Tree biomass in the tree biomass estimation strata; t d.m
A	=	Sum of areas of the tree biomass estimation strata; ha
b_{TREE}	=	Mean tree biomass per hectare in the tree biomass estimation strata; t d.m. ha^{-1}
w_i	=	Ratio of the area of stratum *i* to the sum of areas of tree biomass estimation strata (i.e. $w_i = A/A_i/$); dimensionless
$b_{TREE,i}$	=	Mean tree biomass per hectare in stratum i; t d.m. ha-1

Mean tree biomass per hectare in a stratum and the associated variance are estimated as follows:

$$b_{TREE,i} = \frac{\sum_{p=1}^{ni} b_{TREE,p,i}}{n_i}$$

$$S_i^2 = \frac{n_i \times \sum_{p=1}^{ni} b_{TREE,p,i}^2 - \left(\sum_{p=1}^{ni} b_{TREE,p,i}^2\right)^2}{n_i \times (n_i - 1)}$$

Where:

$b_{TREE,p,i}$	=	Tree biomass per hectare in plot p of stratum i; t d.m. ha^{-1}
S_i^2	=	Variance of mean tree biomass per hectare in stratum i; (t d.m. ha^{-1})^2
n_i	=	Number of sample plots in stratum *i*

Then:

$b_{TREE,p,i} = \sum_j b_{TREE,j,p,i}$ (Equation 1, Annex 1)

Where:

$b_{TREE,j,p,i}$= Biomass of tree j in sample plot *p* of stratum *i*; t d.m

$b_{TREE,j,p,i} = 4.502 \times C + 14{,}379$

Where:

C = Circumference at base in m (20 cm height from soil)

E.3. Calculation of leakage emissions

>> According to PDD no leakage is expected, and it is ensured by allowing fuel-wood collection and grazing activities within the project boundary. In some forest stands, cattle grazing is done by transhumance and these activities are still allowed.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals ($t CO_2e$)	Project GHG emissions or actual net GHG removals ($t CO_2e$)	Leakage GHG emissions ($t CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t CO_2e$)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	0	78,666	0	45,888.5	32,777.5	78,666

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period ($t CO_2e$)	Amount estimated ex ante ($t CO_2e$)
78,666	313,008

E.6. Remarks on increase in achieved emission reductions

>> N/A