Project design document form (afforestation or reforestation) **(Version 10.0)**	

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

BASIC INFORMATION	
Title of the project activity	Niger Acacia Senegal Plantation Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	2
Completion date of the PDD	16/07/18
Project participants	• Achats Services International • Kingdom of Spain - Ministry of Agriculture, Fisheries, Food and Environment & Ministry of Economy, Industry and Competiveness • International Bank of Reconstruction and Development (IBRD) as Trustee of the Bio Carbon Fund Suntory Holdings Limited (until 31/12/2019) • Tokyo Electric Power Company Holdings, Inc (until 31/12/2019) • Sumitomo Joint Electric Power Co., Ltd (until 31/12/2019) • The Okinawa Electric Power Co., Inc (until 31/12/2019) • Japan Iron and Steel Federation (JISF) (until 31/12/2019) • Japan Petroleum Exploration Co., Ltd (until 31/12/2019) • Idemitsu Kosan Co., Ltd (until 31/12/2019) • Sumitomo Chemical Company, Limited (until 31/12/2019) • Ministry of Sustainable Development and Infrastructure (until 31/12/2019)
Host Party	Niger
Applied methodologies and standardized baselines	AR-ACM0003 Afforestation and reforestation of lands except wetlands version 1.0.0
Estimated amount of annual average net anthropogenic GHG removals	24,957 tCO$_2$e/yr

SECTION A.   Description of project activity

A.1.   Purpose and general description of project activity

>> This first Nigerien A/R CDM project activity (Niger Acacia Senegal Plantation Project, NASPP hereafter), aims to restore deforested and highly degraded land in the Sudano-Sahelian zone of the Republic of Niger by empowering rural communities to adopt sustainable agro-forestry practices by establishing plantations using native species *Acacia senegalensis* (Acacia Senegal). This project represents the first effort in Niger to establish Acacia Senegal plantations on a large scale in regions where dry forests are unable to regenerate by natural means. The sale of emission reduction credits from the carbon sequestered in plantations will make the project more viable by providing an additional revenue stream that will supplement income from the sale of Arabic from the acacia tree.

The project is an innovative public-private partnership involving the following parties:
- Achats Service International (ASI), a dynamic Franco-Nigerien agro-business;
- The Ministry of Water, the Environment and the Fight against Desertification (ME/E/LCD);
- Rural communities, which will benefit from the project through employment creation and by developing their own plantations.

Rural communities covered under the Community Action Program[1] (CAP) will be involved in the establishment of plantations, maintenance, harvest, and sale of gum from plantations. The major benefits of this public/private partnership to rural communities will be the technical transfer of know-how and training to be provided by ME/E/LCD and market access for the sale of Arabic gum to be guaranteed by ASI so as to ensure the project's sustainability. In addition, ASI will take responsibility for managing the distribution of tCER revenue to rural communities, corresponding to their share of carbon sequestered. ASI and ME/E/LCD will constitute the main technical and extension support for the project. In return, the rural communities have agreed to develop plantations in accordance with the standards and technologies recommended by ME/E/LCD.

Arabaic gum

Rural communities (mostly women) have expressed high interest in participating in the NASPP and have decided to establish plantations on 8,472 ha by 2013. By 2010, they have already planted 5,170 ha.

A total of about 8,472 ha of Acacia plantations will be developed under the project, which is expected to produce around 4,600 tons of Arabic gum each year at full capacity and sequester about 135,770 tCO_2e by 2012 and over 313,008 tCO_2e by 2017 i.e. an annual average GHG emission reduction of 24,957 tCO_2e.

The planting schedule is detailed in Table 1 below:

Table 1 - NASPP annual plantation objectives

Planting year	2006	2007	2008	2009	2010	2011	2012	Total
Area (ha)	1,300	1,992	305	456	1,204	1,310	1905	**8,472**

In order to facilitate the development and application of best practices of agro-forestry in this area, the ME/E/LCD will provide technical support to rural communities for the implementation of the

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[1] The CAP is a national development program of the World Bank aiming to establish and operationalize decentralized, participatory, and transparent financing mechanisms that empower poor communities to take charge of their own development, with the support of local authorities.

Monitoring Plan (MP), and will develop best practices regarding tree selection, grafting, nursery technology and field monitoring.

Sustainability of the project will depend on three elements outlined below and represented in 1:

- Protection of acacia plantations from cattle and harmful gum tapping techniques during the first four years: this will be achieved mainly through a 24-hour vigilance scheme, set up by the communities, and, whenever possible, by putting fences around the plantations;
- Application of best practices for the development of acacia plantations will allow for production of high quality Arabic gum over a long period. ME/E/LCD will ensure these best practices by diffusing its know-how and high quality grafted seedlings; and
- Reliable sources of revenue from the sale of Arabic gum (which is expected to start by the fourth year of project implementation) and tCERs will be ensured through a facilitated access to international markets for these products.

The project will benefit from the support of several institutions:

- The Ministry of Water, the Environment and the Fight against Desertification (ME/E/LCD) will provide technical training and support to the rural communities, as part of a larger capacity building plan, in particular to ensure proper pruning and tapping;
- The International Crop Research Institute for Semi-Arid Tropics (ICRISAT), a public agricultural research and development institute dedicated to improving agriculture in semi-arid tropics, will also provide technical support and training, either directly to the rural communities or indirectly through the ME/E/LCD;
- The Community Action Program (CAP) of the Ministry of Agriculture and Livestock (MAG/EL) will provide investment and managerial support for rural communities. This will enable the project to start and sustain itself during the first few years where there is no revenue from Arabic gum sales;
- The rural communities themselves, through the participation of their labor force, will work on their own land and be hired to work for ASI;
- ASI will guarantee the purchase of Arabic gum and tCERs at a fair price and allow project participants a fair access to international markets.

Figure 1 - Schematic diagram of the NASPP's contribution to local sustainable development
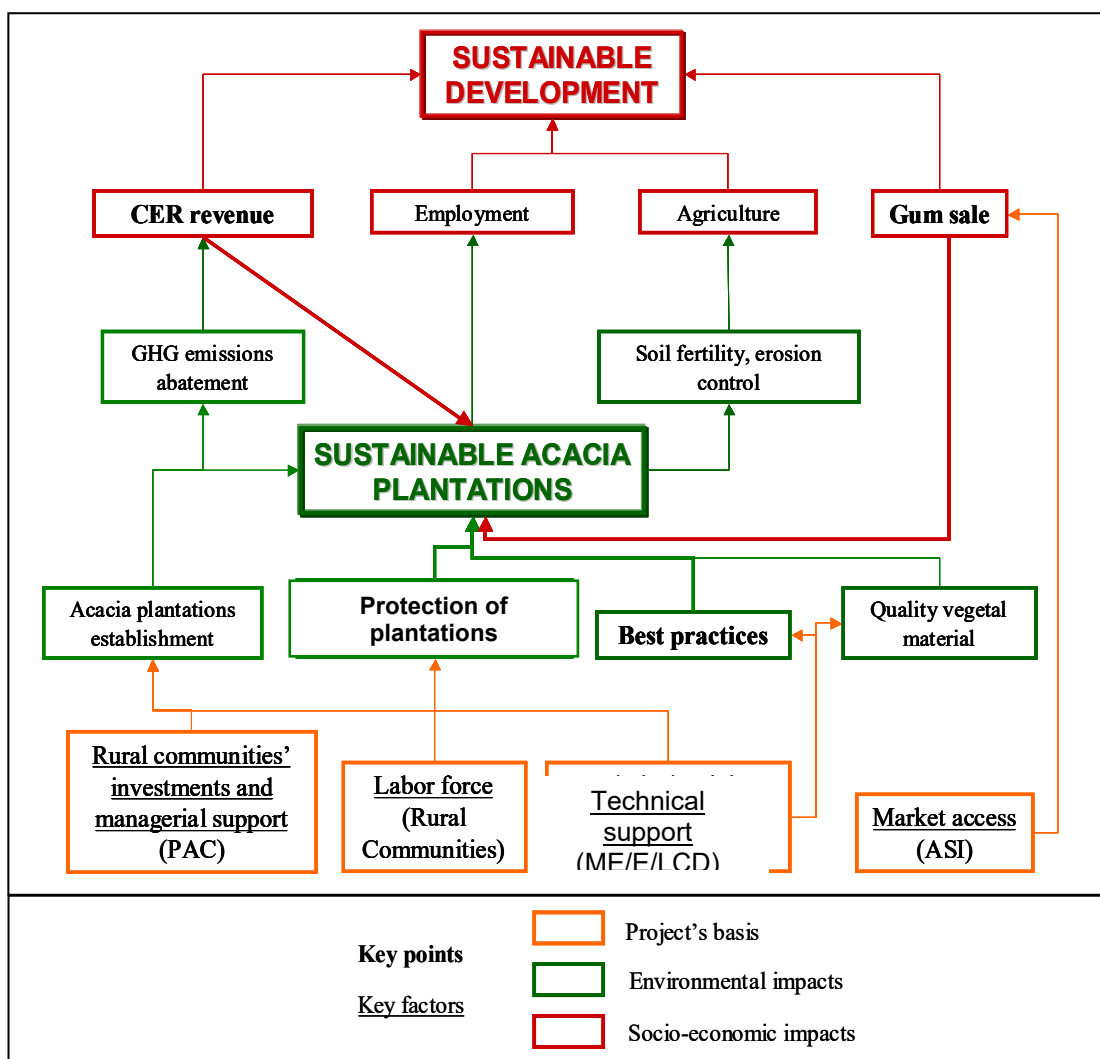
the Figure 1 above, outlines the key factors of the project's sustainability. These key factors lead to positive environmental and socio-economic impacts, which, in turn, contribute to the sustainable development of the project's areas. This new agricultural activity, combined with the employment and the different sources of revenue it generates, will reduce out-migration from project areas.

The proposed project activity is carried out in 26 sites distributed in the regions of Diffa, Dosso, Maradi, Tillaberi and Zinder, on lands previously identified based on the following characteristics: non-forest areas, degraded or being degraded, with the possibility of involving communities and without ownership problems. The areas identified were then evaluated in terms of eligibility and a baseline scenario was chosen according to current regulations of the CDM.

The identified baseline scenario is the continuation of pre-existing activities, ie grazing activities, predominantly under the transhumance system, and subsistence agriculture. These activities occur over degraded /degrading areas with a very low carbon stock in the biomass (4,63 tCO_2e/ha).

A.2. Project boundary

>> The projet sites are distributed in six different regions of the country, namely Tillabéri, City of Niamey, Dosso, Maradi, Zinder and Diffa (see map below).

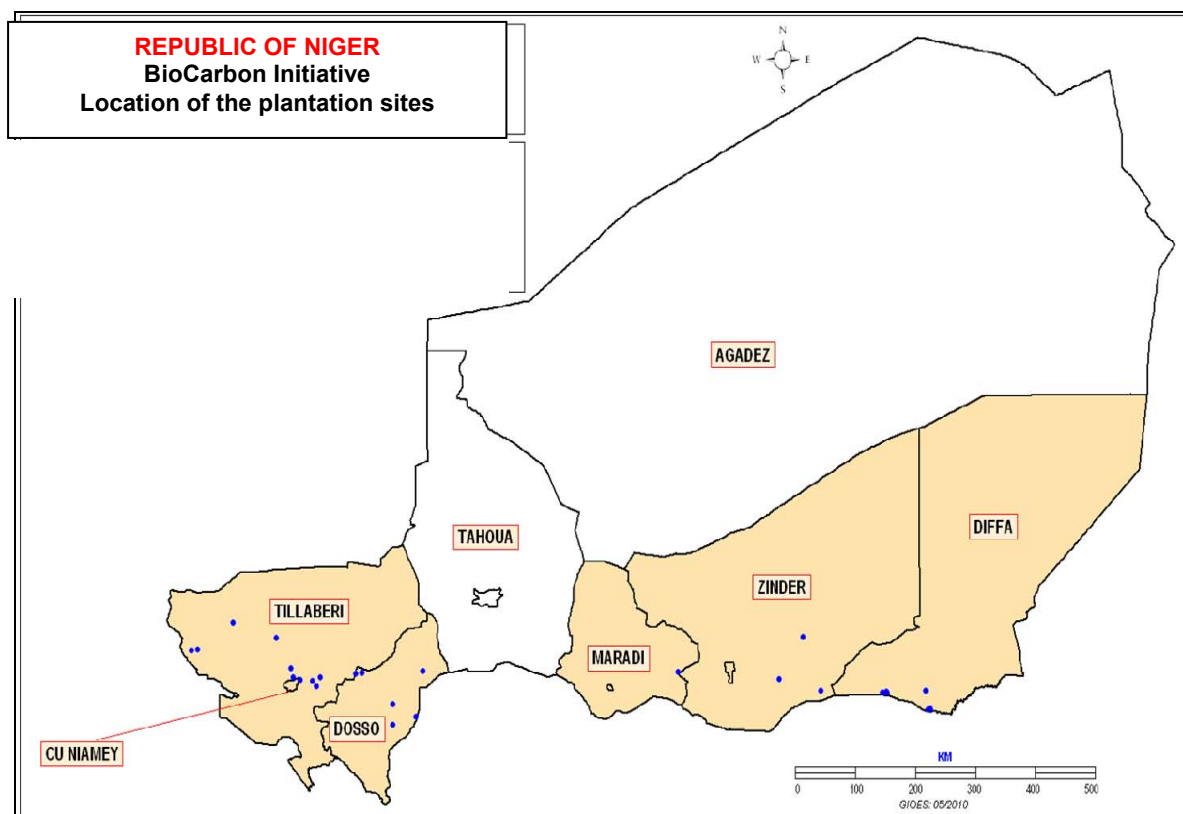**Figure 2 - Site distribution for the proposed A/R CDM project activity**

REPUBLIC OF NIGER
BioCarbon Initiative
Location of the plantation sites

Table 2 - Listing of sites for the proposed A/R CDM project activity

Region	Department	Municipality	Cluster	Site
DIFFA	Maïné Soroa	Maïné Soroa	Tam	Tam
				Grémadi
			Garawa	Tchikatkadoua
			Chéri	Chéri
				Kayatawa
				Bringuidjiram
S/total	**1**	**1**	**3**	**6**
DOSSO	Dogondoutchi	Douméga	Birni Fala	Birni Fala
		Guéchémé	Lido	Lido
		Dan Kassari	Goubey	Goubey
	Loga	Loga	Boukki	Boukki
			Sargadji	Kogorou
	Dosso	Sakka Damma	Sakka Damna	Maoureydey
S/total	**3**	**5**	**6**	**6**
MARADI	Tessaoua	Maijirgui	Chabaré	Chabaré
S/total	**1**	**1**	**1**	**1**
TILLABERI	Tillabéri	Anzourou	Sara Koira	Goulbal
	Téra	Téra	Bégorou Tondo	Bégorou Tondo
				Gouriabon
	Ouallam	Ouallam	Soudji	Dabrey
		Simiri	Simiri	Simiri
	Kollo	Dantchandou	Tchida	Tchida
		Hamdallaye	Banimaté	Béri Koira
		Kouré	Tcharga	Guassan Gourgné
		Karma	Tagabati	Koné Béri

Region S/total	Department 4	Municipality 8	Cluster 8	Site 9
ZINDER	Gouré	Guidiguir	Guidiguir	Yacoubari
		Bouné	Karguéri	Karguéri
			Kafourka	Kafourka
S/total	1	2	5	3
CU NIAMEY	Niamey	Commune IV	Bani Koubey	Kongou Gonga
S/total	1	1	1	1
TOTAL	**11**	**19**	**22**	**26**

Table 3 - Geographical coordinates of the project sites

Region	Site	Longitude	Latitude
DIFFA	Tam 1 Tam 2	12,133	13,138
	Grémadi	12,205	13,003
	Tchikatkadoua	12,159	13,148
	Chéri	12,091	13,429
	Kayatawa	11,419	13,402
	Bringuidjiram	11,481	13,397
DOSSO	Birni Fala	11,471	13,416
	Lido 1 Lido 2 Lido 3	4,076	13,027
	Goubey	3,716	12,908
	Boukki	3,699	12,897
	Kogorou	3,774	12,907
	Maourey	4,179	13,727
MARADI	Chabaré	3,232	13,717
TILLABERI	Goulbal	3,133	13,696
	Bégorou Tondo	3,712	13,215
	Gourouabon	8,203	13,725
	Dabarey	1,199	14,477
	Simiri 1 Simiri 2	0,644	14,066
	Tchida	0,546	14,044
	Béri Koira	1,875	14,261
	Guassan Gourgné	2,144	14,138
	Koné Béri	2,149	14,129
ZINDER	Yacoubari	2,573	13,636
	Kalgeri	2,445	13,574
	Kafourka	2,513	13,491
CU NIAMEY	Kongou Gonga	2,114	13,776

Detailed information about delimitations and geographic coordinates of each site are available in shape files.

A.3. Legal title to land

>> The land tenure commission (Cofo), the National authority in the matter, and their subsidiaries at departmental and local level, (CofoDep and CofoB), conducted different missions to each potential project areas in order to clarify their legal status and delivering land legal acts. With land tenure defined, a contract among land owners (privates or communities) and the office cluster (grappe) were signed.

As a result of these missions, three types of land property were identified and secured:

1. Private property (crops farms);
2. Vacant lands (or state property) and;
3. Classified forests.

1. Private property: this category results of:
   - The acquisition of rural land by succession since many generations is confirmed by the collective memory (heritage of ancestors) ;
   - The attribution to a person in a definitive way by the competent customary authority;
   - Any other mode of acquisition set by the customs of territories (Article 9 of the ordinance N°93 – 015 of March 2th, 1993, concerning principles of orientation of the rural law)[2].

In the framework of the project of Acacia senegal Plantation, and as a result of the different meetings of exchange, land owners have undertaken to establish contracts of farming with the office of the cluster. So, it can be observed that on one single site for example, one can find many farms belonging to different families. The Permanent Secretariat of the Rural Law[3] through the departmental COFOs have been charged to elaborate these acts of security and to enter them in the rural file through the marking off and the individual farms and give to each a **Land Title** or **an Act of Customary Holding** as described below.

2. Vacant lands: the vacant lands are those on which no proof of land owning has been established. They are owned by Government or the local government/territorial collectivity on which they exist (Article 11 of ordinance N° 93 – 015 of March 2nd, 1993), for this type of land, the village chief decides on its use.

The article 12 stipulates that: the accession to vacant lands ownership is done through **rural concession** as defined by the law on the private land of Government and Collectivities and delivered by the Cofodep.

3. The classified forests: According to the law 2004-040 of June 8th, 2004[4] concerning forestry regime in Niger, the forestry domain is made up of forest domains for Government and the territorial collectivities as well as private forests. It should be clarified that the term "classified

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[2] Ordonnance N° 93-015 du 2 mars 1993. Fixant les principes d'Orientation du Code Rural. Republique du Niger.Available in : http://www.hubrural.org/spip.php?&page=details_avancee&id_rubrique=1&docPageStart=1&id_article=7177

[3] The rural code is established as a pragmatic and organized iterating process about 2 complementary principles: (i) legal, a number of legislative texts and in accordance with the regulations, of national or local value in terms of natural resources management; and (ii) institutional based on local or even national structures that implement and monitor the established rules. The rural code makes itself also particular for its participative character that allows rural actors enable to act on the process and bring local adapted solutions.

The rural code constitute a strong legal and institutional instrument to which the legal texts maker assign mid and long term missions organized around basic themes related to (i) reassuring rural operators, (ii) conservation and management of natural resources, (iii) organisation of the rural world, (iv) regional development.

Its implementation is assured by the Permanent Secretary of the National Committee of Rural Code (cf Ordinance N° 93-015 of march 2nd, 1993 fixing Orientation principles of Rural Code and decree N° 97-008/PRN/MAG/EL of January 10th, 1997 stating the organisation, attributions and functioning of institutions in charge of applying the orientation principles of the rural code.

[4] Loi N° 2004-040 du 8 juin 2004. Portant régime forestier au Niger.Republique du Niger. Available in: www.hubrural.org/pdf/10-loi-2004-040.pdf

forest" is a local classification and is not related with the National forest definition under CDM. In fact, as an example, Chabaré is a typical African savannah with some isolated trees as corroborated by GIOES and APOR (2006), even if named as "classified forest" by law. In the case of Chabaré the land was classified as forest land because of its potential to produce forest or its ecological interest needing restoration of the vegetal resource.

All the forests that are not under the private ownership are forest domains. The forest domains include:
-    The classified forestry domain, made up of classified forests;
-    The protected forestry domain, made up of non classified forests.

The forestry domain of territorial collectivities is made up of forest legally acquired according to the means of the written law or through concessions given on the protected forestry domain of Government in conformity to the law in full force.
The concessions are motivated case by case by:
-    The need of making responsible the local populations organized and prepared for this purpose in order to manage rationally natural resources of their region;
-    The transfer of all or part of restored or adjusted lands in order to manage in ecologically rational conditions.

The BioCarbon project occupies a classified forest in Chabaré in Maradi region. The administrative authorities have delivered a rural concession act to the cluster and a contract of lands exploitation between the rural Commune on one hand and the concerned cluster on the other hand, has been established and signed. The Table 4 below shows the distribution of sites by categories and by ownership.

As mentioned before, in project sites, three types of contract were established:

1. **Land Title (**Titre foncier): The Land Title is the document that guarantees, secures and protects the right of private owner. The holder is recognized as the only true owner of the land concerned.

2. **Acts of customary holdings** (Actes de détention cotumière): allows recognizing and formalizing land rights of an individual or group of individuals who valorize a land for a relatively long time, without ownership title or any kind of legal recognition of rights on this land. The delivery of any instrument of customary holdings, issued by the village chief (President of Land Commission Base = COFOBs), participates in securing land sites.

3. **Titles of Rural Concession** (Titre de concession rural): is an administrative contract giving to the cluster (grappe), under determined conditions, the right to occupy and / or temporarily use a public domain.

Finally, under the terms previously described, 17,137 ha has been secured, among which are located the 8472 of this project.

Table 4: Distribution of sites by category

Regions	Categories				
	Vacant Lands	Crops Farms	Vacant Lands + Crops Farms	Classified forests	**Total**
Diffa	2	2	2	0	**6**
Dosso	2	3	1	0	**6**
Maradi	0	0	0	1	**1**
Niamey	0	1	0	0	**1**
Tillabery	6	2	1	0	**9**
Zinder	1	2	0	0	**3**
TOTAL	**11**	**10**	**4**	**1**	**26**

The sites are distributed as follows:
- 11 Vacant Lands ;
- 10 Crop Farms;
- 4 Vacant Lands extended to crops lands;
- 1 Classified forests;

CONTRACT CLAUSES OF COMMUNITIES/ASI

As part of the implementation of project activities, it was available to stakeholders, information booklets (brochures) and organized workshops in order to enhance the visibility of the project and participants, and thus improve the adherence of all public and private partners.

Indeed, before starting project the sale of carbon credits and gum Arabic, the Unit of project Management and Monitoring (UGSP) has conducted field missions to ensure that communities understand their rights and obligations and clearly establish how the funds received will be managed and distributed within the community (allocation of income). [5]

As a common point of these contracts, is established that ASI receives 20% of Arabic Gum and Carbone Credit revenues whereas the remaining 80% are given to the communities.

The Table 5 below gives an example of how the revenues are shared

Table 5 A. Sargadji's Cluster in Dosso Region, urban commune of Loga

BENEFICIARIES	PERCENTAGE	
	Carbon	**Arabic Gum**
Commune	7%	7%
Chief of the canton	3%	3%
Land owners	21%	21%
Villagers Council for Development (7)	39%	39%
Executive Board	5%	5%
Nurseries owners	5%	5%
Offers Analysis and Evaluation Commission	7%	7%
Monitoring –Evaluation Commission	7%	7%
Guards of sites	5%	5%
Municipalities Counsellors of the Cluster	1%	1%
TOTAL	**100%**	**100%**

It is worthy note that beyond the rural concession delivered by COFO, the collectivities have signed a contract of land exploitation with clusters for the length of the project (30 years).

A.4.   Eligibility of land

>> According to the CDM Project Standard,[6] the eligibility of the land of the proposed AR CDM project activities is demonstrated following the latest version of the tool "Procedures to demonstrate the eligibility of lands for Afforestation and reforestation CDM project activities" (EB35 Annex 18) as approved by the Executive Board.

All the study of eligibility has been done in the entire area initially foreseen for the proposed project activities, it means 16,715 ha, although in the framework of the proposed CDM project activities only 8,472 ha will be planted. It corresponds to the total area that will be planted until 2013. Below, the eligibility criteria assessed for the entire project area are described:

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[5] A detailed example about these activites is given in the Report on regional workshops of the project: "Ateliers régionaux sur l'initiative biocarbone Dosso, du 1er au 2 décembre 2008, Zinder du 4 au 5 décembre 2008

[6] CDM-EB65-A05-STAN (available on: https://cdm.unfccc.int/filestorage/u/j/extfile-20130412165420546-pp_stan01.pdf/pp_stan01.pdf?t=eWt8bW03eTZzfDBJg6-VWuyZ67N0d6uwV9xr)

1. (a) The land at the moment the project starts does not contain forest

Forest definition

The Nigerien Designated National Authority (DNA) fixed the following values for afforestation and reforestation activities in the framework of the CDM:
.

- Minimum tree crown cover: 30 percents
- Minimum land area: 1 hectare
- Minimum tree height at maturity: 4 meters

(i) A first study made by GIOES and APOR (2006)[7] consisted in assessing each site proposed for the AR CDM project activities in terms of existing vegetation. For each project site, the georeferenciation was made and some pictures taken in 2006, date of the study and project start. The study demonstrates that the whole project area does not contain forest considering the parameters fixed by the Nigerien DNA for the definition of forest, even for "classified forests" as mentioned above.

Since extensions of project areas were done, a second analysis of satellite imagery for the entire area was carried out by ONF International in order to corroborate the absence of forest within the areas of the first study and within new areas that were added as well. This was done by using three images per site, imagery dating from 1988, 2000, 2003 and 2006 were used.

The characteristics of the images used are the following:
- Sensors: Landsat 7 ETM + and Landsat 4-5
- Resolution: 30m
- Treatment: Images downloaded from the site of the USGS are radiometrically calibrated and orthorectified No further treatment was necessary to allow their use.

To cover the whole area, 11 slabs for a given date were necessary (being 33 slabs). Details of these images are presented below:

Image (sites)	Date	Sensor	Resolution	Reference product
188/51	février 1988	Landsat 4 TM	30m	LT41880511988047XXX04
	avril 2000	Landsat 7 ETM+	30m	LE71880512000096EDC00
	mars 2003	Landsat 7 ETM+	30m	LE71880512003088ASN00
194 / 50 : Baigoro – Gourouabon	mai 1988	Landsat 4 TM	30m	LT41940501988137XXX04
	aout 2000	Landsat 7 ETM+	30m	LE71940502000218EDC00
	novembre 2006	Landsat 5 TM	30m	LT51940502006306MPS00
193 / 51 : Youri – Kone Beri	decembre 1989	Landsat 4 TM	30m	LT41930511989340XXX06
	fevrier 2000	Landsat 7 ETM+	30m	LE71930512000035EDC00
	Octobre 2006	Landsat 7 ETM+	30m	LE71930512006291EDC00
192 / 51 : Kogourou – Bouki – Tchida – Guassam – Beri Koira – Babangata – Maorey – Lido	Janvier 1988	Landsat 4 TM	30m	LT41920511988027XXX03
	Fevrier 2000	Landsat 7 ETM+	30m	LE71920512000044AGS00
	Fevrier 2003	Landsat 7 ETM+	30m	LE71920512003036EDC00

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[7] GIOES & APOR, 2006. Situation de référence des sites de l'initiative biocarbone dans le cadre du programme d'Actions Communautaires . Niamey

Photo-interpretation of project areas

The project developer has provided to ONFI the project boundaries in vector format (polygons). These polygons were overlayed on different satellite images for visual inspection. For each date, an expert photo-interpreter has validated the absence of forest on these sites. For this, the photo-interpreter relies on the information present in the different bands of Landsat images and pictures that were taken on the ground in some sites.

In this process, it was investigated all spectral band for forest detection, in particular Red and Infra Red component. Furthermore, the ground truth mission provided photographs which help to calibrate the forest interpretation for the most recent data and at the same time, to detect forested area over older dataset. Indeed, comparison between ground truth photographs and landsat imagery helps to generalize land cover over all dates. Then, by comparing responses among the stable areas (areas with ground photographs) of the different Landsat acquisition help to identify the response of the study classes over all the acquisition.

Finally, a screenshot for each plot and date has been done, including the polygon covering the project boundaries and the Landsat background, natural color composite (bands by use of near infrared and shortwave infrared).

In Figures 7a and 7b are given two examples of this last analysis, where can be observed the absence of forest in the project area, additionally, Figure 6c shows some pictures for the same sites which corroborate the previous statement. A complete analysis site by site is available in a separate document: "Land eligibility site by site"

Indeed, according with the criteria fixed by FAO (2005), the whole project area being located in severely to very severely degraded areas, very few trees grows (see Figure 8). The existing vegetation observed is essentially composed of a few shrubs and trees typically as shown on pictures below, or even without tree.
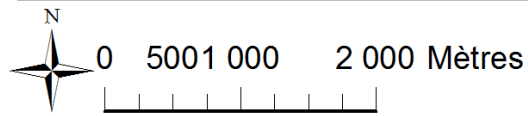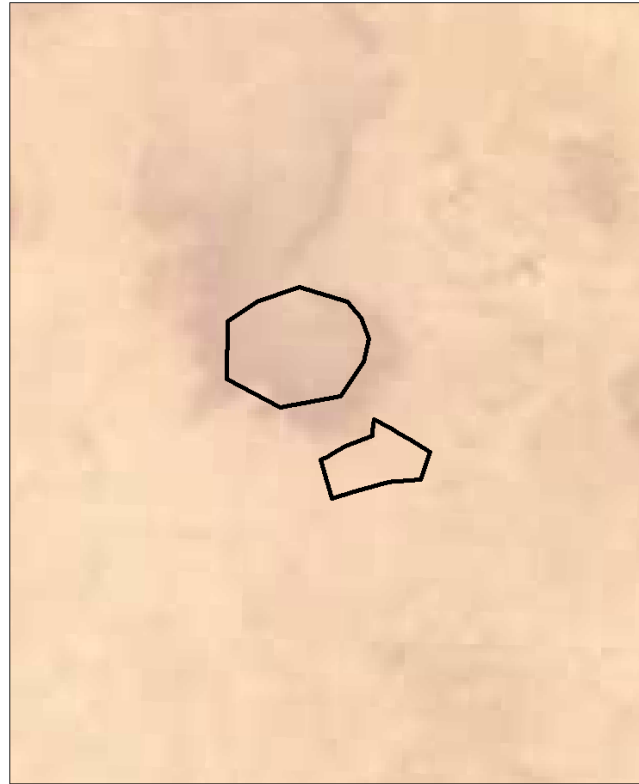
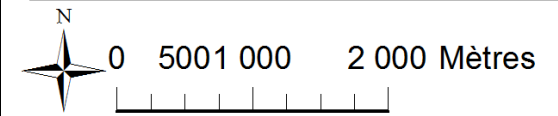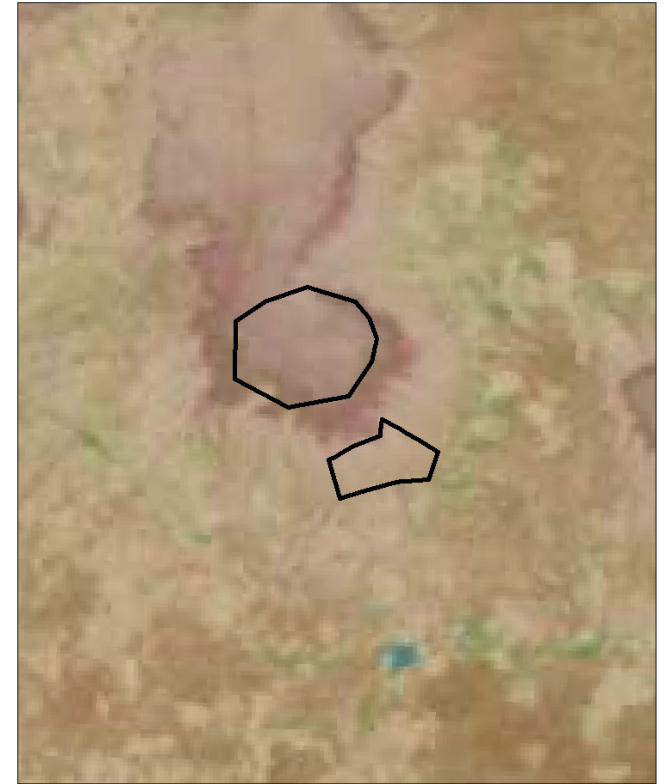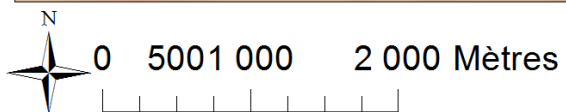| SITE : Simiri	**Area (ha) :** 96.9
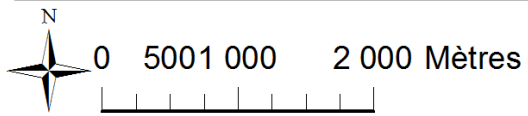
Figure 3a: **Example of satellite images of the project area site of Simiri**

SITE : Tchikakatadoua	**Area (ha) :** 1036.5

Chikatkadoua : Landsat Fevrier 1988
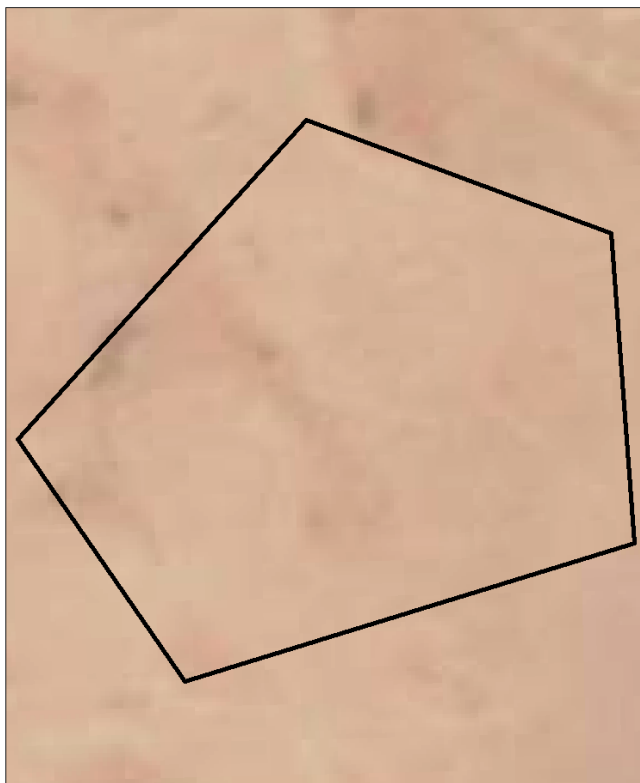
Chikatkadoua : Landsat Novembre 2000

Chikatkadoua : Landsat Mai 2003

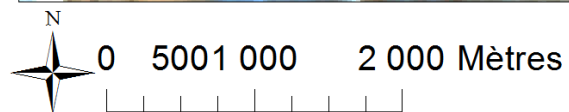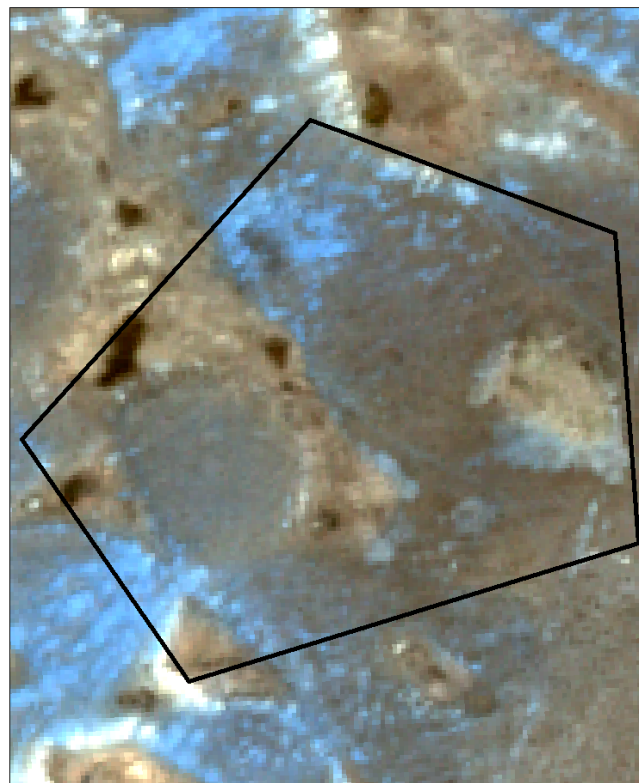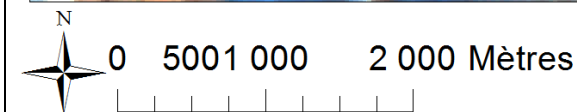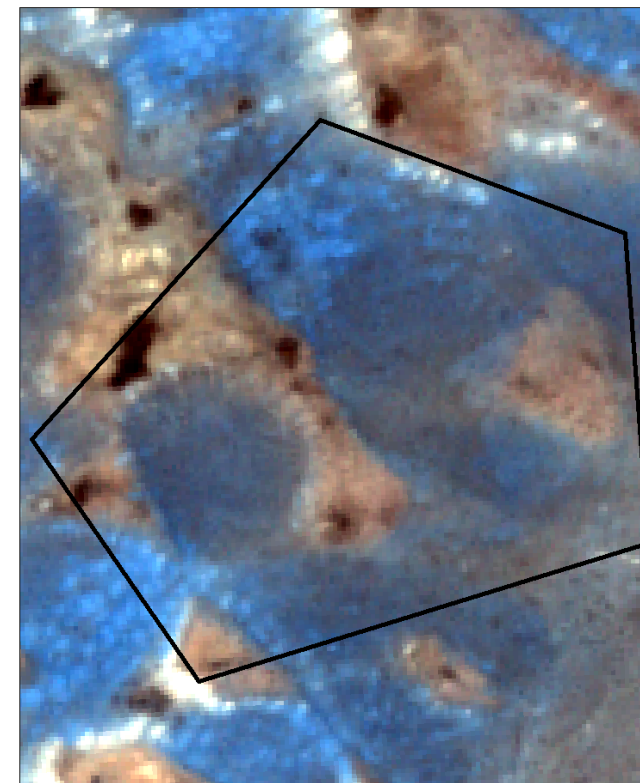**Figure 7b:** Example of satellite images of the project area site of Tchikakatadoua

Sites in Simiri, Tillaberi.

Sites in Chikatkadoua, Diffa

Figure 7c: Pictures of the project area at project start. (Photo: UGSP-NASPP)
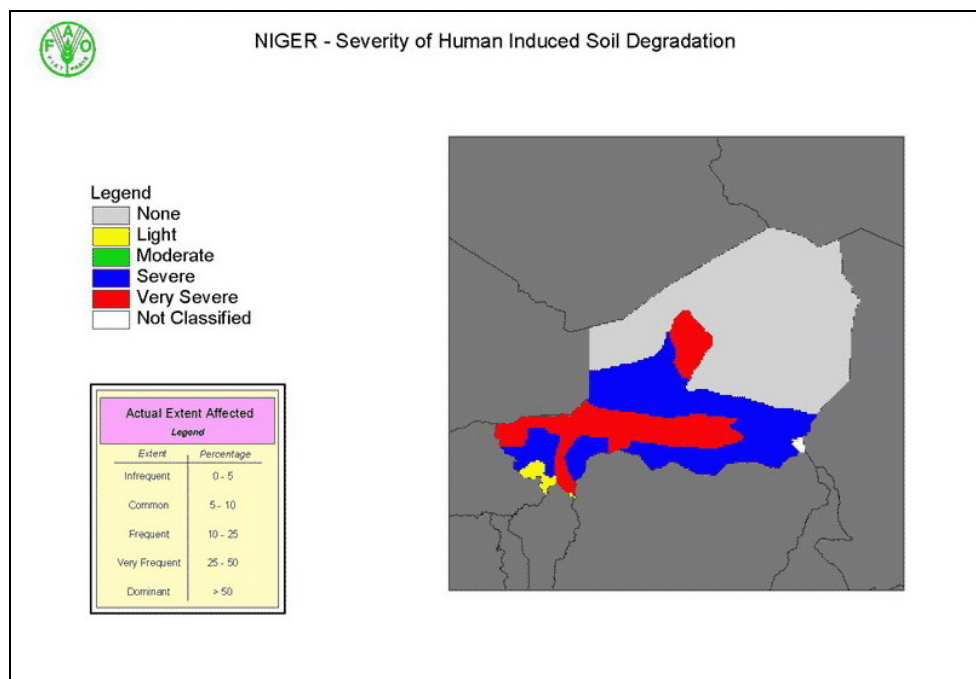
Figure 4: Map of national soil degradation in Niger (FAO, 2005[8])

(ii) All young natural stands are not expected to reach the minimum crown cover and minimum height chosen by the host country to define forest. Indeed, on one hand, the local conditions, as mentioned above, correspond to severely degraded lands (FA0, 2005; GIOES & APOR, 2006). On the other hand, wandering cattle survives by eating this kind of vegetation (BUNEC, 2006). Therefore, only a few individuals, if any, should reach the thresholds fixed by the Nigerien DNA for definition of forest, but not enough to be considered as a forest.

(iii) The land is not temporarily unstocked as no forest existed since at least 1989, as analyzed and demonstrated in the study carried on by GIOES and APOR (2006). Lands are severely degraded and still degrading with very low carbon stocks.

1. (b) Demonstrate that the activity is a reforestation or afforestation project activity

(i) The proposed AR CDM project activities will be carried on through direct planting of young *Acacia senegalensis* trees. *Acacia senegalensis* can reach a height of 6 to 10 meters (Mallet *et al.* 2002[9] ; Ndièngou Sal, 1997[10],). In the framework of the proposed AR CDM project activities, the trees will be pruned to stimulate branching in order to produce more Arabic gum without damaging trees. Thus, during gum production, the trees should not overpass 5 or 6 meters height but will pass 4 meters (threshold fixed by the Nigerien DNA for forest definition).

Regarding planting density, the trees will be planted following two stands; one will be the planting at a density of 313 trees per hectare, and the other will be at a density of 400 trees per hectare.

Therefore, considering a crown diameter per tree of 5 meters, the minimum crown in the framework of the proposed AR CDM project activities will be of 61.5%.

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[8] FAO, 2005. Niger – Severity of Human Induced Soil Degradation. National Soil Degradation Maps. FAO-AGL. http://www.fao.org/landandwater/agll/glasod/glasodmaps.jsp?country=NER&search=Display+map+!

[9] Mallet B., Besse F., Gautier D., Muller D., Bouba N. et Njiti C. 2002. Quelles perspectives pour les gommiers en zone de savane d'Afrique Centrale ? Dans Jamin J.Y., Boukar S. et Floret C. 2003. Savanes Africaines : des espaces en mutation, des acteurs face à de nouveaux défis. Actes du Colloque. CIRAD, Montpellier. 11 p.

[10] Ndièngou Sal P. 1997. Le gommier et la gomme arabique Acacia Senegalensis (L.) Wild. Notes techniques du projet RCS – Sahel – 1 507/RAF/43. MAB, UNESCO. 31 p

Planting density	Crown diameter (m)	Crown area per tree (m²)	Crown area per hectare (m²)	**Crown cover (%)**
313	5	19.63	6 145.74	**61.46**
400	5	19.63	7 853.98	**78.54**

Therefore, as the thresholds of the forest definition given by the Nigerien DNA will be passed by the proposed AR CDM project activities, we can consider that these activities will lead to a forest.

The study made by GIOES & APOR (2006) analyzed the land cover from 1990 until 2000 from the work of Kusserow and Sieffert (2001 – See GIOES & APOR, 2006), thus determining there was no forest within project boundaries at least since December, 31st 1989.

First, GIOES & APOR assessed the land cover with Landsat satellite imagery of 1990, then assessed the land cover of 2000, and then assessed the land cover of 2006, still without forest within project boundary, thus determining that no forest existed between 1990 and 2006 with a multi-temporal analysis of satellite imagery of 1990, 2000 and 2006.

Additionnally to the study of GIOES & APOR, assessing land use change between 1990 and 2000, a new multitemporal analysis was done with satellite imagery in 1988, 2000 and 2003. This achieved to ensure that there was no forest between 31st December 1989 and the start date of the proposed AR CDM project activities.

A.5.   Environmental conditions
>> **Climate:**

The climate of the project zone is tropical semi arid, which is characterized by two seasons: a dry season lasting from October to May and a rainy season from June to September. During the dry season, the temperature fluctuates between 18.1 and 33.1°C (SE/CNEDD 2006, Direction of Meteorology, 2005). During this season, the "Harmattan", a dry and hot wind blowing from North-East to East at moderate speeds (5 to 10 m/s) remains dominant over the entire country. The records of temperatures observed are -2.4°C (observed on January 13th, 1995 at Bilma) for the minimum temperatures and from 49.5°C (observed on September 07th, 1978 in Diffa) for the maximum temperatures (DMN, 2005). During the rainy season, the average temperature varies between 28.1 and 31.7°C (DMN, 2005). The monsoon (wet wind) blows from South-West to North East and remains dominant on the major part of the country. The speed of the wind is generally weak to moderate (2 to 8 m/s; DMN, 2005) during this period, but wind gusts of speeds beyond 40 m/s can be observed (DMN, 2005) during the passage of lines of sand grains going from East to West.

There are four climatic zones in Niger (DMN, 2005):

- The Sahelo-Sudanese zone that represents around 1% of the total area of the country and receives 600 to 800 mm of rainfall on average per year, it is good for agriculture production and cattle rearing;
- The Sahelian zone that covers 10% of the country and receives 300 to 600 mm of rainfall on average par year. It is good for agricultural and pastoral practices;
- The Sahelo-Saharan zone that represents 12% of the country area and receives 150 mm to 300 mm of rain on average par year. It is good for nomadic cattle rearing;
- The Saharan zone, desert area which covers 77% of the country, receives less than 150 mm of rain in average per year. Irrigation is practiced there in some areas.

The plantations are distributed in all climatic zones, except for the Saharan zone.

Rainfalls

Although in a normal year, the rain distribution allows the recharge of the underground water levels, the formation of water streams and the development of the grass, rain distribution is characterized by a high variation in space and time (SE-CNEDD 2006). Information from last 30 years shows an apparently increase of rainfalls in all regions (see figure 3), nevertheless, studies covering a longer time period and using advanced techniques that allow homogenize and analyze the spatial variation, show an alternation of wet and dry periods, and demonstrate that, although in recent years there has been a recovery of rainfall after the great drought of the late 60's, it is not enough to recover the previous values.[11] (See figure 4). (Ozer *et al*. 2010)

The climatic constraints, in particular rainfall, have a great influence on the socio-economic development and the life of the population. Indeed, since 1968, the country has experienced many years of deficit in rainfall (1968, from 1971 to 1974, 1984, 1987, 1989, 1990, 1993, 1995 and 1996) that led to periods of chronic droughts (see figure 4) that continue to reduce the agricultural production and pastoral and forestry resources, on which the population depends.

Figure 5 - Annual rainfall in last 30 years (1980-2010) in project regions

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[11] REE, November 2005

Source: Institut National de Météorologie, Niamey, Niger
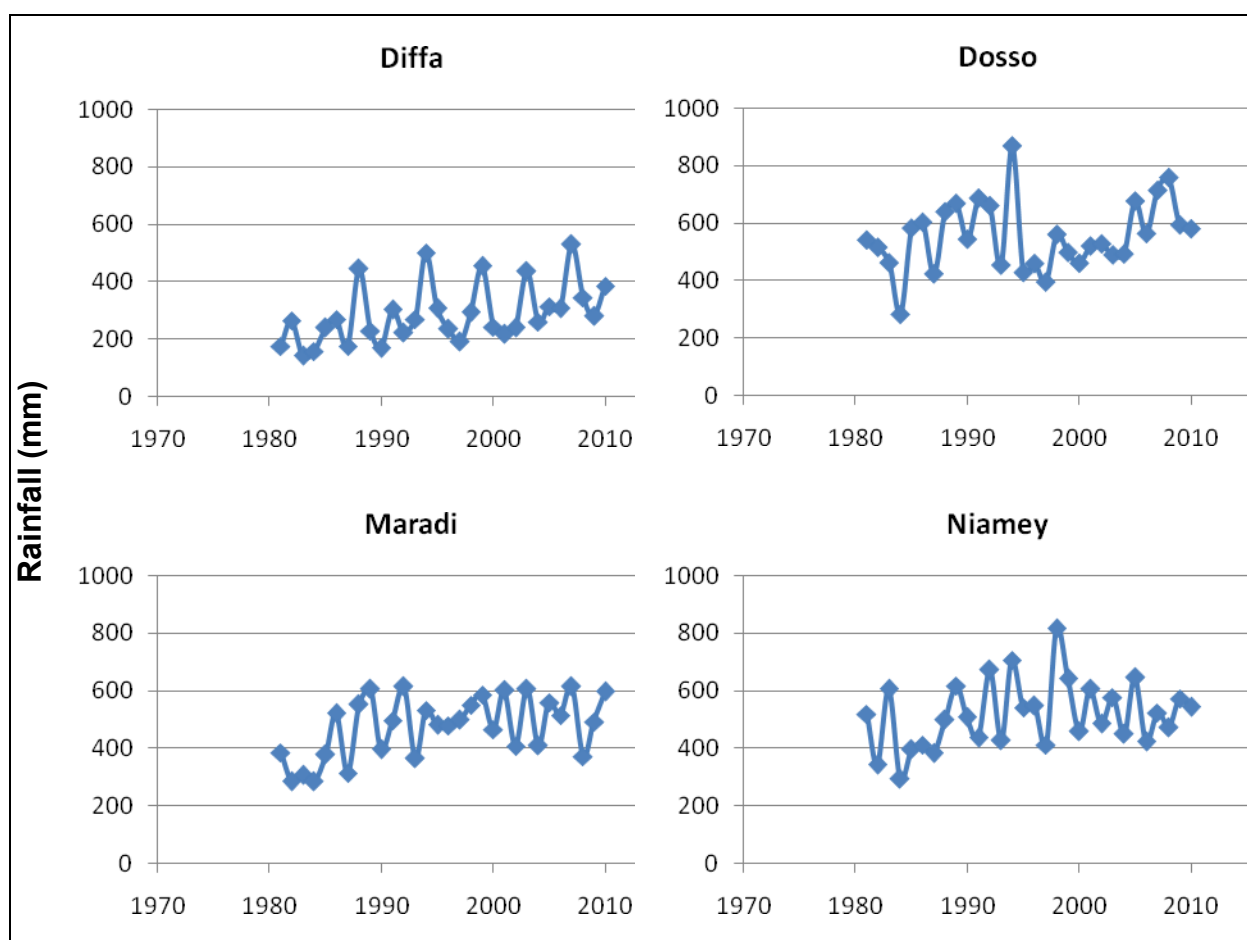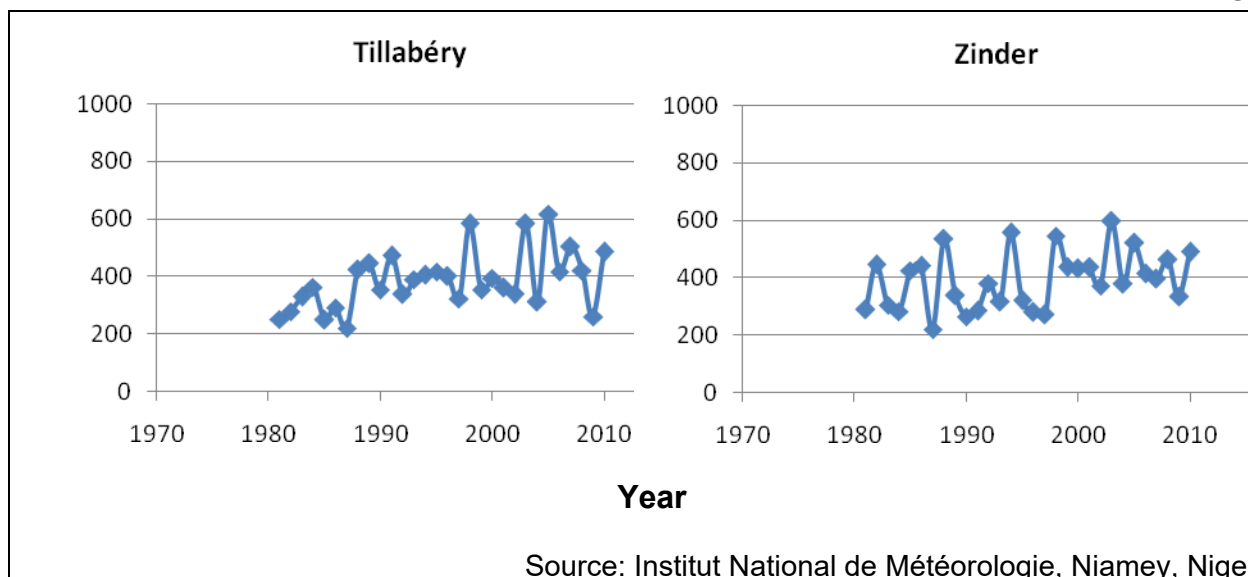
Figure 6 - Variability of rainfall in Niger (1921-2007)
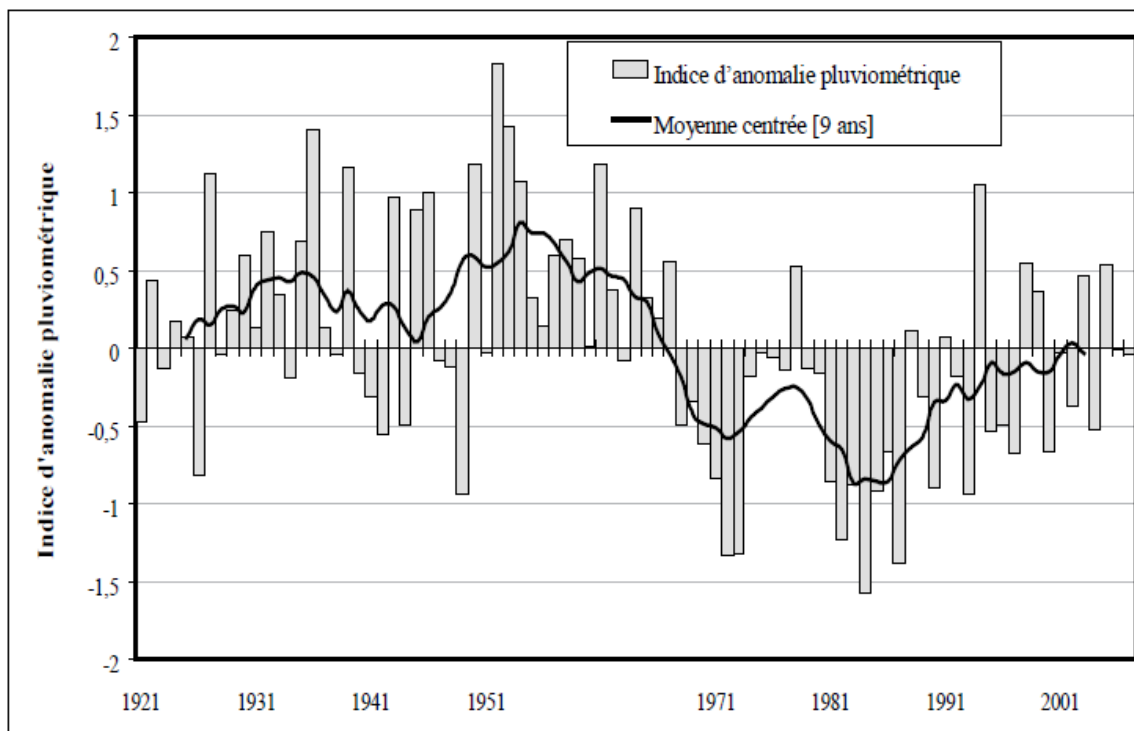
Source : OZER *et al*. 2010 [12]

Hydrology:

With regards to water, even though Niger is a country with a dry climate, it has abundant underground and surface resources that constitute the bulk of the water resources of the country. However, the water network is relatively thin compared with other countries in West Africa. The major constraint is the accessibility to these resources due to often difficult conditions of exploitation (CBD Clearing–house[4]). Presently, this difficulty does not allow for optimum conditions necessary to satisfying the needs of the population, the cattle and other economic activities.

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[12] OZER, P. *et al.* 2010. Désertification au Sahel: Historique et perspectives. Bulletin de la Société Géographique de Liège. 54. 569-84)

The annual average rainfall is 151 mm, for an area of 1,267,000 square kilometers, which corresponds to a total volume of annual rainfalls of 191.3 cubic kilometers (as a matter of comparison, metropolitan France receives 477.99 km³/year). From this volume of rainfall, around 190.3 km³ are lost through evapo-transpiration and infiltrations. Therefore, 1 km³ of water remains available on surface on the territory of the country. In addition, 2.5 km³ of underground water is produced each year (Aquastat[4]).

On top of these 3.5 km³ available in Niger, 30.15 km³ of water originates from outside the country and is available for use once it crosses the boundaries. Approximately 29 km³ comes from the Niger river flowing from Mali (28 km³) and from Burkina Faso (1 km³). Around 1.15 km³ comes from water streams running on the country's borders with Benin and Nigeria (Aquastat [4]).

Adding all up, the total annual water resources of the country are around 33.65 km³ (i.e., 33.65 billion cubic meters), for a population estimated at 14.2 millions in 2007. This corresponds to around 2,360 m³ water per inhabitant, which, contrary to many false ideas, is satisfactory. As for other Sahelian countries such as Mali, the problem is the distribution of water resources, which is geographically extremely unbalanced (Aquastat[4]).

Moreover, if the current demographic boom continues over the next decades in Niger, a scenario that is highly likely, the quantity of water available per inhabitant will drop drastically. It should be added that water resources flowing out of the country can reach 32.4 km³, towards both Nigeria and Lac Chad (Aquastat [4]).

Soils:
Soils in Niger generally lack organic matter and phosphorus. They are affected by continuous decrease of fertility, tendency to acidification, sensibility to water and wind erosion, low water-retention capacity and a phenomenon of alkalinisation and salinity. It is worth noting that 80 to 85% of arable land is made up of dunes and only 15 to 20% are hydromorphic soils with average clay. The mountainous soils and the big plateau (Aïr, Ader Doutchi, and Continental terminal) are dominated with "lithosoils" (SE/CNEDD 2006)..

The fossil valleys (Dallols, Goulbi, Korama), the river valleys, the Komadougou, the Lac Chad and the basins of Manga are dominated essentially with hydromorphic soils and "vertisoils" (SE/CNEDD 2006).

According to GIOES 2006, natural resources, including soils, are being degraded, and this is supported by the study of Dr. H. Kusserow, which establishes that: the phenomenon of natural resource degradation in Tillabéri, North Tahoua and North Maradi, is advertised and all sites are subject to degradation, both in terms of productivity and in terms of plant cover or timber potential, which was reduced to 60% between 1970 and 2000, tending to restrict vegetation only in areas with high water retention (SE/CNEDD 2006).

Acacia plantations have the capacity to improve this low fertility, because they are a good source of organic matter and because they perk up the soil's biology through positive impacts on soil porosity and infiltration of water. Moreover, its strong root system and permanent tree canopy reduces wind and water erosion, stabilizes landscape, and is a major land use option to combat desertification (SE/CNEDD 2006).

Ecosystems:
Niger has many species and vegetal formations represented in several zones of biogeography.

Niger's flora has about 1600 species. The estimated forested area is about 15,000,000 ha. In the southern band of the country (the Sahelo-Sudanese zone), there are forest galleries and wooded savannahs. In the Sahelian zone, small trees and grass savannah are dominant. In the Sahelo-Saharian zone, contracted vegetal formation such as small trees and grass steppes are present (SE/CNEDD 2006).

The bioclimatic zones of Niger allow the country to have rich and varied fauna. The country has approximately 3200 animal species with 168 species of mammals, 512 species of birds, 150 species of reptiles and amphibians, 112 species of fish and many boneless animals (mollusks, insects). The mammalian fauna in Niger is decreasing for two reasons: (i) entropic causes such as poaching, competition with domestic mammals and destruction of habitat, and (ii) natural causes such as drought. Niger, however, has reserves of fauna and national parks. The energy sector is dominated by the consumption for domestic energy, based essentially on ligneous resources such as wood and biomass waste. These ligneous resources represent 90% of the energy sources, compared to 8% directly from hydrocarbons and 2% from electricity. This situation seriously contributes to the degradation of the forest (SE/CNEDD 2006).

Additional information related with the environmental conditions in the project areas are given in the Environmental and Social Study, document that is annexed to the PDD.

Figure 7. Climatic zones of Niger
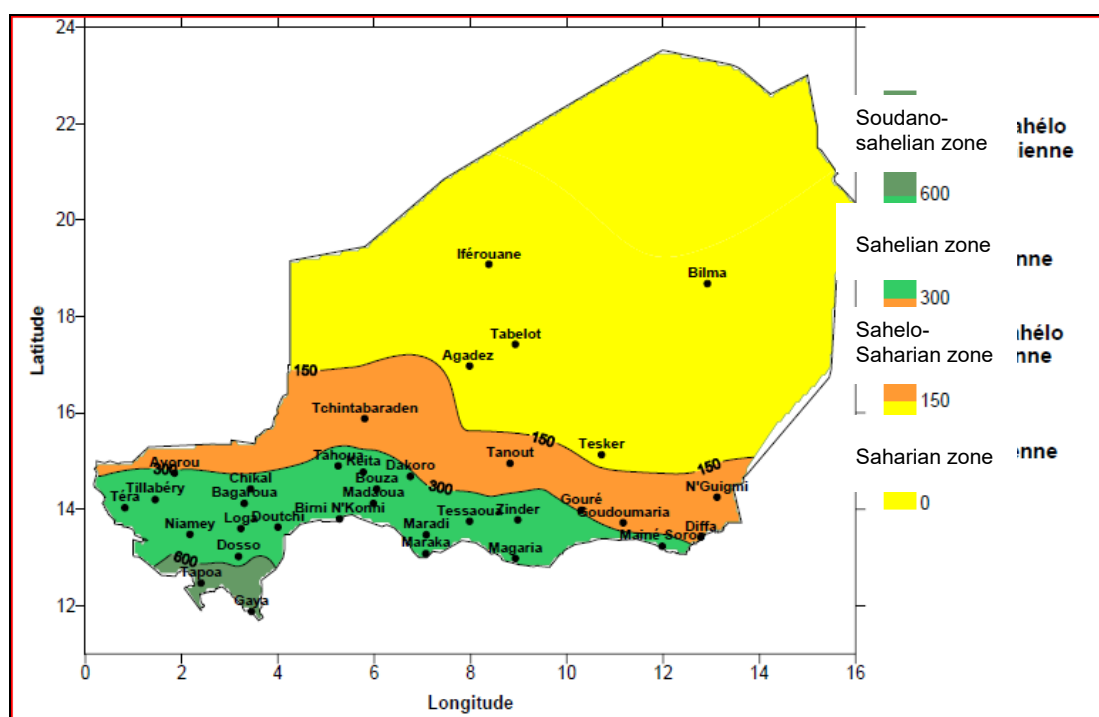
According to the study of environmental and social impacts (2006), there are no protected areas or national parks in the project area, due to the absence of particular ecosystems, rare or endangered species.

The International Union for Conservation of Nature (IUCN) updated the red list of threatened/endangered species. Unfortunately, the situation continues to worsen and the list of endangered species is increasing day by day.

Plant species that have disappeared or are endangered in Niger are the following: Afsélia africana, Anogéissus léiocarpus, Bombax costatum, Boswellia dalzielii, Butyrospermum parkii, Cabada farinosa, Cassia singuena, Ceiba pentadra, Commiphora africana, Detarium microcarpum, Ficus sycomorus, Khaya senegalensis, Kigélia africana, Leptadenia hastata, Parkia biglobosa, Prosopis africana, Pterocarpus eraniceus, Securidaca longepedunculata, Sterculia setigera, Stereospermum kunthianum, Tamarindus indica, Terminalia avicennioide, Ziziphus mucronata.

In terms of animal species, most of them have been exterminated by man, either directly, through hunting, or indirectly, through natural habitat destruction, importation or introduction of non-native/invasive species. The list of animal species that have disappeared or are endangered in

Niger is the following: Acinonyx jubatus, Addax nasomaculatus, Alcelaphus buselaphus, Ammotragus lervia, Balearica pavonica, Bucorvus abyssinicus, Cephalophus rufilatus, Crocuta crocuta, Damaliscus korrigum, Felis caracal, Felis margarita, Gazella rufifrons, Gazelle dama, Giraffa camelopardalis, Hippopotamus amphibius, Hippotragus equinus, Hyaena hyaena, Lutra maculicolis, Lycaon pictus, Orycteropus afer, Oryx dammah, Panthera leo, Panthera pardus, Pelecanus onocrotatus, Python sebae, Redunca redunca, Sagittarius serpentarius, Struthio camelus, Trichechus, Varanus exanthematicus, Varanus niloticus, Vulpes rueplli, loxodonta africa.

According to environmental and social study (2006) the animal species found in the project sites are:
- Mammals: Gazelle rufifrons, Pedetes capensis, Sciurus carolinensis, Canis aureus, Canis zerda Xerus erythropus, Lepus capensis;
- Reptiles: Python sabha, Varanus niloticus y Varanus exanthematicus. Beltis gabonica, Birds: Gyps clypeata.

Vegetal species found in the project sites are:
- In the tree strata: Acacia albida, Acacia raddiana, Acacia senegal, Calotropis procera, Leptadenia pyrotechnica Acacia nilotic, Acacia laeta, and Balanites aegyptiaca, Boscia senegalensis, Guiera senegalensis, Combretum glutinosum, Combretum micranthum, Bauhinia rufescens, Acacia seyal, Anogeissus leocarpus, Piliostigma reticulatum, Piliostigma reticulatum, Cenchrus biflorus, Eragrostis tremula, Pennisetum thyphoïdes; and
- In the herbacesous strata: Eragrotis pilosa, Tribulus terrestris, Digitalia exilis and Corchorus tridens in the herbaceous strata (GIOES 2006).

None of these species are found in the red list.

A.6. Measures

>> The identified baseline scenario is the continuation of pre-existing activities as grazing activities, under the transhumance system, and subsistence agriculture, these activities are conducted in a non tech way, using human or animal force for its execution.

As the baseline scenario is the same as existing land-use scenario, any equipment nor technological systems have to be in place in the absence of the project activity.

By planting Acacia Senegal (*Acacia senegal* (L.) Willd. Var. *senegal*, a native species), the project will rehabilitate highly degraded areas that are little suitable for agricultural activity.

Acacia Senegal, a small tree with a maximum height of 6 to 10 meters (Mallet *et al.* 2002[13] ; Ndièngou Sal, 1997[14]). Presents a top with many branches that are spread, with short and curve thorns assembled in three at the basis of the petiole. It is found in North Africa from the Atlantic Ocean to the red sea, situated between 11° and 17° parallels (AUBREVILLE, 1950).

Acacia Senegal is very resistant to drought; it grows in areas with 100 to 800-mm rainfall per year, preferably 300 to 400 mm, and a period of drought from 8 to 11 months (MAYDELL VON, 1983). On fine textured soils in higher rainfall areas of the South Sahelian and North Sudanese eco-zones, it may also occur on shallow soils and duripan lithosoils. The tolerance to pH is quite broad:

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[13] Mallet B., Besse F., Gautier D., Muller D., Bouba N. et Njiti C. 2002. Quelles perspectives pour les gommiers en zone de savane d'Afrique Centrale ? Dans Jamin J.Y., Boukar S. et Floret C. 2003. Savanes Africaines : des espaces en mutation, des acteurs face à de nouveaux défis. Actes du Colloque. CIRAD, Montpellier. 11 p.

[14] Ndièngou Sal P. 1997. Le gommier et la gomme arabique Acacia Senegalensis (L.) Wild. Notes techniques du projet RCS – Sahel – 1 507/RAF/43. MAB, UNESCO. 31 p

5-8. Acacia senegal generates powerful and deep rooting system which favors run off and water erosion, particularly during stormy rainfall events.

The project can be divided into five stages during which specific technologies will be employed:
- Production of high quality seedling in nurseries;
- Preparation of sites;
- Plantation;
- Pruning;
- Gum harvesting (including gum tapping and sorting).

Step 1: Production of seedlings

The quality of seeds used in the project plays an important role on the success of plantations. Therefore, all seeds used were initially provided by ICRISAT, which is a Centre of internationally renowned research, and then in a second stage (from 2009) seeds are provided by the Tree Seed Centre, a national organism specialized in certified seed.

The seedlings produced are grown in plastic pots in nurseries; in climatic and soil conditions of dry zones, it is advised to produce species in pots because such seedlings present good capacities to grow in plantation.

The young seedlings remain in the nurseries (which already exist) during 3 to 4 months, where water and necessary material for their development is available. The 46 nurseries are located in zones near plantation sites, to facilitate access to water and transportation of seedlings. In the regions of Diffa, Zinder and Maradi, these seedlings are managed essentially by men, whereas in other regions, both men and women do the job.

The transportation of seedlings is done using carts and is a delicate operation. Indeed, during the process, seedlings can be exposed to harsh conditions such as strong winds, burning sun, lack of water, all of which can physically damage them. This is why all 46 nurseries are located near the plantation sites.

Step 2: Preparation of sites

Because the sites have little or no vegetation cover, pre-existing vegetation is not slashed nor burned and pre-existing trees, if any, are left standing. The only intervention on the sites is the construction of "half-moon structures" (*demi-lunes* in French), which are done in order to retain water in the soil, avoid land erosion and improve soil fertility. This local technology, called "CES/DRS" (for its acronym in French), is detailed in MDA, 2006[15].

The sites are prepared before the seedlings are produced. The objective is to:
- Improve the soil structure in order to enhance the growth of seedlings;
- Retain water in soil;
- Facilitate future maintenance by eliminating obstacles; and,
- Facilitate the planting of seedlings.

Step 3: Plantation

The planting technique is simple, low-cost and well-known by rural communities. It consists in:
- Preparing holes in zones with hard soils previously to planting;
- In sandy areas, digging of holes and planting seedlings after the first rain.

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[15] MDA (Ministere du Developpement Agricole), 2006. Recueil des fiches techniques en gestion des ressources naturalles et de productions agro-sylvo-pastorales. Niger p. 270

Plantations will be stratified according to the density of plantation: either 313 trees/ha on plateaus or 400 trees/ha on sandy soils (see technical sheets of management of natural resources and production agro-sylvan-pastoral) MDA, 2006. This will ensure the optimal development of the acacia trees and allow intercropping with groundnuts and cowpeas during the first six years of the plantation where this option is possible, especially thanks to the "Demi-lune" works that retain water locally. Because the harvesting of Arabic gum only starts after 5 years, intercropping and the sale of CERs is crucial to generating revenue during the plantations' initial phase. The forest stands will be among 50 and 1,000 ha. In sandy areas, the sylvicultural treatment applied consists in digging big holes during the plantation and doing the second weeding to facilitate the infiltration of water. Depending on weather conditions, the plantations will generally be done between the second half of July and the first ten days of the month of August. Once the plantations are made, protection of the sites must be ensured during at least 3 years to guarantee the successful growth of seedlings.

Step 4: Plantation Security

- Fences
  The closure of sites is needed to protect plants against the wandering of animals. The sites are fenced with barbed wire in 4 to 5 rows extended over poles or stakes of *Hyphaene thebaica* (Chablis) or *Prosopis chilensis* which will be anchored to ground by using cement.

- Vigilance scheme
  Aditionally to fences, vigilance is necessary in order to avoid wandering of animals. Two people per each 50 ha will be recruited during the first three years of plantation. Everyone will be remunerated with a salary of 22 500 FCA per month.

Step 4: Pruning

Pruning will be carried out from the second year and will continue during the following two years. This technique is used to ensure a good tree stand and to further enhance the production of Arabic gum. It consists in cutting the small branches that stick out or those that are sick to allow others to develop normally. It is done by cutting branches from the bottom. It is an activity that must start very early to give a good shape to the tree. Cuttings are done with sharp tools such as clippers, hoes, axes, etc. It is a cultivation technique that is very important and that requires professional knowledge and skills. Good pruning techniques will be taught to rural communities by ICRISAT and the ME/E/LCD. Wood collected will serve as fuel wood, thereby alleviating pressure on other natural sources.

Step 5: Harvesting of the gum

To ensure sustainable gum production, applying appropriate tapping techniques on trees is essential. If the acacia tree is tapped too deeply it may not survive the incision. Tools for pruning (clippers), tapping (cutlers, knifes) and harvesting (canvas, gum collector) can be manufactured locally and used in Niger (see picture below).

During the harvest, it is recommended to put a plastic under the tree in order to avoid gums falling down and being mixed with impurities. Arabic gum is food, and must be collected according to the "3P" rule, i.e., it should be pure, clean and polymerized (*Pure, Propre et Polymérisée* in French). In 1999, Arabic gum was classified in the CODEX as food product by the Joint FAO/WHO Expert Committee on Food Additives (JECFA).

Appropriate tapping tool	Superficial tapping technique
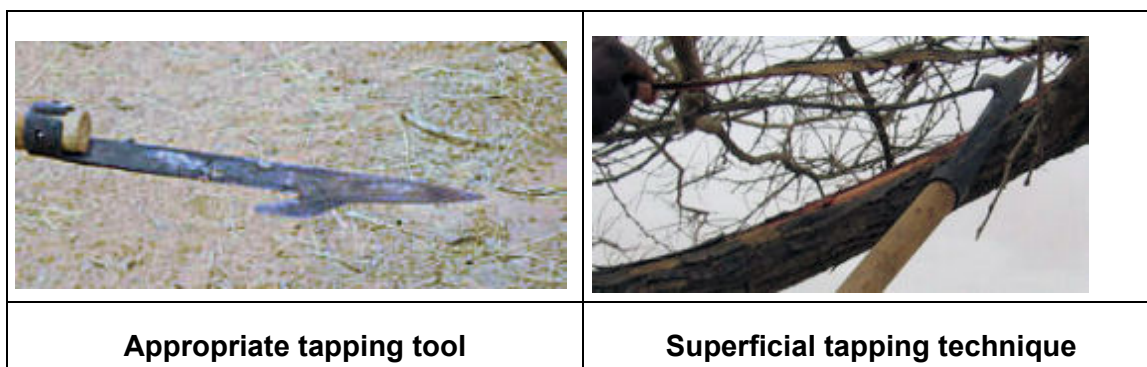
Gum will be collected and sorted after tapping. The sorting of gum is an important requirement to avoid mixing with lower quality gum, and to obtain high-quality homogeneous gum which will obtain the best market value. The objective is also to regenerate degraded soils.

As the objective of the forest plantation is the production of arabic gum, the trees will not be harvested.

Sorted gum

A.7. Approach to addressing non-permanence

>> tCERs are chosen for addressing non-permanence.

A.8. 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 (host)	Achats Services International (ASI)	No
Spain	• International Bank for Reconstruction and Development (IBRD) as Trustee of the BioCarbon Fund • Ministry of Agriculture, Fisheries, Food and Environment & Ministry of Economy, Industry and Competiveness	Yes

| Japan | • Suntory Holdings Limited (until 31/12/2019)
 • Tokyo Electric Power Company Holdings, Inc (until 31/12/2019)
 • Sumitomo Joint Electric Power Co., Ltd (until 31/12/2019)
 • Japan Petroleum Exploration Co., Ltd (until 31/12/2019)
 • The Okinawa Electric Power Co., Inc (until 31/12/2019)
 • Japan Iron and Steel Federation (until 31/12/2019)
 • Idemitsu Kosan Co., Ltd (until 31/12/2019)
 • Sumitomo Chemical, Limited (until 31/12/2019) | No |
| Luxembourg | • Ministry of Sustainable Development and Infrastructure (until 31/12/2019) | Yes |

Achats Service International (ASI)

Achats Services International (ASI) is a limited liability company established in 1986 with a capital of two hundred million francs (FCFA 200,000,000). The main activity of the company is import-export with a particular emphasis on the production and exportation of Arabic gum, "souchet" and hibiscus flour. The current area of the company's gum plantations, mainly with the specie Acacia Senegalensis, is 1,200 hectares. In order to help the communities that are engaged in the production of the Arabic gum and the sequestration of carbon, ASI signed an agreement with the World Bank's BioCarbon Fund on December 18th, 2006 to serve as aggregator for the sale of gum and emissions reductions during the entire period of the program's implementation.

ASI put in place a Project Management and Monitoring Unit (Unité de Gestion et de Suivi du Projet – UGSP), which is in charge of coordinating all the activities related to plantation activities, including (i) monitoring of planting campaigns by the communities (ii) technical assistance on the field with the participation of other structures such as the ME/E/LCD, (iii) monitoring of the carbon stock, (iv) capacity building, (v) communication plan as well as external representation of the project.

On the technical side, the Coordinator of UGSP will work under the supervision of the Director General of ASI, and collaborate closely with all the partners involved in the implementation of the project such as:
  • The Community Action Program of the MAG/EL (phases 1 and 2);
  • The investors and the buyers of Emission Reductions (ERs);
  • The different communities (municipalities and villages clusters) that have signed contracts with ASI,
  • The service providers in charge of carrying out studies and/or works geared towards achieving the objective;
  • The ME/E/LCD;
  • The representatives of civil society;
  • All other partners that may be affected by the implementation of the project and/or could bring contributions for its effective implementation (e.g., the National Secretariat of Rural Law for land use aspects, the Chamber of Commerce for payments of carbon credits, etc).

ASI's role is to:
  • Provide all the resources necessary for the UGSP to work effectively ;

- Sign technical cooperation agreements with partners (CAP, ME/E/LCD, etc.) in order to ensure that the technical support on the field to communities is in place;
- Ensure capacity building for the implementation of the project;
- Communication with the World Bank and the BioCF on the status of the project;
- Ensure the transfer of ER payments to the communities;
- Pursue the efforts of information and sensitization of the entire actors on this initiative through institutional reinforcement and the development of competences and communication.

A.5.2 Role of partner institutions

Community Actions Program (CAP) of the Ministry of Agriculture and Farming (MAG-EL)
- Financing of activities of the UGSP;
- Providing technical support to the project at the regional coordination level;
- Monitoring of the implementation of conventions of financing for the implementation of planting and guarding activities;
- Ensuring the transfer of funds to communities.

ICRISAT
- Bringing its technical expertise to the Monitoring Unit, to agents of the Technical Service of Environment in charge of disseminating ideas and to communities in order to plan, forecast the technical organization and the implementation of plantations
- Ensuring the training of agents of the Technical Service of the Ministry of Environment and communities in techniques of planting and collecting the product of the Acacia Senegal;
- Supplying good quality seeds for planting campaigns;
- Participating in the organization of capacity building activities for planting;
- Participating in field visits to guarantee the quality of the activities on the ground.

Technical Service of the Ministry of Water Resources, the Environment and the Fight against Desertification (ME/E/LCD)
- Effective implementation of activities of planting of the project, ensuring that the annual planting campaigns are started at the right moment and that the appropriate cultivation care and protection are respected in order to guarantee the growth of trees;
- Sending 8 agents, at regional level, to disseminate information on the field (in each region of the country), and provide the technical support to communities (at least a monthly visit on each BioCF site). The agents will be dedicated exclusively to the BioCF project;
- Assisting the UGSP to collect data on the plantations;
- Offering capacity building to communities, providing support to them for the monitoring of activities.

National Council of the Environment for a Sustainable Development (CNEDD)
- Emission of the letter of approval for the project;
- Participation to capacity building and training actions.

Rural Communities
- Ensuring the effective execution of activities of the Project, in conformity with the operation plan (installing and maintaining the vegetal material, ensuring the protection of sites, respecting the boundary of project sites, etc.)
- Ensuring the availability of carbon stock (as outlined in the ERPAs) within the boundary of the project until the end of the project's crediting period;
- Transferring to ASI of the ERs, according to the conditions set forth in their contract;
- Delivering to ASI the amount of Arabic gum at the agreed date and place.

Figure 8 - Project structure diagram
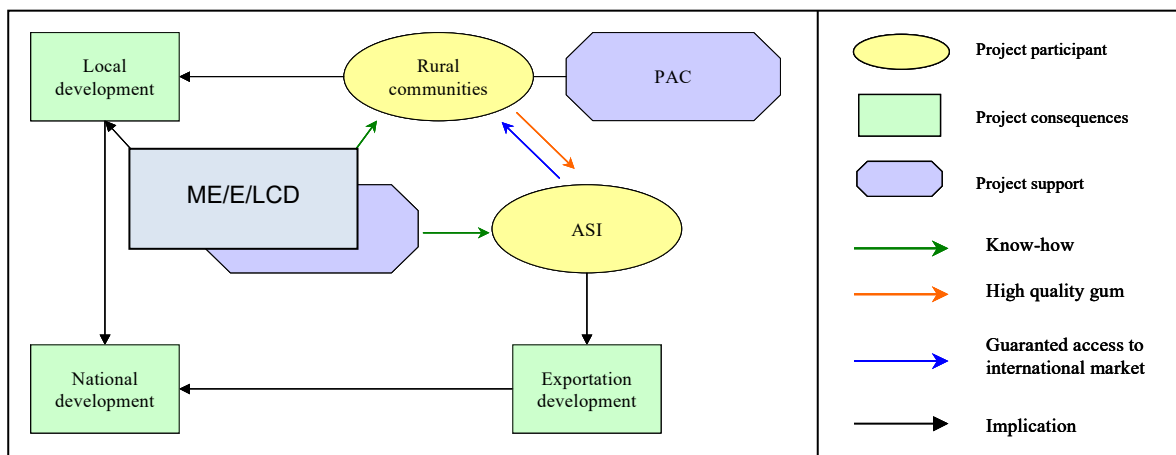
A.9. Public funding of project activity

>> No public funding or funding from Official Development Assistance (ODA) or other official sources are involved in this project.

A.10.   History of project activity

>> Not applicable. The PDD is being revised by request of the DOE following the project's first verification. The project is registered as of July 2013.

A.11.   Debundling

>> Not applicable.

SECTION B.   Application of selected methodologies and standardized baselines

B.1.   Reference to methodologies and standardized baselines
>> A/R Large-scale Methodology: AR-ACM0003 version 1.0.0 "*Afforestation and reforestation of lands except wetlands*"

Tools:
Combined tool to identify the baseline scenario and demonstrate additionality in A/R 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

B.2.   Applicability of methodologies and standardized baselines
>> In accordance with the selected methodology AR-ACM0003 version 1.0.0, it is applicable if the project activity meets the following conditions:
  1. It does not fall in wetland category:
     Project areas are not covered or saturated by water for all or part of the year (e.g., peatland)

  2. Soil disturbance attributable to the A/R project activity does not cover more than 10 per cent of area in each if the following types of land when these lands are included within the project boundary:
     (i)   Land containing organic soils;
     (ii)   Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to this methodology:

     Project areas do not contain organic soils and are not subjected to land-use practices and receives inputs as those described below:

     -   Short-term or set aside croplands with full tillage and high inputs with manure or
     -   Short-term or set aside croplands with reduced tillage and medium inputs or
     -   Short-term or set aside croplands with reduced tillage and high inputs with or without manure or
     -   Short term or set aside croplands without tillage
Only subsistence agriculture (rainy agriculture) is practiced in some project areas

     -   Grassland with improved or non-degraded management:

         Only transhumance grazing activities are present in the project area

Site preparation will be carried on in accordance with the technical guidelines and procedures given by the Ministry of Agriculture Development[16].

As no, or very low pre-existing vegetation is present within project boundary (GIOES & APOR, 2006), site preparation will only consist in punctual soil preparation before tree plantation. Soil preparation consists in building anti-erosion constructions with the aim to limit wind erosion and retain water down trees. These constructions are called "half-moon" in accordance with their geometric form (see Figure 9 below).

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[16] Ministère du Développement Agricole. Recueil des fiches techniques en gestion des ressources naturelles et de productions agro-sylvo-pastorales. MDA – Programme d'Action Communautaire / GEF- Banque Mondiale. 270 p.

Figure 9: "half-moon" anti-erosion work (Photo: T.Dufour)

Depending on tree planting density, the area of soil disturbed by half-moon construction was estimated between 2% and 3.5% of the project area.

Table 6: Soil disturbance during site preparation

half-moon per hectare	Plants per half-moon	Radius of hole (m)	External radius of half-moon (m)	Internal radius of half-moon (m)	Half-moon area (m²)	Hole area (m²)	Disturbed area (m²)	Total area (m²)	**Disturbance (%)**
313	3	0.15	2	1.85	0.91	0.21	350.31	10 000.00	**3.50**
400	1	0.15	1	0.85	0.44	0.07	202.63	10 000.00	**2.03**

Although in some cases soil disturbance can exceed 10 percent of soil disturbance, no significant long-term decreases of soil carbon stocks or increase of non-CO2 emissions from soil are expected.

3. A project activity applying this methodology shall also comply with the applicability conditions of the tools contained within the methodology and applied by the project activity.

Applicability conditions for the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, version 01".

• Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.
The reforestation activity proposed is in line with national and local regulations.

• This tool is not applicable to small - scale afforestation and reforestation project activities.
The proposed project is not a small-scale project: The expected GHG sequestration is more than 16000 tCO2 per year.

Applicability conditions for the tool: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, version 03.0.0"
This tool has no internal applicability conditions.

B.3. Carbon pools, sources and greenhouse gases (GHGs)

>>

	Carbon pools	Selected?	Justification/Explanation
Project activity	**Above-ground biomass**	Yes	This is the major carbon pool subjected to project activity
	Below-ground biomass	Yes	Carbon stock in this pool is expected to increase due to the implementation of the project activity
	Dead wood **Litter and** **Soil organic carbon**	No	Although is expected an increase in carbon stocks of these carbon pools due to implementation of the project activity, they are conservatively omitted.

	Source	GHG	Included?	Justification/Explanation
Project activity	Burning of woody biomass	CO_2	No	
		CH_4	No	As previously explained pre-existing vegetation is not slashed nor burned.
		N_2O	No	

Identification of strata:

According to the applied methodology, two *ex-ante* stratifications shall be done: (i) baseline stratification and (ii) stratification for project scenario. As recommended by the methodology, baseline stratification of the proposed project area is done according to major vegetation types because baseline removals for degrading land are expected to be small in comparison with project removals.

Baseline scenario:

The project landscape is composed of severely degraded and still degrading discrete areas. This state of fact is illustrated by low and decreasing carbon stocks in the biomass as demonstrated in the studies of GIOES & APOR(2006) and BUNEC (2006). Following, carbon contents in pre-existing vegetation are summarized by site:

Table 7 Carbon stocks in pre-existing vegetation

Région	Department	Site	Total area (ha)	Typological Class	Range of Carbon stock	Average stock of CO2 (t/ha)	tCO2/ha
Zinder	Gouré	Yacoubari	224	Type 1 Shrub/Herbaceous steppe	0 - 400 Kg/ha	0.29	4.63
Zinder	Gouré	Karguéri	810.48			0.47	
Zinder	Gouré	Kafourka	983.22			0.48	
Niamey	Niamey 4	Kongou Gonga	42.71			0.53	
Tillabéri	Téra	Gouriabon	363.77			0.67	
Diffa	Maïné Soroa	Grémadi	84.67			0.71	
Tillabéri	Ouallam	Simiri	47.3			1.12	
Dosso	Loga	Kogorou	144.43			1.24	

Tillabéri	Kollo	Béri Koira	113.68			1.27
Diffa	Maïné Soroa	Tchikakatadoua	318			1.41
Tillabéri	Kollo	Guassan Gourgné	181.05	**Type 2 Shrub/Herbaceous steppe**	401 - 1.500 Kg/ha	1.62
Diffa	Maïné Soroa	Tam	307.45			1.93
Diffa	Maïné Soroa	Bourouguijiran	196			2.39
Dosso	Doutchi	Lido*	158.05			2.93
Tillabéri	Ouallam	Dabrey*	234.92			3.00
Diffa	Maïné Soroa	Kayatawa*	629.56			3.01
Dosso	Dosso	Maoureydey*	139.72			3.42
Dosso	Loga	Boukki*	262.25			3.63
Tillabéri	Tillabéri	Goulbal*	94.45			3.91
Tillabéri	Kollo	Tchida*	186.95			3.94
Tillabéri	Ouallam	Koné Béri*	329.75			4.45
Maradi	Tessaoua	Chabaré*	885.24	**Type 3 Shrub/Herbaceous steppe**	1501 - 3.000 Kg/ha	5.62
Dosso	Doutchi	Birni Fala*	**150.32**			7.09
Tillabéri	Téra	Bégorou Tondo*	576.15			8.86
Diffa	Maïné Soroa	Chéri*	787.9	**Type 4 Shrub steppe**	3001 - 7.000 Kg/ha	16.62
Dosso	Doutchi	Goubey*	220.68			20.34

In consequence, only **one stratum is identified for the baseline scenario: degraded/degrading area with very poor vegetation**. This stratum is characterized by degraded soils (*lithosoils*), and very low carbon stocks in the biomass, without tree, or just a few isolated shrubs and trees.

The picture below presents, as an example, what would be the land cover in the baseline scenario.
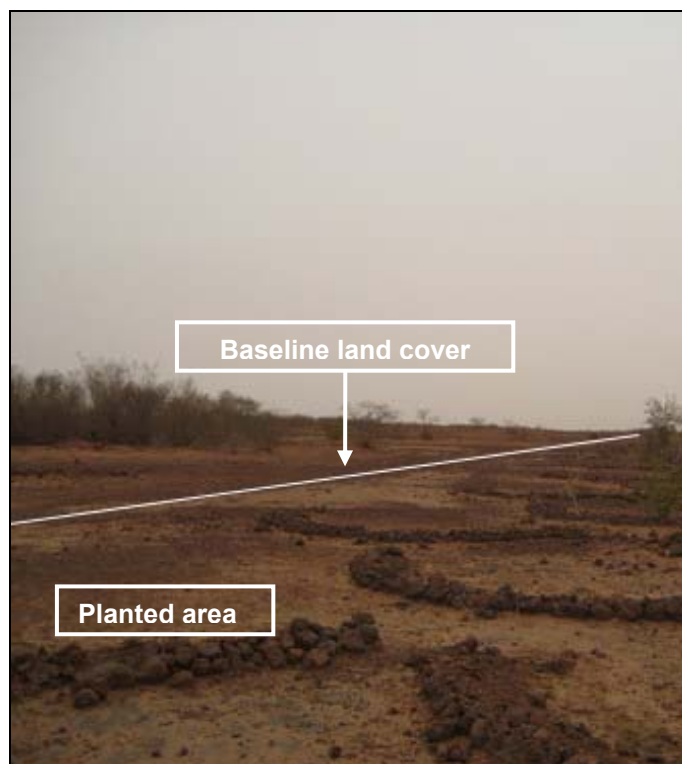
Figure 10: Land cover in the baseline scenario and project area (Photo: T.Dufour).

Project scenario:

In accordance with the applied methodology, the *ex-ante* stratification for the project scenario is based on the project planting/management plan. Therefore, **two strata will be considered in the project scenario.** The stratification criterion is based on planting density:

- **Stratum 1**: planting of *Acacia senegalensis* at a density of **313 trees per hectare**
- **Stratum 2**: planting of *Acacia senegalensis* at a density of **400 trees per hectare**

In accordance with the methodology, the *ex-post* project stratification may be realized considering natural or anthropogenic factors impacting growth of trees. In the framework of the proposed A/R CDM project activities, the mean annual rainfall might have significant impact on plantation growth. Therefore, this factor will be considered for ex-post stratification as a second stratification criterion if significant variability is observed between eastern project area (100 to 200mm of mean annual rainfall) and western project area (200 to 600mm of mean annual rainfall).

On the other hand, each strata is subdivided according to the age of plantation, it means that each strata might have up to seven subdivisions, which are called Blocks.

Table 8: Plantation management plan of the stratified project area.

	Planted area (ha) 2006	Planted area (ha) 2007	Planted area (ha) 2008	Planted area (ha) 2009	Planted area (ha) 2010	Planted area (ha) 2011	Planted area (ha) 2012	Total per stratum (ha)
Stratum 1 *SM1 (313 trees/ha)*	1088.03	875.04	62.7	61	687.84	850	1080	4704.61

Stratum 2 SM2(400 trees/ha)	212.42	1116.63	242.5	395	516.1	460	825	3767.65

B.4. Establishment and description of baseline scenario

>> After apply the "*combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities*", it is concluded that the baseline scenario is the continuation of pre-existing activities, which are described below.

The environmental and socio-economic study made by H. Kimba (2006) [17] characterized the various sites of forest plantations considered for the proposed A/R CDM project activities.

On a social point of view, the whole project area is characterized by rural communities living under a regime of cheffery. All decisions regarding land use and land-use change are concerted and finally decided by the chief of the community. The Communities live essentially from grazing and agriculture activities, and a few of fishing (if any pond), handcraft and small commerce.

For **grazing activities, that represent the traditional prevailing practice** since decades, most of cattle are transhumant. On one hand, traditional pastors cross Sahelian countries with cattle from different communities and lead them to specific areas for grazing. The transhumance is organized in corridors of transhumance clearly delimited. Some of these corridors are present around the project boundary. On the other hand, a few heads of cattle stay in the villages and wander in the surroundings. These heads are kept for food security as a "standing capital".

The **agriculture activities are limited to subsistence "rainy agriculture"** which gives small amounts of food with only 3 months of rain every year, with a tendency to severe droughts. The agriculture is focused on: millet, groundnut, cowpeas, and rice, sesame, sweet pepper, concentrated during the short rainy season between June and September.

The whole project area, characterized by degraded/degrading lands in a process of desertification (Brauch and Spring, 2009) is very dependant of soil quality and accessibility to water. These two elements represent the two limiting factors for the kind of agriculture chosen by rural communities. The two factors being extremely limiting in Niger, and thus leading to a poor food production, the food surplus those rural communities might realize if any is sold to the very local market in order to buy other kind of food (H. Kimba, 2006). Thus, rural communities do not dispose of capital to be able to invest in any land-use change – 85.6% of the population lives below 2 US$ a day (UNDP, 2009[18]) establishing Niger as the last of the poorest countries (among 182).

All the discrete areas proposed by rural communities for the implementation of the proposed A/R CDM project activities represent one baseline stratum. Indeed, the same land use is observed in the whole project area and the pre-existing vegetation is similar in all discrete areas. Therefore, no stratification was established as none stratification criterion was found that could have an influence on baseline carbon stocks.

The lands proposed by rural communities for the A/R CDM project activities should remain "vacant", named given by the Rural Code, as they should not be valorised because of poor soil fertility and large distance from villages. However, as described previously from the study made by

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[17] H. Kimba, 2006 Environmental and Social Impact Study of the Plantation Project in the Framework of CAP 189 pp

[18] UNDP, 2009. Human Development Report. Human and income poverty. Population living below $2 a day. http://hdrstats.undp.org/en/indicators/103.html

BUNEC[19] (2006), some cattle should still wander, as currently, within the proposed project area but it will represent very few animals; the ones staying in the villages, contrary to the major part that is transhumant.

Figure 11: wandering cattle within project area (photo: T. Dufour)

The project area should also continue to be subject to fuelwood collection. However, the amounts of woods collected will remain low, considering the scarcity of the resource and the low population density (9.5/km², from FAO, 2005[20]).

The scarcity of the resource is obvious as the vegetal cover is limited to very few shrubs and trees. During the three months of the rainy season, low grass is also present.
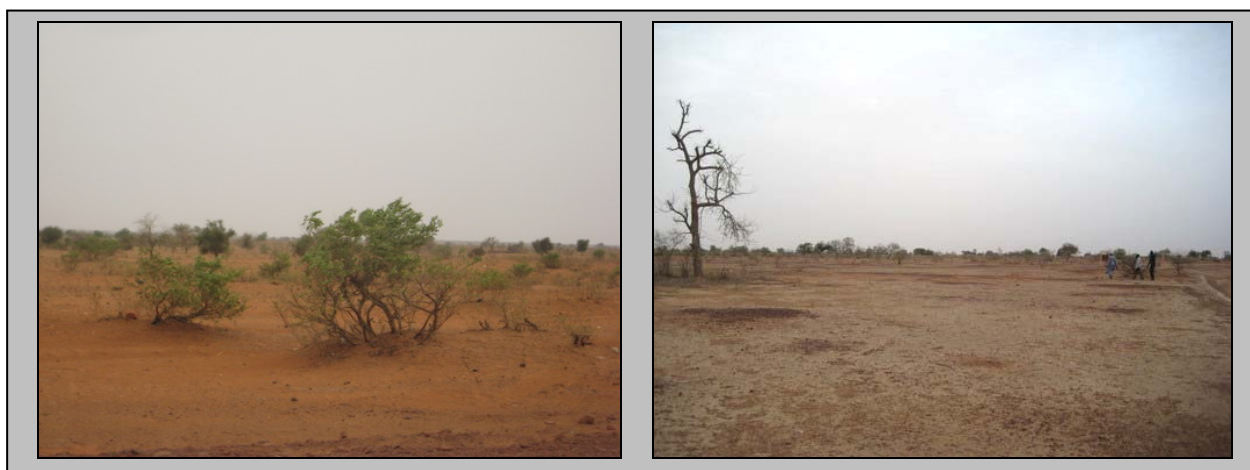
Figure 12: land cover of the project area (photos T. Dufour). The pictures were taken in the most humid zone of the project area near Dosso.

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[19] BUNEC, 2006. Analyse financière et économique des plantations d'acacia senegal sur les sites communautaires. Niger. 313 pp.

[20] FAO, 2005. State of the world's forests. FAO, Roma. 166p.

B.5.   Demonstration of additionality

>> In accordance with the methodology, the demonstration of additionality is carried on with the A/R Methodological Tool *"Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 2[21])* in its latest version.

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

- The evidence that the starting date of the A/R CDM project activity was after 31 December 1999 is given by the invoice related to the first purchase of seeds on 21 December 2005.

- Prior to the start of the project, negotiations were conducted with the management of the BioCarbon Fund. A Carbon Finance Document that covered detailed elements of project feasibility was approved by the BioCarbon Fund Participant's Committee in September 2005 (World Bank, 2005)[22]. The CDM incentive was clearly taken into account in the negotiations with the BioCarbon Fund as reflected in the supporting documentation.
  Moreover, a business plan was made by BUNEC (2006)[23] before project start. The business plan was carried considering the sale of CERs. ASI, the private entity promoting the project, would not have initiated the proposed A/R CDM activity without the support of the BioCarbon Fund based on the sale of the CERs. Indeed, as presented by Rossi (2005)[24], ASI already implemented reforestation activities in the past but considered them not viable economically, considering their relatively small scale. Thus, the support of the World Bank through the BioCarbon Fund, allowing large scale activities, created and incentive for ASI to participate to the project.

  Additionally, the following actions were carried out in order to obtain register the project under the CDM.

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[21] UNFCCC. EB35 Annex 17. http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf

[22] The World Bank, 2007. Approval of Niger Acacia Senegalensis Plantation project by BioCarbon Fund to purchase carbo credits. Letter of July 6th 2007.

[23] Bureau Nigérien d'Etudes et de Conseil, 2006. Analyse financière et économique des plantations d'Acacia Senegal sur les sites communautaires. BUNEC, Niamey. 313 p

[24] Rossi X., 2005. La redynamisation de la filière gomme arabique au Niger: un exemple d'initiative privée. Bois et Forêts des Tropiques, 285(1). Pp 25-32.

Date	Action
May 2005	Completion of the Carbon Finance Document (CFD) and submission to the BioCF
July 2005	Signature of a Letter of Intent (LoI) between the World Bank and ASI related to the sale/purchase of emission reductions to be generated under the project
April 2006	Baseline study completed by ONG APOR
May 2006	Signature of a contract between the World Bank and Eco-Carbone for PDD drafting and services up to the registration of the project Services finished in 2009 and take up by ONFI
June 2006	World Bank mission in Niger (L.Valiergue) - Due diligence paving the way towards ERPA signing
November 2006	World Bank mission in Niger (L.Valiergue) – ERPA negotiations
December 2006	Signature of the Emission Reductions Purchase Agreement (ERPA) between the World Bank and ASI related to the sale/purchase of emission reductions to be generated under the project
June 2007	World Bank mission in Niger (L.Valiergue) – Supervision mission
November 2007	World Bank mission in Niger (A.Aquino)– Supervision mission
April 2008	World Bank mission in Niger (A.Aquino)– Supervision mission
July 2008	World Bank mission in Niger (A.Aquino)– Supervision mission
June 2008	Annex I country LoA
August 2008	Host country LoA (Canada)
May 2009	World Bank mission in Niger (A.Aquino)
November 2009	Signature of a contract between the World Bank and E&Y (DOE) for the CDM validation of the project
December 2009	Signature of a contract between the World Bank and ONF International for the review and completion of the PDD and services up to the registration of the project, services completed in December 2012
April 2010	World Bank mission in Niger (A.de Bassompierre) jointly undertaken with ONF International
October 2010	World Bank mission in Niger (A.de Bassompierre)– Supervision mission
June 2011	Amendment to the ERPA between the World Bank and ASI[following completion of PDD and change in project area]
February 2012	DOE site visit for the validation process
June 2012	Amendment of the contract between the World Bank and ONF International for additional services
June 2013	Amendment of the contract between the World Bank and ONF International for additional services
June 2013	Annex I country LoA (Spain) replacing the Canadian one

Step 1. Identification of alternative scenarios
Sub-step 1a. Identify credible alternative land use scenarios to the proposed CDM project activity

Considering the local context of extreme poverty (H. Kimba, 2006; UNDP, 2009) and extreme agroecological conditions (GIOES, 2006), very few alternatives of land use can be reasonably considered within project boundaries.

- Alternative 1: Continuation of pre-existing activities (*i.e* wandering cattle, subsistence agriculture and fuelwood collection)

- Alternative 2: Improvement of agricultural activities, including the use of trees

- Alternative 3: Reforestation activities not undertaken in the framework of the CDM

 d) *Show that current land use will not change, or will lead to further degradation within project area*

Alternative 1: Continuation of pre-existing activities

In legal terms, the existing activities (small agriculture, grazing activities, and fuelwood collection) do not face any constraint that could prevent them to continue. As mentioned above, the national

legislation mostly focuses on rural communities and land tenure clarification in order to avoid conflicts for natural resource (rural code). The management of natural resources is then left to local communities; each community managing its own land. This scheme does not forbid any of the current land-use activities, but enhance their organization in order, for everybody, to get access to natural resource as the project boundary is not under conservation status.

Moreover, the economical rationality of local population leads them to implement the optimal land use matching with their incomes (Aune, 2007[25]). As local communities live with less than 2 USD per day (UNDP, 2009), small agriculture with small grazing activities and fuelwood collection appear to be the only activities that can be implemented. Therefore, these activities can continue is the bad economic context known in Niger.

As the activities mentioned here do not participate in protecting soils from erosion, by preserving or enhancing vegetal cover, the continuation of such activities should lead to the continuation of the process of desertification.

Alternative 2: Improvement of agricultural activities, including the use of trees

In legal terms, the improvement of agricultural activities does not face any constraint. As a matter of fact, this kind of activities is left to local communities from the Rural Code of Niger. Rural communities are free to implement any activity if not localized in conservation areas. The unique constraint is that these activities shall not lead to land tenure and social conflict. The intensification of agricultural activities is even encouraged by the Rural Code in order to optimize the valorization of lands (Ordonnance N°93-015)[26].

The techniques for agriculture improvement exist in Niger, especially with the work realized by ICRISAT (Ministry of Agriculture Development, 2006[27] ; Aune, 2007). However, the use of such techniques faces various barriers.

Although various techniques were developed to improve agriculture, their diffusion remains an obstacle to their application (Aune, 2007). Communication networks/infrastructures have to be developed in order for farmers to have the opportunities to access these techniques when they are located far from their lands. Even if there is progress regarding telecommunications in Niger, the road network remains weak to transfer knowledge and transport specific material for agriculture improvement (improved seeds, fertilizers, machines, etc.)

From Aune (2007), best techniques for agriculture and grazing activities require the use of fertilizers (for crops and fodder production) because of poor soils. However, these inputs are difficult to obtain in Niger. Moreover, even if they can be accessible for some people, they represent a significant cost that local communities can not afford for most of them. They could look for credit but the access to credit is very difficult to obtain in Niger for rural populations (Aune, 2007).

Therefore, facing various barriers, this alternative appears very unlikely at the scale of the project, involving many rural communities.

Alternative 3: Reforestation activities not undertaken in the framework of the CDM

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[25] Aune J.B, 2007. Best development techniques and approaches for agricultural improvements in the Sahel. Norwegian University of Life Sciences. 34 p.

[26] Ordonnace N°93-015 du 2 mars 1993. Conseil des Ministres fixant les principes du Code Rural. 18p.

[27] Ministère du Développement Agricole. Recueil des fiches techniques en gestion des ressources naturelles et de productions agro-sylvo-pastorales. MDA – Programme d'Action Communautaire / GEF- Banque Mondiale. 270 p.

The techniques for reforestation activities exist and some examples of arabic gum plantations too (Rossi, 2005 [28]). From Rossi, it appears that some initiatives in Niger tend to redynamize reforestation activities for arabic gum as in the proposed A/R CDM project activities. The State of Niger also tried to enhance indirectly reforestation activities with arabic gum through the Decree 2003-196 (MHE, 2003[29]), by supporting the commercialization of arabic gum.

However, the areas mentioned by Rossi are still small, and thus not economically viable. To be viable, reforestation activities with arabic gum have to be made on large areas. Therefore, they require large amounts of funds.

The private company, ASI, presented by Rossi (2005), and that participates also to the proposed A/R CDM project activities did not have sufficient funds to reforest more than 1.200 ha. Therefore, if a private company does not have sufficient funds to implement reforestation activities of arabic gum, it is very unlikely that the rural communities involved in the proposed A/R CDM project activities will be able to implement successful reforestation activities with arabic gum without support. Therefore, this alternative is very unlikely in the baseline scenario.

As a conclusion, it appears that the first alternative, the continuation of pre-existing activities will be the most plausible baseline scenario. The agriculture and grazing activities, and the fuelwood collection will continue to be implemented and will not prevent the processes of desertification evolving from north to south of Niger (Hountndji *et al.*, 2004[30]).

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations
The policies and regulations, in terms of natural resource management, precise modalities and procedures to follow to manage natural resources successfully and to avoid any environmental and social damage. In the framework of the proposed A/R CDM project activities, some policies and regulations are applicable and the proposed activities will have to be in conformity with them.

The applicable policies considered at the national level are listed in the Table 11 below, in accordance with the clarification of UNFCCC on consideration of *"national and/or sectoral policies and circumstances in the baseline scenario for afforestation and reforestation project activities"* (EB23 Annex 19)[31].

Table 9: National policies adopted before November 11th 2001 and related to A/R CDM project activities

Policy	Scope/objective
Constitution of August 9th 1999 Article 27 (title II)	It stipulates that anyone have to right to a healthy environment, and that the State takes care of the protection of environment. Everyone has to save and improve the environment in which he lives The proposed A/R CDM project activities, by restoring degraded area through forest plantations aims to combat desertification and improve environment, are in conformity with the Constitution

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[28] Rossi X., 2005. La redynamisation de la filière gomme arabique au Niger: un exemple d'initiative privée. Bois et Forêts des Tropiques, 285(1). Pp 25-32.

[29] Ministère de l'Hydrolique, de l'Environnement et de la Lutte Contre la Désertification. Décret 2003-196-PRN-MHE-LCD du 24 juillet 2003. Stratégie nationale de relance de la production de la commercialisation de la gomme arabique au Niger. Pp 61.

[30] Hountondji Y-C, Ozer P. et Jacques N., 2004. Mise en évidence des zones touchées par la désertification par télédétection à basse résolution au Niger. Cybergeo : European Journal of Geography. 19p.

[31] Report of the 23th Executive Board of the CDM, Annex 19. National and/or sectoral policies and circumstances in the baseline scenario for afforestation and reforestation project activities.

Law N°98-007 of April 29th 1998	This law fixed the policies related to the hunting and the protection of fauna By restoring degraded area, the proposed A/R CDM project activities will restore former habitat and participate to protection of fauna. This is in conformity with this law
Law N°98-56 of December 29th 1998	Framework law related to the management of environment The main principle is the interdependency between environment, socio-economic development and quality of life in development programs and projects. By carrying on an environmental and social study (H. Kimba, 2006) associated with a financial study (BUNEC, 2006[32]) the proposed A/R CDM project activities are in conformity with this law
Law N°96-067 of November 9th 1996	This law fixed the policies related to rural cooperatives
Law N°93-014 of March 2nd 1993	This law fixed the policies related to water management The proposed A/R CDM project activities, through restoration of degraded area by forest plantations will participate to improve local hydrographical network. Therefore, the project is in conformity with this law.
Law N°98-041 of December 7th 1998	Modification of the Law Law N°93-014 of March 2nd 1993, with the objective to define and determine the water management at the national level, and the conditions of use and protection of water. The proposed A/R CDM project activities, through restoration of degraded area by forest plantations will participate to improve local hydrographical network. Therefore, the project is in conformity with this law.
Law N°93-15 of March 2nd 1993	Law related to the principles for Orientation of Rural Code. The text concerns the rural sector for issues related to the sustainable conflict management The EIES (H. Kimba, 2006) carried on in the framework of the proposed A/R CDM project activities allowed to identify potential social conflicts within project area. The study concluded to negligible conflict but gave recommendations to avoid these ones. Therefore the project is in conformity with this law.
Law N°97-001 of January 10th 1997	Law institutionalising the environmental impact assessment (*Etude d'Impact Environnementale – EIE*) An EIE was made in the framework of the proposed A/R CDM project activities. Therefore, the project is in conformity with this law.
Decree N°97-367/PRN/MAG/EL of October 2nd 1997	The decree determines the modalities of subscription related to land tenure.
Decree N°97-368/PRN/MH/E of October 2nd 1997	The decree determines the modalities of application of the Law N°93-014 of March 2nd 1993 related to water management
Decree N°97-008/PRN/MAG/EL of January 10th 1997	The decree defines the organization, the attributions and the functioning of institutions in charge of the application of principles for orientation of the Rural Code
Decree N°97-007/PRN/MAG/EL of January 10th 1997	The decree fixes the status of affiliation of lands for pastors
Decree N°97-006/PRN/MAG/EL of January 10th 1997	The decree fixes the regulations related to the valorisation of rural natural resource
Decree N°96-430/PRN/MAG/EL of November 9th 1996	The decree determines the modalities of application of the Law related to cooperatives
Decree N°2000-369/PRN/ME/LCD of October 12th 2000	The decree gives attributions, organisation and functioning of the governmental entity in charge of assessing EIEs (BEEEI), in application of the article 35 of the framework law on management of the environment

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[32] Bureau Nigérien d'Etudes et de Conseil (BUNEC), 2006. Analyse financière et économique des plantations d'Acacia Senegal sur les sites communautaires., Niamey. 313 p

Decree N°2000-397/PRN/ME/LCD of October 20th 2000	The decree give administrative procedures for EIEs to be assessed, especially procedures that a project developer must follow in order to carry on the EIE, the content of the EIE report, and the procedure to make the EIE publicly available. The EIE was realized and allowed to receive the authorization to pursue the proposed A/R CDM activities in the framework of the Law N°97-001 of January 10th 1997. Therefore the project is in conformity with this decree
Decree n°2000-398/PRN/ME/LCD of October 20th 2000	The decree defines the list of activities, works and management plans requiring and EIE. It allows the governmental entity in charge (BEEEI) to know if a project must or must not carry on an EIE.

Regarding the national policies, the environmental and social impact assessment (H. Kimba, 2006) did not conclude that the proposed A/R CDM project activities were not in conformity with the policies. The study also gave recommendations on policies and regulations to consider when carrying on the proposed project activities.

The resulting policy incentives and constraints for the project activity – also with regard to its impacts on natural forests – can be summarized as follows:
- Reforestation activities are in line with the prevailing sector policy objective to promote new plantations in order to decrease pressure from the use of natural forests.
- The existing sector policies have to a certain extend supported the activities along the wood chain, *i.e.* via investigation programs.
- The implementation of these policies, however, has not led to revert or affect the degradation process through implementation of new plantations, or other land use that would restore or increase carbon stocks, in the region of the project activity. Indeed, today, only 73.000 ha of forest plantations are present in Niger (FAO, 2005[33])
- The prevailing sector policies do no alleviate (*e.g* by fiscal incentives) three main problems hindering the implementation of new plantations: the limited access to capital, the long pay-back times and a low internal rate of return of investments into reforestation activities.

From the assessment of the impacts of prevailing legislation (national, state, local) on the A/R activities, including the mandatory requirements on the land uses, it can be concluded – also with regard to its impact on natural forests and existing and future land uses:
- No legal obligation exists for the project participant and the associated land owners to implement reforestation activities (see also policy objectives above);
- Current legislation does not oblige land owners in the region to cease cattle grazing activities
- Governmental funds for enhancing reforestation activities are very limited, unpredictable in its availability, as it is illustrated by the low level of reforestation activities in the last decade (FAO, 2005)

According to EB 23, annex 19 "National and/or sectoral land-use policies or regulations, which give comparative advantages to afforestation/reforestation activities and that have been implemented since the adoption by the COP of the CDM Modalities and Procedures (decision 17/CP.7, 11 November 2001), need not be taken into account in developing a baseline scenario (*i.e.* the baseline scenario could refer to a hypothetical situation without the national and/or sector policies or regulations being in place)".

The three alternative scenarios in *sub-step 1a* are in compliance with the mandatory legislation and regulations above.

Step 2. Barrier analysis

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[33] FAO, 2005. State of the world's forests. FAO, Roma. 166p.

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

The proposed A/R CDM project activity faces various barriers. Four major types of barriers were identified as preventing strongly the implementation of the proposed activities in the baseline scenario:

- investment barriers
- technological barriers
- barriers due to social conditions
- barriers due to ecological conditions

Investment barriers

On one hand, the economy of rural communities involved in the proposed A/R CDM project activities relies currently on agriculture activities; crops for subsistence and a few incomes and transhumant grazing activities. Considering the poor soil fertility within and around project area (GIOES, 2006), the productivity of agriculture is very low, generating very low incomes; most of these rural communities live with less than 2 US$ per day (UNDP, 2009). In these conditions, farmers have very few or no saving at all.

Moreover, rural communities face very strong difficulties to get access to credit for the following various reasons:

  ➢ the bank and financial institutions network in Niger is very poor (SNV, 2005[34] ; Pedrosa & Do, 2008[35]);
  ➢ the quality of credit portfolio is bad in rural areas with high interest rates (Wampfler, 2005[36]);
  ➢ the lack of producer organizations that could negotiate with banking and financial institutions (SNV, 2005)

On the other hand, the plantation costs assessed for the proposed A/R CDM project activities were estimated at 450 USD per hectare (BUNEC, 2006), considering only the two first years of plantation activities.

Therefore rural communities cannot implement the proposed A/R CDM project activities without the external support provided by the World Bank and the BioCarbon Fund based on the pre-purchase of CERs to start the proposed A/R CDM project activities.

Regarding ASI, this project participant already implemented reforestation activities with *Acacia Senegalensis* and, as a private company based in Niamey close to banking and financial institutions, has easier access to credit than rural communities. However, from Rossi (2005), the reforestation activities of ASI are not considered economically viable as they are small scale forest plantations. Currently, ASI reforested 1.200 ha with *Acacia Senegalensis,* representing moreover the wider forest plantations in Niger. Because of the difficult economic viability of reforestation activities, ASI focuses on distribution of arabic gum, more than production.
Therefore, in this context, it is very unlikely that ASI, having invested in 1.200 ha of forest plantations since 1988, can invest or get enough credit to invest for 8.472 ha of forest plantations as proposed in the framework of the A/R CDM project activities.

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[34] SNV, 2005. Accès aux marches pour les pauvres. Stratégie 2005-2006. 18p.

[35] Pedrosa J. and Do Q-T., 2008. How does geographic distance affect credit market access in Niger? Working paper N°4772. The World Bank. 24 p.

[36] Wampfler B., 2005. Atelier sur le partenariat entre organisations paysannes et institutions de microfinance. Synthèse de l'atelier. 8-10 juin 2005, Niamey. 15p.

Therefore, on one hand, investment barriers prevent the implementation reforestation activities, or more intensive agriculture because these activities require funds that project participants do not have or cannot have access to.

On the other hand, the mix of agriculture, grazing and fuelwood collection activities is the continuation of the pre-existing activities that do not require additional funds.

Technological barriers

From oral interviews with rural communities and from the decree N°196 of 2003 (MHE-LCD, 2003[37]), it appears that rural communities have strong difficulties to access *Acacia Senegalensis* quality seed sources, and that they lack of skills regarding the production of good quality seedlings, and successful tree planting, pruning, and tapping. The lack of skills was also mentioned in protecting trees from fire, pests and diseases. Moreover they are not trained for grafting techniques in order to enhance arabic gum production.

Therefore, the technological barriers does not concern plantations *sensu stricto* but planting *Acacia Senegalensis* that will have chances to survive and produce gum in order to make the forest plantations sustainable. This is a major point as the income generated by the sale of arabic gum, more than carbon credits, represents the incentive inducing the rural communities to participate to the proposed A/R CDM project activities. Indeed, farmers make their decisions economically rational; that's why they do not currently invest time and money in tree cropping considering the risks linked to agroecological conditions within project boundary (Aune, 2007[38]).

Technological barriers do not prevent the implementation of the most plausible scenario, with a mix of agriculture, grazing and fuelwood collection activities, because these activities are performed in a traditional way, and local communities have sufficient knowledge to carry them out. Nevertheless, these technological barriers may emerge for the other two activities: intensification of agriculture activities, including the use of trees and reforestation activities not undertaken under the CDM, because of additional skills would be needed.

Barriers due to social conditions

The Ministry of Hydrolic, Environment and Fight Against Desertification (MHE-LCD, 2003) mentioned that in 2003, the arabic gum sector needed to be developed at all levels. According to this study, farmers lacked training for efficient production techniques and know-how related to the improvement of gum quality. Moreover, they lacked organization and knowledge about gum market.

Rural communities have traditionally been involved in the production of goods that can be sold directly on local markets (H. Kimba, 2006). However, arabic gum requires a more complex process from investment to production and international marketing, and rural communities do not have the skills to manage these processes. Additionally, the lack of organization and management structure also prevents them from overcoming the technological barriers mentioned above. English (2006[39]) also indicated that gum production had not really been improved as Niger is exporting only 2.000 tones of arabic gum per year, representing about 4% of the market.

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[37] Ministère de l'Hydraulique de l'Environnement et de la lutte contre la désertification, 2003. Décret N°2003-196-PRN-MHE-LCD du 24 juillet 2003 portant adoption du document de stratégie nationale de relance de la production et de la commercialisation de la gomme arabique au Niger.

[38] Aune J.B, 2007. Best development techniques and approaches for agricultural improvements in the Sahel. Norwegian University of Life Sciences. 34 p.

[39] English P., 2006. Niger. Etude Diagnostique sur l'Intégration Commerciale (EDIC). Integrated Framework (IF). 29p.

As Investment barriers, social barriers do not prevent the implementation of any of the three plausible scenarios identified. First of all, because the most plausible scenario, with a mix of agriculture, grazing and fuelwood collection activities is the continuation of the pre-existing activities, so these activities have existed and will continue existing naturally. On the other hand, the Intensification of agriculture activities, including the use of trees or Reforestation activities not undertaken under the CDM are not possible with the current levels of investments.

Barriers due to ecological conditions

Typical Sahelian country, Niger presents extreme agroecological conditions. As described in the social and environmental study (H. Kimba, 2006) the project area is characterized by severe degradation processes, inducing very poor soil fertility and moving towards desertification (Hountondji et al., 2004[40]).
Moreover, the arid climate leads to severe droughts that increased in the last decades due to a decrease of precipitations (Ozer et al., 2005[41]). Therefore, the water stress tends to increase since a few decades, enhancing moreover risks of fire.

In these extreme agroecological conditions, it is very unlikely that rural communities implement successful forest plantations on such wide areas without strong technical support and training, from plantation to collection of arabic gum, that investors motivated by CDM incentives can bring.

Although it is difficult to forecast the future climate trends and its effects over the plausible scenarios, according to the analysis above, the most plausible scenario could remains as it has adapted to changing conditions. Nevertheless, this is; perhaps, the only barrier that affects the proposed project activity, such as alternative scenarios.

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers
As mentioned above, the three plausible scenarios identified, other than the proposed A/R CDM project activity, were:

- Continuation of pre-existing activities
- Intensification of agriculture activities, including the use of trees
- Reforestation activities not undertaken under the CDM

As mentioned by Aune (2007), the rural communities have developed the most optimized activities to valorize their lands considering their incomes and the agroecological conditions. Therefore, their economic rationality led them top invest on short-term agriculture, less expensive and less risky face to droughts than other land use. The very few incomes they get from agriculture and grazing activities is just enough to prepare the next season without requiring credit. Thus, there is no investment barrier preventing this activity, except for the poorest people who have no more alternatives at all.

Technically, the continuation of traditional land use activities logically does not require any new skill. They have sufficient know-how to continue these activities, and improve them if they can get access to some small savings at least.

The social barriers do not prevent pre-existing activities as these ones do not require real organization. Indeed, and as mentioned above, rural communities are traditionally involved in the production of goods (crops, meat) that can be sold directly on local markets (BUNEC, 2006). However, arabic gum is a commercial product that needs centralization to be transformed in further

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[40] Hountondji Y-C, Ozer P. et Jacques N., 2004. Mise en évidence des zones touchées par la désertification par télédétection à basse résolution au Niger. Cybergeo : European Journal of Geography. 19p.

[41] Ozer P., Bodart C., et Tychon B., 2005. Analyse climatique de la région de Gouré, Niger oriental : récentes modifications et impacts environnementaux. Cybergeo : European Journal of Geography. 25p.

steps and distributed (English, 2006). Therefore rural communities do not need new skill to continue their current activities.

The barriers due to ecological conditions prevent pre-existing activities as they prevent the proposed A/R CDM project activities. However, rural communities can control much more easily the pre-existing activities as they are localized closer to the village (GIOES, 2006) and on much smaller surfaces than the proposed A/R CDM project activities.

Following, some evidences of degradation are provided:
The project area is categorized by FAO (2005) under severe to very severe degraded area; because of hydraulic and mostly wind erosion. Moreover, the study made by GIOES & APOR (2006) in the whole project area, site-by-site assessment concluded that the whole project area is in process of degradation since at least 20 years

Additionally, in the framework of the study on the situation of communication for development in Niger (PNUD 2003[42]), diverse problems have been identified for each region based on surveys carried out with public institutions, ONGs, projects and programs. The main results regarding degradation were:

- Maradi:
Severe land degradation (water and wind erosion)
Constant threat of bushfires
Accelerated degradation of the environment
Very advanced state of degradation of forest resources

- Diffa:
Degradation of vegetation cover
Poor soil qualities
Water and soil salinity

- Tillaberi
Water and wind erosion
Environmental degradation, especially of vegetal cover
Strong degradation of natural resources
Bush fire, and over cutting of green wood

- Dosso
Drying and degradation of ecosystems
Accentuation of wind erosion
Impoverishment of the land
Drying up of surface water
Loss of vegetation (deforestation

Therefore, the identified barriers preventing the implementation of the proposed A/R CDM project activities do not prevent the continuation of the pre-existing activities which represent the most plausible baseline scenario.

Sub-step 2c. Determination of baseline scenario

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?
→ yes, then:
Does the list contain only one land use scenario?
→ No, then continue with Step 3: Investment analysis.

Option 2: Continue with Step 3: Investment analysis.

Since only the continuation of pre-existing activities is not prevented by any barrier, this is the baseline scenario.

Step 4. Common practice analysis

The largest forest plantations of *Acacia Senegalensis* in Niger belong to ASI and represent 1.200 ha. The proposed A/R CDM project activities will establish more than 8.472 ha of *Acacia senegalensis*. Obviously, the proposed A/R CDM project activities present a much larger scale than the existing similar forest plantations (ratio of 10), and becoming the first of its kind.

Therefore, step 4 is not satisfied, i.e. there is no similar project to the NASPP existing in Niger, and the proposed A/R CDM project activities can be considered additional.

B.6.   Estimation of net anthropogenic removals

B.6.1. Explanation of methodological choices

>> According to selected methodology AR-ACM0003 the estimation of GHG removals by sinks begins with the estimation of Baseline net GHG removals by sinks (Section 5.4 of the applied methodology). Then, actual net GHG removals by sinks are estimated by using the allometric method, this method is the most appropriated given the availability of data. Finally for estimating the carbon stock change in trees the stock change method is used.

Baseline net GHG removals by sinks

The baseline net GHG removals by sinks is calculated as follows:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} \qquad (1)$$

Where:

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO2-e

$\Delta C_{TREE\_BSL,t}$ = Change in carbon stock in baseline tree biomass within the project boundary 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 CO2-e

$\Delta C_{SHRUB\_BSL,t}$ = Change in carbon stock in baseline shrub biomass within the project boundary, 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 CO2-e

$\Delta C_{DW\_BSL,t}$ = Change in carbon stock in baseline dead wood biomass within the project boundary, 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 CO2-e (Not considered)

$\Delta C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, 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 CO2-e (Not considered)

In accordance with the results obtained in sections B.5 and B.6, the baseline net greenhouse gas removals by sinks are expected to be negative.

It is conservatively assumed that baseline net greenhouse gas removals by sinks are zero. This assumption is supported by the following conditions;

(a) No growing trees or woody perennials exist. Indeed, as mentioned in section A.7, on the basis of GIOES & APOR (2006), when woody perennials exist, they are under process of severe degradation and are therefore not expected to grow, considering moreover the increasing frequency of draught events (DMN, 2005).

(b) No trees or other woody perennials will reach start to grow at any time during the crediting period. With higher frequency of draught events (DMN, 2005), combined with degradation process, the vegetation is expected to decrease. The new vegetation that could potentially appear will as a matter of fact be eaten by transhumant and wandering animals, considering the scarcity of food due to the degradation process.

Then,

$$\Delta C_{BSL,t} = 0$$

B.6.2. Data and parameters fixed ex ante

Data/Parameter	R_j
Data unit	Dimensionless
Description	Root-shoot ratio for tree species
Source of data	IPCC 2003 default value, table 3A.1.8
Value(s) applied	0,27
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Used in equations (1)and (2)

Data/Parameter	*44/12*
Unit	Dimensionless
Description	Ratio of molecular weights of carbon and CO_2
Source of data	
Value(s) applied	44/12
Choice of data or measurement methods and procedures	Universal constant
Propose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

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
Propose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

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
Propose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Local-derived and species-specific value have the priority (IPCC default = 0.5)

Data/Parameter	*zα/2*
Unit	dimensioless
Description	Value of the statistic z (normal probability density function), for α = 0.05 (implying a 95% confidence level)
Source of data	
Value(s) applied	1.645
Choice of data or measurement methods and procedures	N/A
Propose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

Data/Parameter	*Dj*
Unit	(t d.m. m-3)
Description	Wood density of species *j*
Source of data	literature[43]
Value(s) applied	0.8
Choice of data or measurement methods and procedures	Information specific for the species
Propose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Local-derived and species-specific value have the priority This parameter is not used in *ex-ante* estimations, but could be used in ex-post estimations

Data/Parameter	*BEF*
Unit	dimensioless
Description	Biomass expansion factor
Source of data	to be defined if used in ex-post estimations
Value(s) applied	N/A
Choice of data or measurement methods and procedures	Local-derived and species-specific value have the priority (IPCC default in LULUCF GPG 2003, Table 3A.1.10)
Propose of data	Calculation of actual net GHG removals by sinks;
Additional comment	This parameter is not used in *ex-ante* estimations, but could be used in ex-post estimations

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[43] Détienne, P. 2005. Les bois des gommiers sahéliens. Bois et forêts des tropiques. 283 (1) pp 19-23

B.6.3. Ex ante calculation of net anthropogenic removals

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Actual net GHG removals by sinks:

According to approved methodology AR-ACM0003/ version 1.0.0 the quantity of the actual net GHG removals by sinks within the project boundary are estimated using equation 2:

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

Where:

ΔC_{ACTUAL} Actual net greenhouse gas removals by sinks in year t; t CO_2-e

$\Delta C_{P,LB}$ Change in the carbon stocks (above- above below-ground biomass), 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 an A/R CDM project activity, in year t; t CO_2-e

Estimation of actual changes in living biomass carbon stocks in the project scenario:

The first variable in equation 2 is estimated with equation 3:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$ (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

$\Delta C_{DW\_PROJ,t}$ 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 (No included)

$\Delta C_{LI\_PROJ,t}$ 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 (No included)

$\Delta SOC_{AL,t}$ 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 (No included)

Estimating ex-ante change in carbon stocks within the project boundary:

Since only changes in tree biomass are considered in project scenario, Is used the Methodological tool "Estilmation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"

a) Selection of the technique and use the appropriate equation for estimating the carbon stock in trees

Analysis of information available for Acacia senegal.

In order to estimate carbon stocks in above ground biomass of *Acacia senegal*, a search following the priority steps proposed in the methodology is done:

- Existing local and species specific: In project sites there are not local inventories or biomass studies.
- National and species specific (e.g. from national GHG inventory): In Niger there is no information of Acacia Senegal inventories or biomass studies.
- Species specific from neighbouring countries with similar conditions: Three specific studies were found in neighbouring countries and with similar bio-climatic conditions:

The first study from Poupon (1977) "Production de matière sèche d'*Acacia senegal* (L.) Willd dans une savane Sahelienne au Sénegal". Although this study fits a biomass growth model, it presents many inconsistencies in the firsts 12 years old, because of the estimations in these years is decreasing, which is illogical. This, may be, is a result of two causes, first of all, the fitted model is not a biological model, and secondly, tree data were obtained of trees older than 10 years, thus model is only valid for trees upper to 10 years and any estimation below to this age is an extrapolation. In the following graphic is evidenced this situation.

$$AGB = -0,0009t^3 + 0,1067t^2 - 2,0733t + 11,0463$$
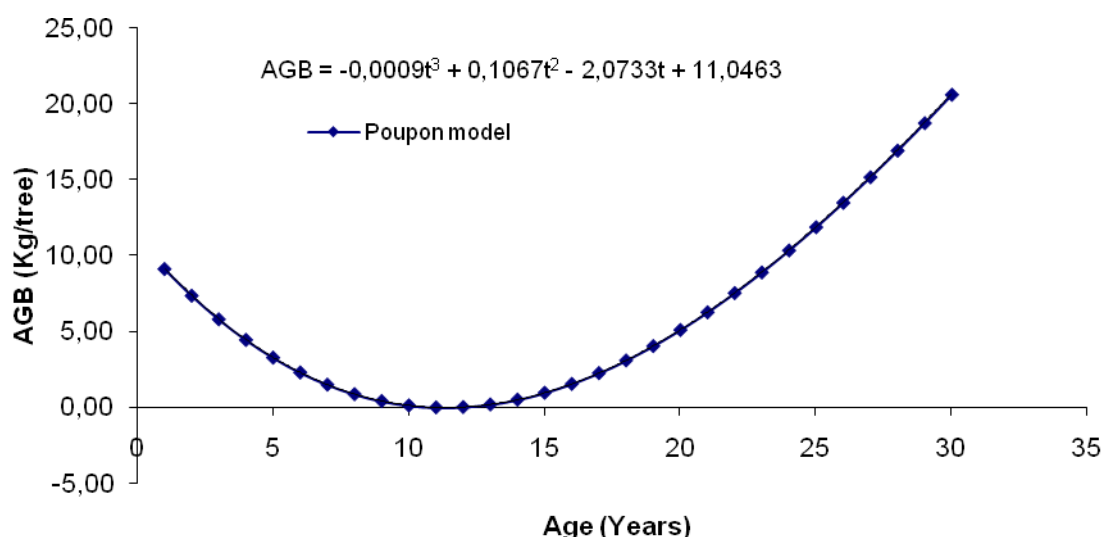
Figure 13. Illustration of the allometric model for Acacia senegal

The second study found was from Smektala *et al.* (2002) "construction de tarifs de biomasse pour l'évaluation de la disponibilité ligneuse en zone de savanes au Nord-Cameroun". In this work, allometric equations were fitted for fresh biomass in function of the diameter measured to 0.5 m height. Nevertheless, in order to use this equation two difficulties arise: first, there is no data for dry biomass or humidity content of the trees in the study, and second, there are no growth models or yield tables that allow estimating diameter growth. Therefore, this study cannot be used.

Finally, a third study in Senegal, by J.D. Deans (1999) "Nutrient and organic-matter accumulation in *Acacia senegal* fallows over 18 years". Although this study does not fit allometric or growth equations, it establishes that "the biomass increased linearly with time, from age 3 to age 18 and was linearly related to steam cross-sectional area at 30 cm height". In this period of time, AGB and

BGB accumulation averaged 1770 Kg ha-1 year-1 for trees evenly spaced at 6 m. (278 trees ha-1) i.e. a rate of growth of 6.37 Kg tree-1 year-1.

Because of this study presents the most reliable data and was done with trees growing in very similar environmental and forest management conditions, theirs results are used in order to obtain ex-ante estimations of carbon change in living biomass in the firsts 18 years. For the remaining crediting period, Poupon's model 1977 is used. This information corresponds to the **allometric equation technique** as described in section 8.2 of the Methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"

$$B_{TREE,j,p,i,t} = f_j\left(x1_{p,i,t}, x2_{p,i,t}, x3_{p,i,t}, \ldots\right) \times \left(1 + R_j\right) \qquad (4)$$

Where:

$B_{TREE,j,p,i,t}$ = Biomass of trees of species j in sample plot p of stratum i at a given point of time in year t; t d.m.

$f_j\left(x1_{p,i,t}, x2_{p,i,t}, x3_{p,i,t}, \ldots\right)$ = Function relating measured tree dimensions (x1, x2, x3, …) to above-ground biomass. Tree dimensions are measured in sample plot p of stratum i at a given point of time in year t.
Tree dimensions x1, x2, x3, … could be, for example DBH, height of tree, etc.

R_j = Root-shoot ratio for tree species j; dimensionless

j = 1, 2, 3, … tree species in plot p

p = 1, 2, 3, … sample plots in stratum i

In order to discount biomass reductions due to pruning activities, an estimation of 0,4%, 0,8% and 1,4% of the total biomass stock in years 2, 3 and 4 respectively, are discounted.

Therefore, for ex-ante estimations in NASPP, two stand models are considered, which depends on planting density. Thus the estimations are as follow:

Table 10. ex-ante estimation of living biomass in project scenario

	Stand models							
	Acacia senegalensis pure plantation[1]							
	Growth Total biomass AGB+BGB [44]		Pruning $L_{th,11t}$		Cumulative Totalbiomass AGB+BGB		Cumulative AGB biomass AGB [45]	
t (yr)	t dm.ha-1.yr-1 (400 trees/ha)	t dm.ha-1.yr-1 (313 trees/ha)	t dm.ha-1.yr-1 (400 trees/ha)	t dm.ha-1.yr-1 (313 trees/ha)	t dm.ha-1 (400 trees/ha)	t dm.ha-1 (313 trees/ha)	t dm.ha-1 (400 trees/ha)	t dm.ha-1 (313 trees/ha)
1	2,55	1,99			2,55	1,99	2,01	1,57
2	2,55	1,99	0,02	0,016	5,07	3,97	3,99	3,13
3	2,55	1,99	0,06	0,047	7,56	5,92	5,95	4,66
4	2,55	1,99	0,14	0,110	9,97	7,80	7,85	6,14
5	2,55	1,99			12,51	9,79	9,85	7,71
6	2,55	1,99			15,06	11,78	11,86	9,28

[44] Total biomass obtained from Deans 1999: 2.55= 6.37 * 400/1000 and 1.99 =6.37*313/1000 (t/ha=Kg/tree *trees/ha/1000 kg/t)

[45] AGB= Total Biomass/1,27 (root /shoot ratio=0,27)

7	2,55	1,99		17,61	13,78	13,86	10,85
8	2,55	1,99		20,15	15,77	15,87	12,42
9	2,55	1,99		22,70	17,76	17,87	13,99
10	2,55	1,99		25,25	19,76	19,88	15,56
11	2,55	1,99		27,79	21,75	21,89	17,13
12	2,55	1,99		30,34	23,74	23,89	18,69
13	2,55	1,99		32,89	25,73	25,90	20,26
14	2,55	1,99		35,43	27,73	27,90	21,83
15	2,55	1,99		37,98	29,72	29,91	23,40
16	2,55	1,99		40,53	31,71	31,91	24,97
17	2,55	1,99		43,07	33,71	33,92	26,54
18	2,55	1,99		45,62	35,70	35,92	28,11
19	0,61	0,48		46,23	36,18	36,41	28,49
20	0,68	0,54		46,92	36,71	36,94	28,91
21	0,75	0,59		47,67	37,30	37,54	29,37
22	0,82	0,64		48,49	37,94	38,18	29,88
23	0,88	0,69		49,37	38,63	38,87	30,42
24	0,94	0,73		50,30	39,36	39,61	30,99
25	0,99	0,77		51,29	40,14	40,39	31,60
26	1,04	0,81		52,33	40,95	41,21	32,24
27	1,09	0,85		53,42	41,80	42,06	32,91
28	1,13	0,89		54,55	42,69	42,95	33,61
29	1,17	0,92		55,72	43,60	43,88	34,33
30	1,21	0,95		56,93	44,55	44,83	35,08

b) Selection of the method for estimating the carbon stock change in trees

Stock change method is used to estimate carbon stock changes as described below, and all calculations are supported in the tool TARAM (file annexed)

Then, in order to estimate carbon stock changes $\Delta C_{P,t}$ and according with the information found for *Acacia senegal*, stock change method is employed and the following equations are used:

$$C_{TREE,t} = \frac{44}{12} \times B_{TREE,t} \times CF_{TREE} \qquad (5)$$

$$dC_{TREE,(t_1,t_2)} = \left(\frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} \right) \qquad (6)$$

$$\Delta C_{TREE,t} = dC_{TREE,(t_1,t_2)} \times 1 \; year \quad \text{for } t_1 \le t \le t_2 \qquad (7)$$

Where:

$C_{TREE,t}$ Carbon stock in tree biomass within the project boundary at given point of time in year *t*; t CO$_2$-e

$B_{TREE,t}$ Total tree biomass within the project boundary at a given point of time in year *t*, t.d.m

CF_{TREE} Carbon fraction of tree biomass; tC t d.m.$^{-1}$

$dC_{TREE,(t_1,t_2)}$	Rate of change in carbon stock in tree biomass within the project boundary during the period between a point of time in year t_1 and a point of time in year t_2; tCO$_2$-e
C_{TREE,t_2}	Carbon stock in tree biomass within the project boundary at a point of time in year t_2 tCO$_2$-e
C_{TREE,t_1}	Carbon stock in tree biomass within the project boundary at a point of time in year t_1 tCO$_2$-e
$\Delta C_{TREE,t}$	Change in carbon stock in tree biomass within the project boundary in year t, tCO$_2$-e

The project activity proposes planting only one species, *Acacia senegal*. The parameters used in equations above are presented in the following table:

Table 11. **Default parameters used**

Variable	Value	Comment
t^*	30	
j	1	
i	2	Stand density: 313 and 400 trees/ha
R_1	0.27	IPCC 2003 default value, table 3A.1.8
CF	0.5	IPCC 2003 default value
Species	*Acacia senegal*	

Hence, the changes in stock living biomass are the following.

Year	Carbon Stock living biomass cumulated (tC02/ha) 400 trees/ha	Carbon Stock living biomass cumulated (tC02/ha) 313 trees/ha	Total Carbon Stock living biomass cumulated (tC02) 400 trees/ha	Total Carbon Stock living biomass cumulated (tC02) 313 trees/ha
1	4,67	3,65	5 080	776
2	9,30	7,28	14 206	5 626
3	13,86	10,85	23 513	11 317
4	18,27	14,30	32 878	18 356
5	22,94	17,95	45 599	27 170
6	27,61	21,61	62 475	37 824
7	32,28	25,26	84 318	51 452
8	36,95	28,91	105 975	65 051
9	41,62	32,57	127 604	78 652
10	46,29	36,22	149 293	92 252
11	50,96	39,87	171 259	106 017
12	55,63	43,53	193 225	119 783
13	60,29	47,18	215 191	133 548
14	64,96	50,83	237 157	147 313
15	69,63	54,49	259 124	161 078
16	74,30	58,14	281 090	174 844
17	78,97	61,79	303 056	188 609
18	83,64	65,45	325 022	202 374
19	84,76	66,33	343 131	215 550
20	86,02	67,31	358 280	225 650
21	87,40	68,39	373 458	235 213
22	88,90	69,56	388 665	243 834

23	90,51	70,82	401 675	251 209
24	92,22	72,16	411 990	257 537
25	94,04	73,58	418 887	261 840
26	95,94	75,08	426 314	266 478
27	97,94	76,64	434 242	271 430
28	100,01	78,26	442 639	276 679
29	102,16	79,94	451 475	282 205
30	104,37	81,67	460 722	287 990

Estimation of GHG (increase in GHG emissions by sources within the project boundary as a result of the implementation of an A/R CDM project activity):

According to the applied methodology, GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary,and transportation attributable to the project activity are considered insignificant and therefore accounted as Additionally, burning activities in site preparation are not carried out. Therefore, there are not non-CO_2 GHG emissions due to this activity.

Therefore, GHG in NASPP project are estimated to be zero.

Leakage:

The applied methodology, AR-ACM0003, considers the leakage due to the displacement of agricultural activities, this source of leakage is described and assed for NASPP project bellow:

Leakage due to displacement of agricultural activities
The project activity allows the establishment of intercrops during first 6 years of the plantation, with this measure is expected to have at least the same cropping area as that existing in baseline scenario. In addition, since soil properties are improved thanks to their preparation for planting, particularly by the "half moon" structures it is possible to establish crops where it was not possible before. In consequence, displacement of agricultural activities is discarded and it can be conclude that the project activity proposed has not leakage

B.6.4. Summary of ex ante estimates of net anthropogenic removals

Year	Baseline net removals (t CO_2e)	Actual net removals (t CO_2e)	Leakage (t CO_2e)	Net anthropogenic removals (t CO_2e)	Cumulative anthropogenic removals (t CO_2e)
2006	-	5 856	-	5 856	5 856
2007	-	13 975	-	13 975	19 832
2008	-	14 998	-	14 998	34 830
2009	-	16 405	-	16 405	51 234
2010	-	21 535	-	21 535	72 769
2011	-	27 529	-	27 529	100 299
2012	-	35 472	-	35 472	135 770
2013	-	35 255	-	35 255	171 025
2014	-	35 231	-	35 231	206 256
2015	-	35 289	-	35 289	241 545
2016	-	35 731	-	35 731	277 276
2017	-	35 731	-	35 731	313 008
2018	-	35 731	-	35 731	348 739
2019	-	35 731	-	35 731	384 470

Year					
2020	-	35 731	-	35 731	420 202
2021	-	35 731	-	35 731	455 933
2022	-	35 731	-	35 731	491 665
2023	-	35 731	-	35 731	527 396
2024	-	31 285	-	31 285	558 681
2025	-	25 250	-	25 250	583 931
2026	-	24 740	-	24 740	608 671
2027	-	23 828	-	23 828	632 499
2028	-	20 385	-	20 385	652 884
2029	-	16 643	-	16 643	669 527
2030	-	11 201	-	11 201	680 728
2031	-	12 065	-	12 065	692 792
2032	-	12 880	-	12 880	705 672
2033	-	13 646	-	13 646	719 318
2034	-	14 363	-	14 363	733 680
2035	-	15 031	-	15 031	748 712
Total	-	748 712	-	748 712	
Total number of crediting years	30				
Annual average over the crediting period	-	24 957	-	24 957	24 957

B.7. Monitoring plan

The monitoring plan for NASSP is done in compliance with the approved methodology AR-ACM 0003 version 1.0.0 "Afforestation and reforestation of lands except wetlands". The full document is developed in Appendix 5. In following sections a summary of key factors and variables are shown.

B.7.1. Data and parameters to be monitored

In order to monitoring of the actual net GHG removals by sinks, the section III.5 of the approved methodology selected is used and measurement and data collection procedures are described in section 4 of Monitoring Plan (Appendix 5). A list of data and parameters that are monitored, are showed below.

Data/Parameter	PL_{ID} (2.1.1.69)
Data unit	alpha numeric
Description	Sample plot ID
Source of data	Project and plot map, GIS
Value(s) applied	N/A
Measurement methods and procedures	N/A
Monitoring frequency	5 years
QA/QC procedures	The Project Management and Monitoring Unit (USGP) carry out a random verification over the project area using the geographic information database to ensure that each stratum is correctly identified
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Numeric series ID will be assigned to each permanent sample plot

Data/Parameter	PL_{Ik}
Data unit	Total number of plots in stratum i, stand model k
Description	dimensionless
Source of data	determined before Forest Inventory and adjusted during the monitoring event

Value(s) applied	N/A
Measurement methods and procedures	Calculated
Monitoring frequency	5 years
QA/QC procedures	The Project Management and Monitoring Unit (USGP) verify the calculation of the number of sample plots by using equation 7
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

Data/Parameter	*A*
Data unit	ha
Description	Total size of all strata (A), e.g. the total project area
Source of data	measured
Value(s) applied	8,472 ha
Measurement methods and procedures	Measured with GPS receptor before the start of the project and adjusted thereafter every 5-year
Monitoring frequency	Before the start of the project and adjusted thereafter every 5 years
QA/QC procedures	Total project area is estimated by adding areas of each stratum, and this sum is verified by the Project Management and Monitoring Unit (USGP) using the GIS
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

Data/Parameter	*Aikt*							
Data unit	ha							
Description	Area of stratum *i*, stand model *k*, at time *t*;							
Source of data	measured							
Value(s) applied	Stratum 1 **SM1** *(313 trees/ha)*	1088.03	875.04	62.7	61	687.84	850	1080	4704.61
	Stratum 2 **SM2** *(400 trees/ha)*	212.42	1116.63	242.5	395	516.1	460	825	3767.65
	See Table 10 for details							
Measurement methods and procedures	Measured with GPS receptor							
Monitoring frequency	Before the start of the project and adjusted thereafter every 5 years							
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	Calculation of actual net GHG removals by sinks;							
Additional comment	Measured for different strata and stands							

Data/Parameter	*AP*
Data unit	m²
Description	Sample plot area
Source of data	measured
Value(s) applied	1000
Measurement methods and procedures	A preliminary value of 1000 m² will be used in order to ensure minimum 20 trees per plot
Monitoring frequency	5 years
QA/QC procedures	10% of the permanent sample plots are to be verified in each monitoring event by the USGP.
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

Data/Parameter	*BD*
Data unit	cm
Description	Diameter at base of living and standing dead trees
Source of data	measured
Value(s) applied	
Measurement methods and procedures	Standard measurement in forest inventory. Is measured in all trees within the plots with a diameter tape
Monitoring frequency	5 years
QA/QC procedures	BD is measured in 100% of permanent sample plots and verified in 10% of them
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Measuring at each monitoring time per sampling method

Data/Parameter	*fj(BD,H)*
Data unit	
Description	Allometric equation for species *j* linking above-ground tree biomass (kg tree-1) to diameter at breast height (BD) and possibly tree height (H) measured in plots for stratum *i*
Source of data	calculated
Value(s) applied	
Measurement methods and procedures	Is considered a good practice for IPCC
Monitoring frequency	5 years
QA/QC procedures	The project might develop allometric models specific for the project. The equation should then be monitored in order to add more trees when plantations will be older
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	If an allometric model from literature is used, the model will not be monitored Moreover, if BEF method is used, the monitoring of allometric model will not be relevant. Local allometric models are being developed and they can be used other parameters, but with direct relation with DBH or H, as basal area or girth.

Data/Parameter	*iID*
Data unit	alpha numeric
Description	Stratum *i*D (1, 2, 3, … *mSP* project scenario (*ex post*) strata)
Source of data	defined
Value(s) applied	N/A
Measurement methods and procedures	
Monitoring frequency	At stand establishment
QA/QC procedures	The Project Management and Monitoring Unit (USGP) carry out a random verification over the project area using the geographic information database to ensure that each stratum is correctly identified
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Each stand has a particular year *to* be planted under each stratum

Data/Parameter	*IDikt*
Data unit	alpha numeric
Description	Stand ID
Source of data	defined
Value(s) applied	N/A
Measurement methods and procedures	N/A
Monitoring frequency	At stand establishment
QA/QC procedures	The Project Management and Monitoring Unit (USGP) carry out a random

	verification over the project area using the geographic information database to ensure that each stand is correctly identified
Purpose of data	Calculation of actual net GHG removals by sinks;
Any comment	Each stand has a particular year *to* be planted under each stratum

Data/Parameter	*lat/long*
Data unit	
Description	Plot location
Source of data	measured
Value(s) applied	N/A
Measurement methods and procedures	Using GPS to locate before start of the project and at time of each field measurement
Monitoring frequency	At stand establishment
QA/QC procedures	The Project Management and Monitoring Unit (USGP) in charge of controlling the quality of the Geographic information system through internal review by at least two GIS experts.of a random verification of Plot coordinates using GPS.
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

Data/Parameter	$n_{TRPLikt}$
Data unit	dimensionless
Description	Number of trees in the sample plot t
Source of data	measured
Value(s) applied	
Measurement methods and procedures	Counted in plot measurement
Monitoring frequency	5 years
QA/QC procedures	measured in 100% of permanent sample plots and verified in 10% of them
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	

Data/Parameter	*H*
Data unit	m
Description	Tree height
Source of data	measured
Value(s) applied	
Measurement methods and procedures	
Monitoring frequency	5 years
QA/QC procedures	measured in 100% of permanent sample plots and verified in 10% of them
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Measuring at each monitoring time per sampling method

Data/Parameter	st_i
Data unit	dimensionless
Description	Standard deviation for each stratum *i*;
Source of data	estimated
Value(s) applied	
Measurement methods and procedures	
Monitoring frequency	5 years
QA/QC procedures	The estimation of standard deviation will be verified by the USGP at the moment of each verification
Purpose of data	Calculation of actual net GHG removals by sinks;
Additional comment	Measuring at each monitoring time per sampling method

B.7.2. **Sampling plan**

>> The ex-ante stratification will be the starting point to sampling design. Nevertheless, any change in ex-ante stratification as a result of the implementation of the project planting / management plan, will be registered and the new strata completely identified. Natural or anthropogenic impacts that add variability to growth patterns, and in consequence to carbon stocks, will be also registered.

Factors to be considered in ex-post stratification:

- Changes in forest establishment and forest management plan

- Natural impacts: Fires, plagues and diseases, landslides, etc.

- Anthropogenic impacts: illegal burnings or logging

Procedures to modify ex ante stratification

The changes in field can be detected in three ways:

1. Routine trips (vigilance and control of plantations)
2. In monitoring and measurement of permanent sample plots (directly in field, or *a posteriori* in plot data analysis)
3. Visualized by gum harvesters

Then, once identified the changes and the site involved, it is measured with GPS. The methodology to measure, register and archive the data is described below, and detailed in baseline study (GIOES 2006)

A preliminary cartography and geo-referencing methodology of the project boundary is established in baseline study. This cartography will be updated with new attributes or internal divisions of the strata, measuring each node of the project boundary at the same time as planting activities are done, for this; a global position system with metric resolution is used. Then, the data are downloading in a computational device and stored in a database specific for the Project. These data will feed the project database.

Sample size

A first estimate of sample size is done assuming constants costs for all strata, and in compliance with the applied methodology, the targeted precision level for biomass estimation within each stratum is +/- 10% of the mean at a 90 % confidence level.

For the entire project, the number of needed plots (n) is calculated using the following formula:

$$n = \frac{\left(\sum_{i=1}^{m_{PS}} N_i * st_i \right)^2}{\left(\frac{N * E}{z_{\alpha/2}} \right)^2 + \left(\sum_{i=1}^{m_{PS}} N_i * st_i^2 \right)}$$

(7)

With:
- *N*: Maximum possible number of sample plots in the project area,
- *N_i*: Maximum possible number of sample plots in stratum *i*,
- *St_i*: Standard deviation for each stratum *i*, A value of 50% over average is used according whit IPCC 2006.
- *n*: Total number of sample plots
- *E:* Allowable error (10%)
- *m_{ps}* total number of strata
- $Z_{\alpha/2}$: Value of the statistic z (normal probability density function), for α/2 = 0.05 (implying a 90% (confidence level)

The total number of sampling plots estimated *a priori* is 96; their allocation among strata is done using the following equation:

$$n_i = \frac{\displaystyle\sum_{i=1}^{m_{PS}} N_i * st_i}{\left(\dfrac{N * E}{z_{\alpha/2}}\right)^2 + \left(\displaystyle\sum_{i=1}^{m_{PS}} N_i * st_i^{\,2}\right)} * N_i * st \qquad\qquad (8)$$

With:
- n_i: Number of sample plots in stratum i, Others variables as described in equation above.

Following are the results of this estimation:

Strata	Area (ha)	Ni	Average*(t CO2e/ha)	t value	st (50% of the average)	E (10%)	Sample size
1 (400 trees/ha)	4704.61	47046	23.35		11.68		59
2 (313 trees/ha)	3767.65	37677	18.27	1.96	9.14	2.11	37

* Average carbon stocks values at first verification event, (i.e at fifth year) are used; nevertheless, the sample size for subsequent monitoring interval will be modified if there is any variation in carbon stock changes after the first monitoring event.

Sampling plots area: Circular plots of 1000 m² (radius= 17.84 m) for both stand models (313 and 400 trees/ha) will be laid out in order to ensure a minimum of 20 trees per plot (refer to Appendix 5).

Plot size was selected so that a plot contains at least 20 trees.
In a pessimistic scenario, with a survival rate of 75% and plantation density of 313 trees/ha it is expected that 23 trees/plot will be covered, while for 400 trees/ha are expected 30 trees/plot. Although the 75% are chosen in order to consider an extreme case of mortality and ensure a minimum quantity of trees per plot. In any case, a mortality of 10% or more will lead to replanting of trees lost.

B.7.3. Other elements of monitoring plan

>>
Information on how geographic coordinates of the project boundary are established, recorded and archived: A preliminary cartography and geo-referencing methodology of the project boundary is established in baseline study. This cartography will be updated with new attributes or internal divisions of the strata, measuring each node of the project boundary at the same time as planting activities are done, for this; a global position system with metric resolution is used. Then, the data are downloading in a computational device and stored in a database specific for the Project. These data will feed the project database.

SOPs and quality control (QC) and quality assurance (QA) procedures undertaken for data monitored: the quality control (QC) and quality assurance (QA) activities that are carried out for NASSP are the following:

Data (Indicate ID number)	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
2.1.1.52 $lat/long$	low	Random plot verification using GPS to ensue the consistent measuring and monitoring of the carbon stock change over time
2.1.1.51 i_{ID}	low	Random verification over the project area to ensure that each stratum is correctly identified
2.1.1.75 tID	low	Random verification over the project area to ensure the area in terms of plantation age is correctly measured
2.1.1.28 BD	low	Random plot verification

In order to assess possible impacts of land preparation on water balance, control plots will be identified in the lower part of the watershed and the potential affected communities will be consulted at the moment of verification in order to know if water resources have been impacted.

ASI will support the monitoring, measurement and verification of the project. Additionally, a Technical Committee will be established with participation of a representative from each of the following institutions: ASI, CAP, ICRISAT, CNEDD, and the Ministry of Environment. The Technical Committee will meet at least three times a year to discuss the project implementation and recommend corrective actions.

Further details are provided in Appendix 5.

The flowchart below presents in detail the organization of this mechanism.
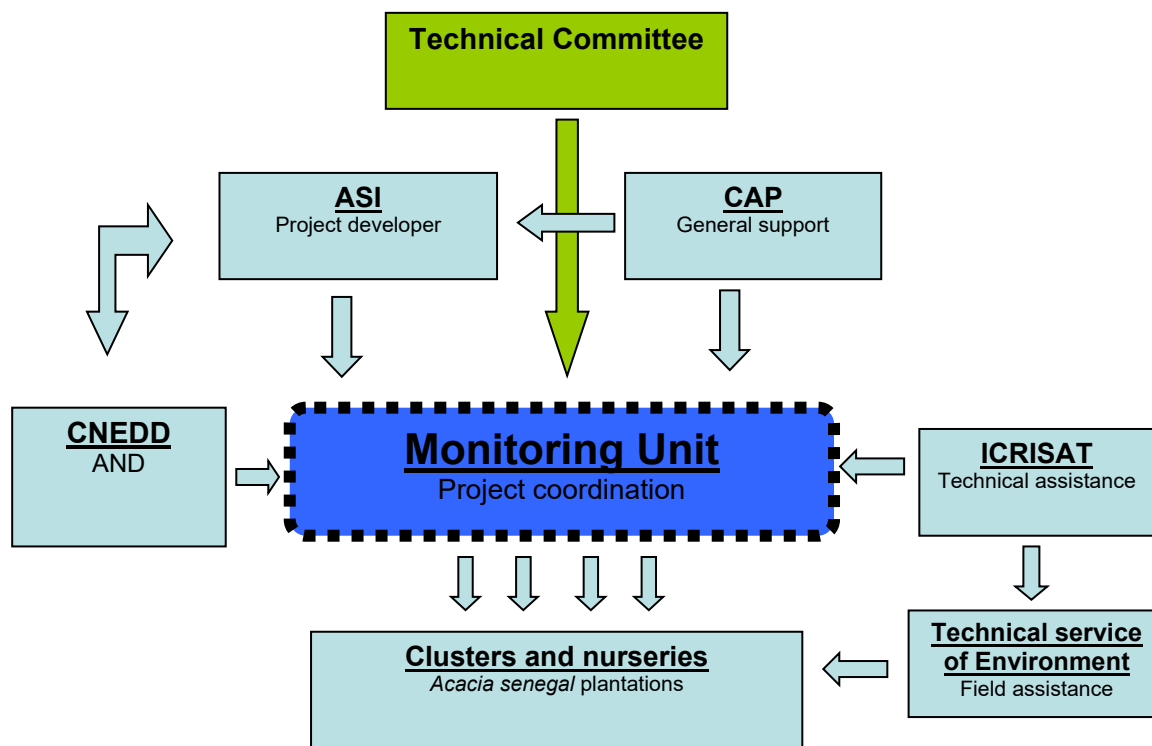
SECTION C.   Start date, crediting period type and duration

C.1.   Start date of project activity
>> 21 December 2005
This date corresponds to the purchase of seeds which officially launches of the project activities.

C.2.   Expected operational lifetime of project activity
>> The expected operational lifetime will be at least of 30 years. However it is expected that the forest plantation of the project remains on the very long-term.

C.3.   Crediting period of project activity

C.3.1. Type of crediting period
>> Fixed crediting period.

C.3.2. Start date of crediting period
>> The start date of crediting period is the same start date of project activity, i.e. 21 December 2005.

C.3.3. Duration of crediting period
>> 30 years, 0 months.

SECTION D.   Environmental impacts

D.1.   Analysis of environmental impacts
>> A field study has been conducted on plantations sites. The analysis of the environmental impacts is detailed in the study attached to the PDD (social and environmental impacts): ***Environmental and Social Impact Study of the Plantation Project in the Framework of CAP***, H. Kimba, May 2006.

This study intends to:
- ✓ Identify the negative environmental and social impacts on the implementation of *Acacia senegal* plantations;
- ✓ Identify and propose measures of compensation in conformity to the policies of saving and to the national policy;
- ✓ Identify and propose measures to be taken in case of negative impacts, for corrective actions as well as the schedule of their implementation.
- ✓ Make recommendations for the implementation of measures of ease.

The results in view at the end of the study are:

- ✓ negative environmental and social impacts on the implementation of *Acacia senegal* plantations have been identified;
- ✓ The measures of compensation have been identified and planned for;
- ✓ The measures to be taken to conduct the corrective actions as well as the schedule of their implementation have been elaborated;
- ✓ Recommendations for the implementation of measures of ease have been done.

Thus, the study has shown that the potential impacts on the socio-economic and environmental components are those that come directly from different activities that will be executed during the implementation of the project. The main activities identified and susceptible to be potential source

of positive or negative impacts on the components of the milieu (biophysics and human) are as follows[46] :

 ➢ Acquisition of sites;

 ➢ Putting in place of nurseries and production of seedlings;

 ➢ Creation and rehabilitation of bore holes, digging and cleaning out of wells;

 ➢ Putting in place and implantation of means of pumping out;

 ➢ Preparation works of sites (Conservation des Eaux et du Sol - Défense et Restauration des Sols CES/DRS (treatment of Kooris, anti-erosive works);

 ➢ Tree plantation;

 ➢ Agro-forestry ;

 ➢ Putting in defence, guarding, fencing of sites, etc. ;

 ➢ Diverse trainings (in nursery techniques, Conservation and Defence of water resources and soil, in monitoring and evaluation, specific trainings on the role of management committees, in village forestry, agro-forestry, agricultural techniques) ;

 ➢ Study trip and organisational promotion ;

 ➢ Production and commercialization of the Arabic gum ;

 ➢ Valorisation of other products and forestry sub products;

 ➢ Exploitation of wood, service and energy;

 ➢ Struggle against bush fires;

 ➢ Marking off of animal passage couloirs; etc.

This list is not exhaustive and other sources of impacts that are not planned for and that can occur during all the works or even after their implementation.

One of the main environmental advantages of the project will be the progressive regeneration of the soil by the Acacia plantations. This will further ameliorate the productivity of the Acacia species chosen in future. Also, due to the training and the know how given by ICRISAT and the Ministry of Environment as well as the guarantee of ASI to purchase the integrality of the Arabic gum produced, there will be a financial interest from the local communities to continue their plantations, rather than converting the land for other goals, guaranteeing so the durability of the operation.

Thus, the potential of reforestation using this endemic species is wide and is extended to many regions of the country, the project will be particularly important as catalyser, because it will establish a wide network of know how (from local communities as well as ASI) and infrastructure to control the plantations (in particular the nurseries). These efforts will be easily transferred elsewhere once the project has been a success, because the local communities become more experimented with the plantations, they will wish certainly increase their efforts of reforestation. Also, a certain number of private companies and/or locales or community organizations are susceptible to be implicated in the plantations as well as the nurseries.

The direct environmental impacts awaited from the implementation of the project can be enumerated as follows:

 ➢ Erosion control (through both improved agriculture and trees). Indeed, the deep root system of acacias is known to stabilize the soil;
 ➢ Shade and windbreaks for crop land;
 ➢ Nitrogen fixation in soil, as acacia is a leguminous plant;
 ➢ Improved soil fertility from sustainable agriculture, thanks to the life cycle of acacia whose leaves falling each year will fertilize the soil;
 ➢ Natural habitats for bees, birds, small animals;
 ➢ Restored biodiversity;

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[46] Study on environmental and social impact , February 2006

➢ Raised water table and improved rainfalls, as forests are a source of micro-climates;
➢ Improved beauty of the landscape.

The proposed project activity is implemented under two stand models, which are chosen according to type of soils, this aims to reduce soil impacts and enhance water disponibility per plant and finally, optimize growth of acacia. For these reasons, is considered that stand models do not have negative impacts on the biophysical environment.

Plantation activities are scheduled according to weather conditions, in such a way that plantation activities match with the start of the rainy season. Thus, soil preparation and seedling production are carrying out in the dry season. Then, with respect to the previous site conditions, soil preparation will have only positive impacts on soil properties, since this activities lead to an increasing in soil water retention and reducing runoff, which in turn facilitates the implantation of other vegetal species and consequently animal species.

On the other hand, the environmental and social impact asseement (Kimba 2006) stated that only one negative impact might emerge because of the high use of water in dry season for seedlings production, which could lead to competition for water resources with neighboring communities, nevertheless, this impact is minimized since nurseries are distributed in different sites strategically selected. Additionally, in some sites, others measures to mitigate this impact are implemented, such as: training of nurserymen, determination and strict control of the amount of water to be used, construction of water reservoirs. It should be also notice that ground water stocks in Niger are not scarce.

In general way, the interrelations between the activities source of impact and the components of the milieu through the implementation of the Project are described in the table below.

<u>Chart</u>: **Matrix of interrelationship between impact source activities and milieu components**

Type activities /implementation phase	Human Milieu							Biophysic Milieu			
	Social Organization.	Cond. women & children	Socio-economic activities	Land rate	Use of water	Use of land	Population health	water	Fauna	Flora	Soils
- Sites acquisition	+	-	- -/+	--					+	+	+ +
- Training in ponds management	++	++/-	++		+++	++		++			+
- Training in nursery techniques	++	++/-	++			+		+/-		++	+
- Digging wells for watering plants	+	++	+ +	-	+/-		++	- -	+ +	+	- -
- Cleaning out wells for watering plants	+	++	+		+/-		++	- -	+		- -
- Drilling or rehabilitation of boreholes for watering plants	+	++	+		+/-		++	- -	+ +	+	- -
- Nursery creation	+	++	++	-	+/-			- -		++	
- Production & planting *acacia senegal* plants	+	+/-	+ +	-				- -	+	+ +	+
- Training in CES/DRS	++	++/-	++	+	+	+					
- Training in fixing dunes	++	++/-	++	+	+	+					
- CES/DRS	++	++/-	++	+	+	+		++	+	++	++
- Dunes fixing	++	++/-	++	+	+	+	+	+	+/-	++/--	+++/-
- Scarifying	++	++/-	++			+		++	+	++	+++/-
- Kooris/ponds treatment	+	+	++	++	++	++	++/-	+	+	+	++
- Marking off passing corridors or access paths	+	++	++/ -	-/+				-	+	--	-
- Establishing protection devices	+	-	++/-	-		-			++	+++	++
- Fence of sites	+	+/-	++/--		-	-			+/-	+++	+++

Type activities /implementation phase	Human Milieu							Biophysic Milieu			
	Social Organization.	Cond. women & children	Socio-economic activities	Land rate	Use of water	Use of land	Population health	water	Fauna	Flora	Soils
- Making passing corridors	+++		++/-	-/+				-	+	--	-
- Post placement & hole making	+	+/-	+				-				
- Plantation				-				-/+	++	++	++
- Production labor wood, wood of service & energy	+	+++	+++			+	+		-	++	
- Production & trading of arabic gum	++	++/-	+++				++				
- Agroforestry	+	++		++	++	++		+	++	++	++
- Valuation of forestery products & sub-products		++		++			++				
- Fighting against bush fire						++	++		++	++	+
- Management of sites	++/-	-		++							

Legend :

		Significance of the impact		
		Major	Average	Minor
Nature of the impact	Positive	+ + +	++	+
	Negative	- - -	- -	-

Therefore, in its global situation, the study has revealed that activities sources of impacts upon different milieus as well as possible measures of ease are synthesized in the following chart:

Human milieu		
Positive impact	**Negative impact**	**Measures for ease**
Sources of monetary revenues	Loss of infrastructures	Rational choice of sites
Increase of the agricultural & pastoral production	Limitation of access	
source of energy	Loss of agricultural and/or pastoral lands	
Community management of natural resources	Conflicts in use of resources,	Establishing a framework for Community management of natural resources
Framework for management of industrial disputes	Altering rights of ownership and use of resources	Establishing village committees of site management inside each cluster
Physic milieu		
Positive impact	**Negative impact**	**Measures for ease**
Reconstitution of degraded soils	Risks of hydraulic erosion of soils in case of failure of CES/DRS work	Making work according to art techniques
Fixing soils & enrichment by fixing atmospheric nitrogen		
Biologic milieu		
Reconstitution vegetal cover	Elimination of vegetal cover by removing stump of dead trees	Controlled cuttings
Biodiversity Rehabilitation		Establishing protection devices
		Establishment of village committees of natural resources management
Residue of impacts		
Proliferation of types of harmful fauna (seeds eating birds)		
Risks of conflicts between farmers and herders in connection of space use		

D.2. Environmental impact assessment

>> As noted above and described in the two tables, no significant negative impact has been revealed. The impact observed are potential impacts having average and minor significant levels. This is relatively due to the fact that the process of choosing sites and intervention of the project that is done in through consultation and on the basis of priorities defined by the communities and has a nature of eliminating the awaited negative impacts.

Among the potential negative impacts, it has been revealed that one can note:

- On water: the creation of Nurseries and the production of seedlings will necessitate an important utilization of water and will lead de facto, a high need and an important deduction on available resources, nevertheless this impact can be considered no significant since this activity is distributed in different sites which are strategically selected. Additionally, ground water stocks in Niger are not scarce

- The works of fencing of sites and establishing protection devices, will limit the access to infrastructures, (farms and villages) or resources (water points, firewood/fuel wood) located beyond the site. This will be mostly felt by women and children that are in charge of fetching water and collection wood since they have to do contours in such cases. However, the impact will be small due to the taking into account of these aspects during the community consultation for the identification of sites. In addition, fencing activities are temporary, once acacia trees reach a certain size, fences can be removed.

- Although there is no evidence of negative impacts outside the project boundaries. It is possible that land preparation activities alter the water balance by reducing the amount of water runoff, generating a negative impact on human activities dependent on downstream water and vegetation, therefore, as a measure of prevention, a monitoring of this potential impact is proposed in next section.

To alleviate the negative impacts and ameliorate the positive impacts, the following measures can be implemented:

- Implement an appropriate communication plan in order to inform the local populations of works forecasted and the opportunities given to them as well as on the protection and the valorization of trees with multiple usages notably the *Acacia senegal*.
- Create and animate a consultation forum of different actors that helps to pass strong signals on the intervention strategy of the project ; this forum will have meeting when needed with the other partners (projects, NGOs, etc.) intervening in the rural development sector to inform regularly the customary authorities on the implementation of projects and allow them to exchange and solve or prevent conflicts;
- Support the Land Committees (COFO) so that these structures will be at the fore front of solving conflicts that may occur;
- Make the plantations in blocs of 50 ha as maximum to reduce the restrictions of access and freedom of enjoyment of some resources such as the grazing lands/fodder ;
- Conception and coordination of project works with all the users of lands (farmers, nomads, transhumant…)
- Encourage the involvement of vulnerable groups in the program.
- Inform the local population of the potential benefits of the Program for the community to identify the individual behaviors that could contribute to achieve these benefits.
- Involve women in all the phases of implementation of the Program activities and make them responsible them sufficiently.
- Control plots will be identified in the lower part of the watershed and the potential affected communities will be consulted at the moment of verification in order to know if water resources have been impacted.

SECTION E.   Socio-economic impacts

E.1.   Analysis of socio-economic impacts

>> The analysis of the social impacts is detailed in the environmental and social impacts study. By the synthesis of different specific reports to concerned sites by this study, it is observed that the main social risks that can bring the activities of the *Acacia senegal* plantation project on the human milieu are imputable to risks of loss of infrastructures, limitation of access to infrastructures located around the site, with the risk of losing farming lands and/or grazing lands, with the risk of conflicts linked to the usage of resources between the promoter (cluster) and other users, risk of alteration of rights of ownership and usage of natural resources such as the areas of route, etc.

However, the study notes that the risks are minute and very weak, because the choice of the entire activities is done through a participative process and consigned in the Local and Communal Development Plans. The priority of investments is guided by the local or communal council which makes sure of the regularity of the request of financing and the mobilization of the community participation. So, the project before bringing its financial support makes sure of the conditions of eligibility of the micro project approved by the Approval Committee (note that the micro project is part of the PDL/PDC and has been identified as priority investment, is in conformity to local technical capacities, respects the national main principles regarding rural development and environment management, is not subject of intervention from other projects of the government or other donors, has planned for a mechanism of management that includes the beneficiaries and covers the maintenance expenses and the training of beneficiaries, takes into account the measures to safeguard environmental and social aspects, etc.).

From the economic and financial analysis of Acacia senegal plantations in Niger carried out by the "Bureau Nigérien d'Etudes et de Conseils", it is observed that the Project will have the following socio-economic impacts:

- Contracted farmers: about 10,000 farming families are expected to benefit from the project by being offered the possibility of managing their own acacia plantations. On average, each community will manage about 10-20 ha.
- ASI-related job creation: ASI will own and manage acacia nurseries, which are expected to create around 100 full-time jobs. In addition, Arabic gum harvesting, sorting and bagging will create several hundred temporary jobs every year.
- Direct benefits include income from Arabic gum sales to ASI as well as revenue from carbon credits.
- Indirect benefits are derived from the restoration of the soil, as well as harvesting of intercrops and animal fodder. These benefits are likely to exceed direct income from the plantation. This estimate does not take into account fuel wood generated by pruning over the years, as well as harvesting after 30 years.
- Local development: As planting acacias is going to restore soil productivity and make intercropping possible, and therefore reduce poverty in the long run. The return of an economically attractive activity in the project area will avoid the massive out-migration process going on today. According to local farmers, it could even partly reverse this process. Moreover, the training provided by the ICRISAT to local farmers will help transfer know-how and create a more favorable basis for long-term income growth.
- Foreign Exchange: At full project capacity (from 2015 onwards), at least 3,000 tons of high quality Arabic gum will be produced annually. This in turn will generate a foreign exchange inflow of about US$ 4 million per year.

The sites selected by the communities for the activities of Acacia plantation are not being used at the moment, as soil fertility is too low to allow either agriculture or fodder. This project activity will create a new, and one of the only, profitable sources of revenue through the rehabilitation of degraded soils. The plantation and other activities of monitoring of farming works of plantations will be carried out by communities distributed in 19 communes in the 6 regions of the country. All

communities involved have equal rights under Niger legislation, and there is no evidence that any group will be disadvantaged in the course of implementation of the proposed project. One of the criteria of eligibility of sites in the framework of the implementation of the activities of Acacia plantation resides in the clarification of land ownership status and this, in order to avoid conflicts linked to the utilization of land and the resources. To our knowledge, there is no land ownership conflicts in the areas where the plantations will be located, as the communities to be involved have to clarify land ownership status before the investments. No adverse social impacts on the local community are anticipated. As noted above, communities themselves will need to give their approval before the project can be implemented, significantly mitigating the risk of negative social impacts.

The interest in the project comes again to reinforce the economic position of women. In fact, in the zones of production, they are used to collect Arabic gum when they can find some and they know it is sold at a good price on local markets. But *Acacia senegal* is becoming more and more rare and that is why they are aware of their interest to get involved in the activities of plantation (presently, many land owners are planting Acacia in order to have revenues from the gum and rehabilitate their degraded lands); it will give them the financial support they need to establish acacia plantations on their land and the necessary know-how to maintain high and long term productivity.

So, through the economic and financial analysis, measures are proposed to ameliorate to the positive impacts, they are:

- The choice of varieties of *Acacia senegal* having a good yield regarding Arabic gum production ;
- The training of human resources on techniques and periods of tapping of the Acacia tree, the adequate material, the techniques of harvesting and drying and the conservation of the gum for a better value ;
- The capacity building of communities involved on the technologies of intensification of agriculture (garden of biodiversity and eco sahelian farm) ;
- The capacity building of the entire actors on the mechanisms of evaluation and sale of sequestered carbon credits;
- Putting in place of a mechanism of information on prices of the Arabic gum on national and international market ;
- The installation of Arabic gum purchasing counters in order to valorize the gum presently collected at communities level ;
- The creation of a community development fund through the sale of products and sub products of plantations and the other revenues for an amelioration of living conditions of local populations and the maintenance of infrastructures acquired due to the Project ;
- The sharing of revenues from the sale of products and sub products of the Project, in equal parts between the local community members; at this level the elaboration of a way of sharing the revenues is a conditionality of financing the plantation activities.

E.2.   Socio-economic impact assessment

>> Please refer to section F.1 and F.3.

SECTION F.   Local stakeholder consultation

F.1.   Modalities for local stakeholder consultation

>>

Process of public consultation:

The strategy of the applied public biding is consisted of two steps:

First step: Information and sensitization about the Project

During the first step, the different stakeholders have been informed and sensitized about the Project. In these sessions that the representatives of local districts, local communities, professional organizations and NGOs have developed the questions related to objectives (i) of PPAS.

In addition to the dissemination of the information over the objectives, the activities and the expectations of the Project, the exchanges made throughout these meetings have been used as an advantage to appreciate better the aspects to be taken into consideration the environmental and social evaluation.

Second step

During the second step, consultation sessions with stakeholders have been organized at the local level. It is in this regard that public meetings with local communities have been organized, whereas local districts have been consulted throughout meetings reserved to the managers. The haranguing technique use has permitted to drive the debates towards the expression of expectations and the troubles (environmental, economic, and/or social) that the presented activities could generate in the place. The reactions that have been registered with this consultation exercise can be classified into two categories constituted of expectations and worries.

In addition to these formal meetings, the different stakeholders have snatched upon opportunities, whenever necessary, to express their expectations. In this regard, worries of communities and other beneficiaries have been taken into account during consultations related to the elaboration of different studies such as (i) studies of environmental and social impact, (ii) economic and financial analysis, (iii) the clarification of legal land status of sites as well as (iv) during contract clauses elaboration between communities and ASI.

F.2.   Summary of comments received

>> Rural communities proved interest in participating in the proposed A/R CMD project activity for the following reasons:

- Employment creation in village communities through production of seedlings, Arabic gum (crop, sorting, storage conditions, etc.).
- Environment protection and fight against the desert by improving the local environment;
- Rehabilitation of degraded lands and improvement of life framework;
- Fodder production;
- Maintaining biodiversity;
- Capacity building and teaching through good practices of agriculture intensification promoted by **ICRISAT**;

- The image of the village community (that is going to implement a sub-regional piloting activity) that will be the focus of visits and regular contacts with the external world.

However it is worthwhile noting some exchange difficulties related to:
- Comprehension of the theme: the stakeholders have difficulties to
  o make the link between plantations and carbon sequestration " bad air ";
  o the quantification of sequestrated quantities of gas that will result to payment of credits;
  o the functioning of carbon market;
  o the reasons for which carbon credits, through plantations , are presently encouraged.

F.3.   Consideration of comments received

>> Stakeholders' comments have been taken into account and have served as models from one region to another. The observations have been integrated mainly in the different documents of reference (legal land status of sites, environmental and social impact, information and sensitization workshops for communities, study trip intercommunity, etc.).

Concretely, the comments have been elaborated in the framework of the improvement of Project activities (case of collected opinions that have permitted to modify site implantation) and to improve the social cohesion.

SECTION G.   Approval and authorization

>> The project has the approval from both parties involved, Niger and Spain, Letters of Approval are available and are provided at the time of validation.

Appendix 1.   Contact information of project participants

Organization name	International Bank of Reconstruction and Development (IBRD) as Trustee of the BioCarbon Fund
Country	USA
Address	1818 H St, NW – Washington, DC 20001
Telephone	202-458-1873
Fax	202-522-7432
E-mail	IBRD-carbonfinance@worldbank.org
Website	www.carbonfinance.org
Contact person	Simon Whitehouse

Organization name	Achats Services International (ASI)
Country	Niger
Address	B.P 12014, Niamey
Telephone	+227 74 12 22
Fax	+227 74 17 60
E-mail	Iasi@intnet.ne
Website	
Contact person	Boureima Wankoye

Organization name	Kingdom of Spain-Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness
Country	Spain
Address	C/Alcalá 92, 28009, Madrid
Telephone	+34 91-4361549
Fax	+34 91-4361501
E-mail	and@mma.es
Website	
Contact person	Alicia Montalvo

Appendix 2.   Affirmation regarding public funding

No public funding or funding from Official Development Assistance (ODA) or other official sources are involved in this project.

Appendix 3.   Applicability of methodologies and standardized baselines

Appendix 3 is left intentionally blank, all information regarding to applicability of selected methodology is provided in section B.2.

Appendix 4. Further background information on ex ante calculation of net anthropogenic removals

Appendix 4 is left intentionally blank, all information regarding to ex ante calculation of removals by sinks is provided in section B.6.

Appendix 5. Further background information on monitoring plan

Introduction

Niger Acacia Senegal Plantation Project covers an area of 8,472 hectares. The project is proposed to be implemented by 26 rural communities spread over seven distinct administrative regions of Niger. Achats Services International SA is responsible for supervising the implementation and monitoring of the p**roject**.

The main objective of this project is to develop an "Arabic gum" sector in Niger for the benefit of rural communities. The first significant harvest of gum is expected to occur in 2011. Communities have to gain access to international markets to be able to increase the value of their gum production. In this context, ASI has offered to serve as an "aggregator" by playing an intermediary role between international markets and rural communities.

1.1 Elements of monitoring plan

The monitoring plan presents the steps to be followed in implementing the project in compliance with methodology AR-ACM0003 (version 1.0.0). It clarifies procedures for monitornig and measuring of *ex post* net anthropogenic GHG removals by carbon sinks:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

Where:

$\Delta C_{AR-CDM,t}$ = **Net anthropogenic GHG removals by sinks, in year *t*; t CO₂-e**

$\Delta C_{ACTUAL,t}$ = **Actual net GHG removals by sinks, in year *t*; t CO₂-e**

$\Delta C_{BSL,t}$ = **Baseline net GHG removals by sinks, in year *t*; t CO₂-e**

LK_t = **GHG emissions due to leakage, in year *t*; t CO₂-e**

The actual net GHG removals by sinks ($\Delta C_{ACTUAL,t}$)is the sum of the changes in living biomass carbon stocks (above-ground and below-ground) within the project boundary ($\Delta C_{P,t}$), minus the increase in GHG emissions (sources) as a result of the implementation of the project ($GHG_{E,t}$).

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

Where:

ΔC_{ACTUAL} Actual net greenhouse gas removals by sinks in year t; t CO_2-e

$\Delta C_{P,LB}$ Change in the carbon stocks (above- above below-ground biomass), 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 an A/R CDM project activity, in year t; t CO_2-e

This monitoring plan focuses on three monitoring sub-efforts for the lifetime of the project to reach the anticipated results. These monitoring efforts are outlined below:

1. **Monitoring of changes in above-ground and below-ground biomass carbon stocks**

Monitoring of increases in GHG emissions as a result of the implementation of a project

1. Monitoring of the baseline net GHG removals

As per the methodology, the baseline carbon stock changes need **not** be monitored after the project is established as the baseline approach 22(a) assumes continuation of historic and existing scenario of changes in carbon pools within the project boundary.

2. **Monitoring project boundary and project implementation**

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

The monitoring of project boundary is intended to demonstrate that the actual area afforested or reforested conforms to the area outlined in the PDD. The following activities are foreseen:

- Field surveys concerning the project boundary within which the A/R activity has occurred, site by site;

- Measurement of geographical positions (latitude and longitude of each corner polygon sites) using GPS;

- Checking whether the afforested/reforested areas are consistent with the eligible areas as defined in the CDM-AR-PDD;

- The measured geographical positions are used to verify the boundary of each stratum and stand;

- The project boundaries shall be monitored periodically all through the crediting period. If project boundary is affected by natural hazards (forest fires, plagues, etc.) or human interventions (harvesting, deforestation), the location and area affected shall be identified. Similarly, if the planting on certain lands within the project boundary fails these lands will be documented.

2.2. **Monitoring of forest establishment**

To ensure that the forest establishment conforms to the practices described in AR-CDM-PDD, the following monitoring activities will be conducted in the first three years after planting:

- The site preparation activities implemented as per the practices documented in PDD. Considering the highly degraded status of the lands, no significant pre-existing vegetetation is observed on most project sites. In cases, where pre-vegetation exists, this will not be removed in the project preparation operations.

- The planting practices in each stratum are in line with the PDD.

- Cleaning and site preparation measures: date, location, area and other measures undertaken;

- Planting: date, location, area, tree species (establishment of the stand models);

- Survival checking:

    o 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 % of the initial planting density.

    o Necessary replacement planting will be carried up to three years

    o Final check of seedling survival will be conducted three years after planting.

    o The survival checks may be conducted using permanent sample plots.

- Weeding: The weeding practices are implemented as described in the PDD.

- Deviation from planned forest establishment activities are recorded.

2.3. Monitoring of the forest management

Forest management practices are important drivers of the GHG balance of the project, and thus must be monitored. Practices to be monitored include:

- Pruning: date, location, area, tree species, intensity, volumes or biomass removed;

- Gum harvesting: date, location, area, tree species, volumes or biomass removed;

- Monitoring of disturbances: date, location, area, type of disturbance, biomass lost, implemented corrective measures, changes in the boundary of strata and stands.

3. Monitoring the actual net GHG removals by sinks data

This monitoring includes field inventories to assess the changes in carbon stocks. In this context, design a sampling frame and estimation of sample size is of major significance, which impact the accuracy of carbon stock assessment.

The inventory will be developed with a target precision **of 10% on carbon stocks** at 5% significance level (95% confidence level).

3.1. Stratification

a) Inventory unit

The Inventory **unit** encompasses all forested blocks described in the PDD. It includes 26 sites covering a total area of 8,472 hectares.

b) Blocks

The inventory unit is divided into **fourteen** different **blocks** taking into account the plantation schedule and establishment density. i.e. these blocks include all forested blocks of the same age-class. Since the planting effort will be spread over a 7-year period from 2006 to 2012, progress and two plantation density (400 and 313 trees/ha) on all fourteen blocks will be assessed based on reforestation efforts recorded annually in the field.

Area of blocks

Planting year	2006	2007	2008	2009	2010	2011	2012	Total
Area (ha) with 400 trees/ha	1 088	875	62.7	61	687.8	850	1 080	4 704.6
Area (ha) with 313 trees/ha	212.4	1 116.6	242.5	395	516.1	460	825	3 767.7
Total	1 300	1 992	305	456	1 204	1 310	1 905	8 472

The figures below indicate plantation design.

Figure 1. Plantation and "half moon" design.

313 trees/ha = 8 * 5   400 trees/ha = 6,25 * 4
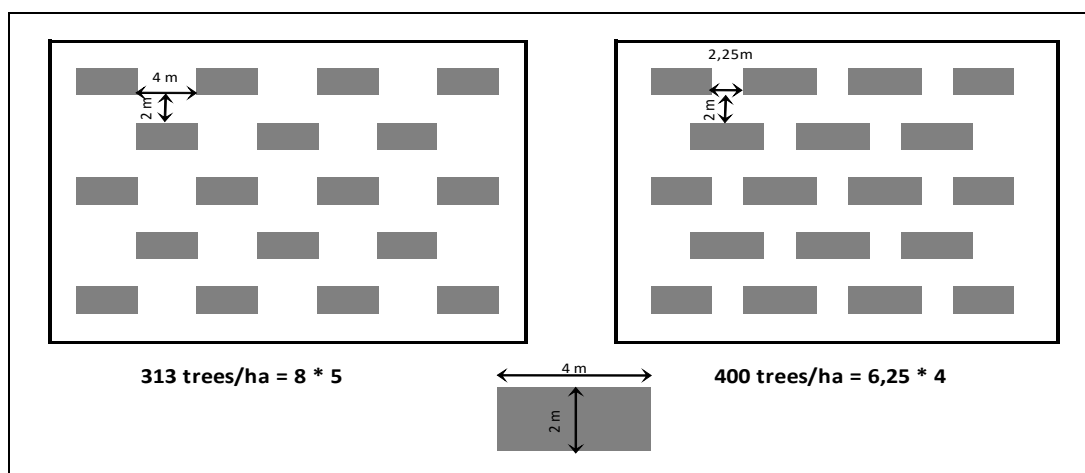
Figure 2. Project blocks example
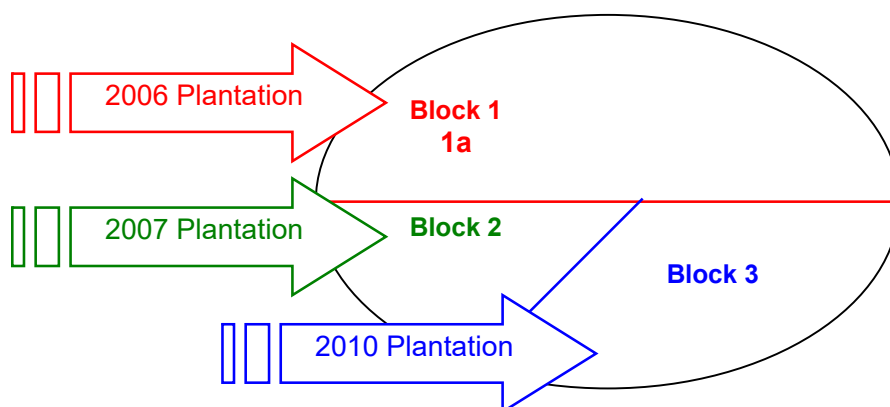
The quantitative results for each block will be presented in a **reference table**, and would include the following data:

1. _Number of stems per hectare_, by diameter, as well as for all diameter classes,

2. _Biomass (dry weight in tons) per hectare_, by diameter class, as well as for all diameter classes,

3. _Carbon stocks (in tons of carbon and carbon dioxide equivalent) per hectare_, by diameter classes, as well as for all diameter classes.

3.2. Sampling Frame

a) Definition of sample size

The permanent sample plots will be used to estimate the carbon stock change. The plots are laid out randomly in the strata selected and the parameters (e.g., tree basal diameter, height) are measured for the calculation of carbon stocks per hectare as well as for the total project area. Permanent sample plots method enables monitoring of carbon stock changes in terms of gains and losses on a periodic basis.

The number of permanent sample plots is calculated based on the expected coefficient of variation of the carbon stock. A coefficient of variation about 50% is assumed in the carbon stock growth of the project considering the prevailing conditions (e.g., soil, management, droughts etc.) in the Sahel, which is conservative as large numbers of sample plots will minimize the variance in the assessment of carbon stock changes.

The size and number of plots depend on the variability of vegetation and areas of the sampling strata. The number of plots (n) needed to cover 8, 472 ha in fourteen (14) blocks is calculated using the sample size formula described in section B.7.2 of the PDD.

Sample size assessment

Strata	Area (ha)	Ni	Average*(t CO2e/ha)	t value	st (50% of the average)	E (10%)	Sample size
1 (400 trees/ha)	4704.61	47046	23.35	1.96	11.68	2.11	59

2 (313 trees/ha)	3767.65	37677	18.27	9.14	37

According these results, at least 96 permanent sample plots, shall be established in order to monitoring the growth of plantations

b) Allocation among blocks

The allocation of plots among the blocks is **done** taking into account area **of the** block**s**. **The plot allocation is presented below.**

Number of sample plots per block

No. of plots	2006	2007	2008	2009	2010	2011	2012	Total
313 trees/ha	3	17	4	6	8	7	13	59
400 trees/ha	9	7	0	0	5	7	8	37

c) Sample plot size

The circular plots with an area of 1000 m² approx. radius of 17. 84 m and diameter of 35.84 m will be laid out. Plot size was selected so that a plot contains **at least 20 trees**.

Plots will be laid out with a **Pardé's rod** and a **dioptric viewer**. The field has to be in a horizontal or inclined plan in order to use a Pardé's rod.

d) Plot location

To avoid subjective choice of plot locations (plot centers, plot reference points, movement of plot centers to more 'convenient' positions), the permanent sample plots shall be located randomly with a random start, which is considered good practice in IPCC GPG-LULUCF. This can be accomplished with the help of a GPS in the field. The geographical position (GPS coordinate), administrative location, stratum, stand and series number of plots shall be recorded and archived.

Also, it is to be ensured that the sampling plots are as evenly distributed as possible. For example, if one stratum consists of three geographically separated sites, then it is proposed to:

- Divide the total stratum area by the number of plots, resulting in the average area represented by each plot;

- Divide the area of each site by this average area per plot, and assign the integer part of the result to this site. e.g., if the division results in 6.3 plots, then 6 plots are assigned to this site and 0.3 plots are carried over to the next site, and so on.

3.3. Monitoring frequency

For the purpose of verification, monitoring and measurement of carbon stock changes are planned at **five-year** intervals during the crediting period.

4. Measurement of carbon stock change over time

a) Reference maps and documentation

Prior to the survey, a set of maps and documentation should be prepared with the following information:
- Scale,
- Geographic orientation (Geographic North),
- Boundaries of 14 reforestation blocks,
- Sections of an UTM kilometric grid (zone 31, 32, or 33 depending on the map),
- Square grid with a side of940 m indicating plot centers on nodes,
- Inventory blocks, to be updated based on plantation rate,
- Other information deemed useful (infrastructure, etc.).

The network (indicating plot centers) will be oriented along the UTM grid axes. One of the grid nodes used to locate inventory plots will have the following coordinates:

- Longitude East: 01° 00' 00''
- Latitude North: 13° 00' 00''

This will determine the location of all inventory plots (based on the selected grid orientation). This mapping document will be developed by the *Monitoring Unit* established by ASI with support from CAP for the first years of operation. All data collected by the NGO APOR will be included in the Monitoring Unit database to develop a baseline scenario.

b) Field equipment

- <u>Equipment for identifying land parcels</u>
    - o A GPS for orientation on grid nodes,
    - o A compass in case of GPS failure,
    - o A measuring instrument: thread measuring device (such as a Topofil Chaix) or a surveyor's chain,
    - o A protractor and a ruler

- <u>Equipment for plot sampling</u>
    - o A stamp or a piece of chalk to mark trees of a plot,
    - o A coin to flip,
    - o A Pardé's rod (8 cm- diameter) with slope correction for each plot
    - o A clinometer (graduated in degrees) to adjust (distance between rod markers) the outline of near-circular plots based on slope,
    - o A dendrometer (Blume-Leiss or Suunto) with a large angle dioptric viewer (tg γ = 3 / 100) to keep at a distance from the rod.
<u>quipment for stems inventory</u>
    - o A pair of pruning shears in case of difficult access to stems,
    - o A forest compass graduated in centimeter or compensated (i.e. graduated in 5-cm diameter sections).

- Tally equipment
  - A rigid yet light wood board and accessories (cord, pliers, rubber band, etc.),
  - A plastic case to protect all important documents: inventory map, summary of codes, slope correction tables, etc.,
  - A medium-hard pencil (HB), an eraser and a pocket knife (or sharpener),
  - Tally forms (see models in Annexes) in sufficient quantity (plan for as many as the number of plots plus a small additional supply).

1) Procedures for the maintenance of equipment

The common procedures to be followed in the maintenance of equipment used in vegetation measurement are outlined below. In case no ready guidance on the procedures is available, the recommendations of local forest management agency will be followed.

- When compass is used in the field, it is calibrated to compensate for the local difference between magnetic and true north (magnetic declination) and adjustment is completed in order to facilitate the recording of accurate bearing.

- The aspect measurements are recorded to the nearest eight directions: N, S, E, W, NE, SE, NW and SW. The same procedure is used to determine the azimuth to any desired target object such as a tree and the azimuth value should be recorded to the nearest percent, The azimuth direction is expressed in degrees: North at 360 (zero) degrees, East at 90, South at 180, and West at 270.

- It is recommended to use DBH tapes made of steel or aluminum, and cloth tapes should be avoided considering their propensity for wear and tear that could result in measurement inaccuracies.

- Pacing can be useful to establish the relationship between map and photo information with the measurements on the ground. One step represents half of a pace and two steps equal one pace. Therefore, crew should be trained in pacing on flat ground.

c) Plan of inventory

The objective of field inventory is to measure changes in above-ground and bellow-ground biomass carbon stocks by setting up _permanent sample plots_.

Permanent plots will be surveyed on a regular basis. Trees with the following characteristics will be sampled:
- A basal diameter of at least of 2.5 cm (basal diameter: stem diameter measured at 20 cm above ground)
- Planted or naturally regenerating trees as a result of the project (due to control of grazing, etc.).

Diameter measurement is done using a measuring tape or a caliper and a marker.

Basal diameter is measured using the following procedure:

- o   Mark 20 cm above ground on tree trunk
- o   Place the calipers/tape at 20 cm
- o   Measure and record the basal diameter (BD) or basal girth (BG)in cm
  - o   If a tree has multiple shoots count and measure BD/BG for all shoots
  - o   If the tree is large normally basal girth (8 cm) is measured using a measuring tape
  - o   If the tree is young and has girth lesser than the prescribed, measure BD using a slide caliper

Tree height refers to total tree height as the vertical distance from the ground level to

the upper most point. Tree height is also referred to as the merchantable height, since

many allometric equations are derived for this height. Height is measured for all the tree

stems for which basal diameter is measured. As maximum height will reach the trees is

5 m, a graduated rod could be used.

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

Location: GPS reading: Parcel ID:	Land use system: Stratum:						Plot no: Size of the plot		Inventory personnel Date:		
S. N o	Specie s name	Tree numb er	GBH (cm)					Planted or regenerat ed	Heig ht (m)	Statu s of crow n[1]	
			Stem 1	Stem 2	Stem 3	Stem 4	Stem 5				
1								**Article II.**		**Article**	
								Article IV.		**Article**	

(i)   [1] indicate the percentage crown cover present or damaged

Although no specific difficulty applies to sampling existing trees at the first survey session, this will not be the case for subsequent surveys. Therefore, all existing trees at the first inventory session will be marked so that they can easily be found later. Marking will be discreet to avoid drawing any attention (to discourage any special treatment in the

area that can alter assessment of changes in carbon stocks) and will be maintained for the entire duration of the project.

d) Inventory teams

Size and composition
In general, an average inventory team consists of three members:
- A team leader is in charge of quality and tally. He/she fills in the tally forms,
- An operator / guide: this person is in charge of defining plot locations and performing all necessary measures (and activities) on each plot. Obviously, team composition and task attribution can be adapted specifically to each case,
- A driver to transport the measurement team to different plots.

Training
Training of inventory teams is important. Experience shows that a team with a clear understanding of tasks to be performed works in a quick and efficient way. It must be remembered that the quality of survey is crucial for the number of generated CERs and subsequently for revenue from sequestered carbon

e) Inventory procedure

The route followed by the team from one plot to another, must be as precise and quick and preparation is needed at several levels:
- Task sharing among team members,
- Definition of the order of progression of each team in the designated area,
- Specification of the order of visit of plots in the daily program.

In large forested areas, the distance between two consecutive plots is 1,100 meters. Using the GPS and its "Go To" function will ease progression if the coordinates of plots to be visited are entered beforehand.

If part of the itinerary has to be covered with a compass, for instance in case of a GPS defect, it should be remembered to:
- Correct the distance to be covered in the field by checking the "Slope Correction Table for Progression" if the angle of the horizontal progression is more than 4°,
- Take the slope into account (angle δ formed by the magnetic north and the north of the grid). This value will be indicated on the progression diagram.

Sampling circular 1000 m² plots with a dendrometer with dioptric viewer

Once at the center of the plot, the guide sets the Pardé's rod vertically at the plot center. The greatest grade of the plot is measured and the distance between the two white marks on the rod is adjusted carefully by moving the top of the mobile cylinder on the corresponding graduation. This distance is provided in the "slope correction table for distance between markers on Pardé's rod".

The rod must be adjusted for each plot, even if the slope has not changed, because the mobile cylinder could slip, during progression.

Once the rod is set up and adjusted, the operator holds the dendrometer and looks at the rod through the dioptric viewer. In order to locate the plot perimeter, he will go forward or backwards until the four "white marks" (both white marks on the rod and the double images obtained with the dioptric viewer) are reduced to three.

Figure 3. Diopteric use

Observation inside the plot

Observation on the plot perimeter

Observation outside the plot
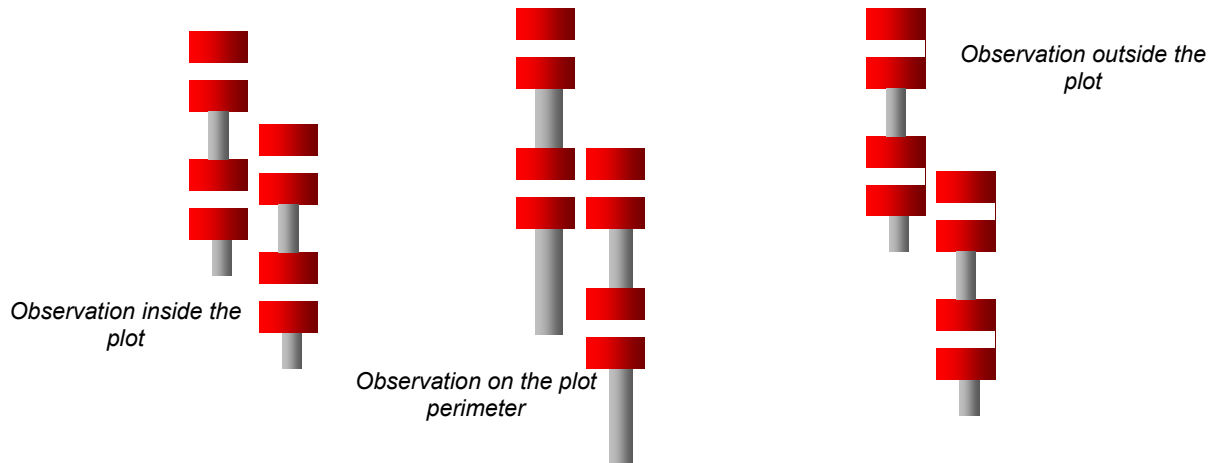
Border tree
During this delimitation, one tree could be at the perimeter of the plot. In order to determine clearly if this tree is inside or outside the plot, the guide must know that the center of the tree has to be at the correct distance. If the former rule cannot help clear the uncertainty, decision will be made by tossing up a coin.

Border plot
In case of a plot center P is near the boundary, depending on the location of point P, several scenarios are possible:
- If point P is outside the CDM project, the corresponding plot should not be sampled,
- If point P is exactly on the border, which is extremely rare, decision will be made by tossing a coin and the resulting operating mode will be applied,
- If point P is inside the project, there are two options:
    - Point P is at a sufficient distance from the perimeter so that the plot is totally included in the project. In this case, the plot is considered normal,
    - Or point P is close enough to the border and the plot is only partly inside the inventory unit. In this case, the plot center has to be moved to a point P', which is the center of a plot located just at the project border. To define point P', one of the following four suggestions should be applied. They should be tested one after the other in the order indicated. The first successful option will be applied:
        1 – Move point P southward
        2 – Move point P northward
        3 – Move point P westward
        4 – Move point P eastward

The plot defined as a result of a move is called a _border plot_.

Figure 4. Border plot
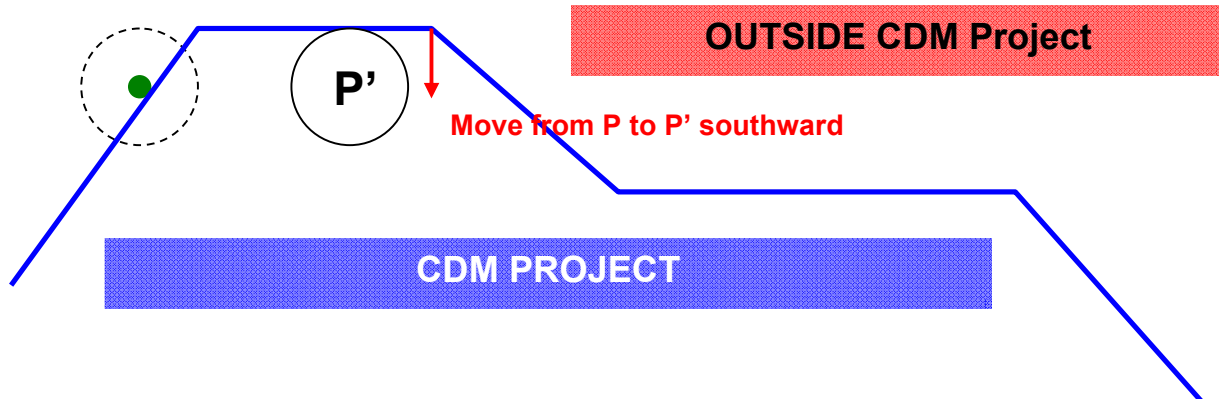
Note: If a plot point P is located near a border (of the inventory unit) between two blocks in the inventory unit (CDM project perimeter), the plot is normal and belongs to the block containing its center P, even if the plot has no trees.

f) Measurement and observations on the plot

The tally form is divided into three parts:

- A row for Plot,
- Rows for tree species,
- Rows for samples.

The objective of the "Plot Row" is to clearly identify the permanent plot on which the survey team works. This is mandatory in order to record the source of the collected data. If any question arises during the result interpretation phase, it is possible to return to the field to check the data.

The "Tree Species Rows" are for the survey itself by collecting additional quantitative data on stands. The planted species (*Acacia senegal*) is singled out among other species that could naturally regenerate as a result of implementation of the project (total or partial prohibition of grazing for instance).

The "Sample Rows" simplify the survey itself while guaranteeing results quality. Basal diameter and height are needed information for fitting and using of allometric equations applied to estimate biomass of sample trees.

When an easy access to trunks is not possible to measure the diameter (Dbh) then diameter at the base has to be measured. *Acacia senegal* is a prickly species, especially at a young age. However, the base of the tree is always accessible. Therefore, correlation between the dbh and the diameter measured at 30 cm on several sample trees will allow a good estimation of biomass of prickly trees.

Moreover, although we need to estimate the height (for the allometric equation), it is better to accurately measure individual trees with a dendrometer rather than

systematically applying this measurement to the entire set of trees with less precision. The average height measured on the sample trees will be applied to the entire set of trees.

Additional administrative work after the survey

Following the field survey, all tally forms will be collected by an individual, the controller, who will be in charge of filing and control. The controller should ask the inventory team for any additional information before entering the information on the tally forms in the project computerized database.

g) Calculation of carbon stock change

The most relevant allometric equation available for the region and species should be selected. If a suitable allometric equation is not available, biomass assessment should be made as per the procedures of *ex post* carbon stock assessment outlined in the section III.5 of AR AM0004.
Data for calculation of change in the above ground carbon stock would be based on the biomass measurements of permanent sample plots. Carbon stock changes over time shall be calculated using data on biomass growth.

Accuracy assessment of the carbon stock calculations would be done as per the guidance of the methodology and the procedures of the national forest inventory.

5. GHG emissions by sources

The project establishment does not involve loss of biomass (total or partial) through slash-and-burn activities in site preparation. The silvicultural practices do not include the use of nitrogen fertilizer or vehicles and mechanized equipment. Therefore, there is no need to account for or measure increases in GHG emissions of project sources.

$$GHG_E = 0$$

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

The Project Management and Monitoring Unit (Unité de Gestion et de Suivi du Projet – UGSP) is committed with project monitoring throughout the entire accrediting period of the project, and it will implement a QA/QC program to ensure net anthropogenic GHG removals by sinks are to be measured and monitored precisely, credibly, verifiably and transparently. This program will be conformed by the following activities:

1. Standard Operating Procedures:
    i. Geographic Information System
    ii. Sample plot establishment and measure
    iii. Data entry and storage
    iv. Data documentation
    v. Data storage
    vi. Development of local Allometric models

1. Recruitment and training
     i. Conformation of a group of Qualified personnel
     ii. Training and skills development

2. Verification of data quality
     i. 10% of sampling units will be randomly selected for re-measurement by an independent measurement team. Any errors found will be corrected and recorded.

3. Data maintenance and archiving
     i. Data archiving will be completed in multiple formats. Copies of all data will be held by multiple project participants and at multiple locations. Data will be stored on durable media such as external drives and updated to new archiving media as technology develops. Original copies of all field measurements, interviews, and data analysis spreadsheets will be archived.

All of these procedures are being implemented and documented and they will be available for first verification.

7. Organization of project monitoring

ASI will support the monitoring, measurement and verification of the project. ASI will also support the compliance requirements of Climate-Community-Biodiversity (CCB) standard's monitoring criteria/indicators, for this, a Management and Monitoring Unit (UGSP) is created and supported by the entire accrediting period of the project.

7.1. Monitoring Unit
The Monitoring Unit will be linked to ASI and will count on the support of various partners including CAP, ICRISAT, the technical service of the Ministry of Environment, and CNEDD.

A **Technical Committee** will be established with participation of a representative from each of the following institutions: ASI, CAP, ICRISAT, CNEDD, and the Ministry of Environment. The Technical Committee will meet at least three times a year to discuss the project implementation and recommend corrective actions. The project Coordinator will send the Aide-Mémoire of each meeting to the Steering Committee at the World Bank. The Technical Committee will approve by simple majority of votes the Annual Operational Plan of the project.

The flowchart below presents in detail the organization of this mechanism.

Figure 5. Flowchart for monitoring of *Acacia senegal* plantation project
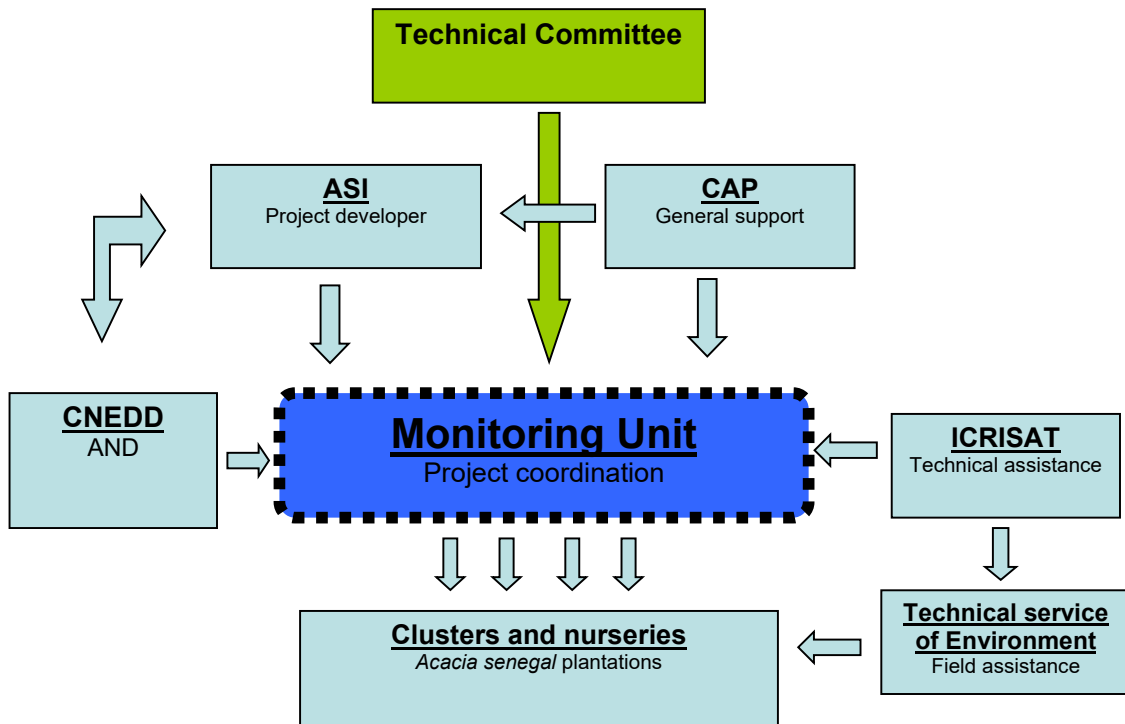
7.2. Roles of each partner institution

ASI
- General implementation of project, ensuring that annual plantation campaigns start at the right moment and tree growth is monitored;
- Make all needed means available to Monitoring Unit for proper operation;
- Signs technical cooperation agreements with partners (CAP, ICRISAT, Ministry of Environment, etc.) to guarantee that field technical support to communities is in place;
- Communication with the World Bank and BioCF including development of a quarterly status report ;
- Guarantee payment (carbon income) transfer to communities; and
- Project institutional communication.

CAP
- Funding of Monitoring Unit activities from 2009 to 2011;
- Technical support to project at the regional coordination level;
- Checking that funds are regularly transferred to communities.

ICRISAT
- Provides technical expertise to Monitoring Unit, to extension agents from the Environment Technical Service, and to communities to plan plantations technical organization and implementation.
- Trains extension agents from the Technical Service of the Ministry of Environment and communities in plantation and *Acacia senegal* product

collection techniques.
- Provides the project with germoplasm for plantations campaigns through regional nurseries;
- Participates in organizing capacity building activities for plantations; and
- Participates on a regular basis in field visits to ensure quality of activities.

Technical Service of the Ministry of Environment
- Provides at least 8 extension agents in the field to the Monitoring Unit (for each region of the country) for technical assistance to communities (at least a monthly visit on each BioCF site). These agents will work exclusively for the BioCF project;
- Support the Monitoring Unit for data collection on plantations.

CNEDD – Conseil National de l'Environnement pour un Développement Durable
- Strategic monitoring of project implementation;
- Issuance of approval letter for the project;
- Participation in capacity building and training efforts.

7.3. Composition of Monitoring and Management Unit

Schedule of activities of monitoring unit

	2007 Starting in September	**2008**	**2009**	**2010**	**2011-2012**	**2013, 2018, 2023, 2028, 2033**
1 Coordinator (General coordination including interface between communities and CAP)	**To be hired by Achats Services International**					**Monitoring events**
1 Carbon Expert (Monitoring plans, GIS, carbon income distribution, etc.)			Implementation of a carbon monitoring plan requires a sufficient prior growth of plantations to reach the pre-inventory diameter (Basal diameter of 2.5 cm), therefore this will only start in 2009 **To be hired by Achats Services International**			
1 Survey team (2 field agents)			Implementation of a carbon monitoring plan requires a sufficient prior growth of plantations to reach the pre-inventory diameter (Basal diameter of 2.5 cm), therefore this will only start in 2009 **To be hired by Achats Services International**			
1 Extension technician (support to communities)	**To be hired by Achats Services International** Must master the use of GPS to ensure *good* determination of location of plantations within the CDM project perimeter. Could benefit from international expertise support as part of capacity building					

The Monitoring Unit headquarters will be located at Niamey from it will provide administrative support to the project. Target date for an operational Monitoring Unit is December 2009.

8. Annexes

Annex 10.1 Tally Form

PLOT ROW			Metric coordinates of plot												Block number			Border plot		Date of inventory						#Block													
			Longitude						Latitude											Day		Month		Year															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A																																								

TREE SPECIES ROWS	Tree species	Hight of measure													Health status			Diameter group																					
																		5		10		15		20		25		30		35		40		45		50		55		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
B																																								
C																																								
D																																								
E																																								
F																																								
G																																								

SAMPLE ROWS	Tree species																	Diameter at 30cm (cm)	Dbh (cm)	Total height(m)																
	1	2	3			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
H																																				

Republic of Niger - Achats Services International - BioCF Project

Annex 10.2 Summary of codes of tally form

Plot row (Row A)

1   Columns 2-8: plot coordinates, abscissa (in metric coordinates) of central point (P) of the permanent plot

    2   Columns 9-15: plot coordinates, ordinate (in metric coordinates) of central point (P) of the permanent plot.

    3   Column 16: identity (code) of inventory block

- o **1** : 2006 acacia plantation
- o **2** : 2007 acacia plantation
- o **3** : 2008 acacia plantation
- o **4** : 2009 acacia plantation
- o **5** : 2010 acacia plantation
-    6 : 2011 acacia plantation

4   Colums19-20: Border plot.

- o Code **00**: the permanent plot is not a border plot
- o Code **01**: the plot is a border plot. Its center has been moved to be tangent to the block boundary and/or to the CDM perimeter.

    5   Columns 21- 26: Date, consecutively enter information on:

- o Date: **01 to 31**
- o Month: **01 to 12**
- o Year: **06 to 35**

      1   Columns 27-28: site number **01 to 26**
        2   Column 29: compartment number **A to Z, if needed**

Tree species rows (Rows B, C, D, E, F, G)

Rows B to G are reserved for the inventory of planted or naturally regenerated species. To be entered in the rows for species, trees have to reach their pre-inventory diameter (basal diameter of 2.5 cm) after the beginning of the project which is 2006.

      1   Column 2: Species code

Code	Species
1	*Acacia senegal*
2	* *Acacia seyal*
3	* *Acacia albida*
4	* *Acacia* sp.
5	* *Ziziphus mauritiana*
6	* *Balanites aegyptiaca*
7	* *Combretum* sp.
8	* *Pterocarpus* sp.
9	* Other species

* If regeneration occurs

2 Column 3: Height of diameter measurement. A breast height is preferred unless it is impossible (excessively prickly tree, etc.):

- o Code **0**: breast height at 1.30 m
- o Code **1**: measurement at 30 cm

Note: if the same species is surveyed on a plot with both measurement types, two different rows for species should be filled in.

3 Columns16-18: Health status of surveyed species, not only at the permanent plot scale but also on surrounding stands:

- o Code **0**: withering and/or dying species
- o Code **1**: poor health status
- o Code **2**: satisfactory to good health status

4 Columns19-40: number of stems per compensated diameter class:

- o **01** for a surveyed tree
- o **02** for two surveyed trees
- o Etc.

Sample rows (Row H)

This row is assigned to *the nearest tree from the center of the permanent plot*, for which the following measures can be easily and simultaneously performed:

1 Column 2: Species code

Code	Species
1	*Acacia senegal*
2	* *Acacia seyal*
3	* *Acacia albida*
4	* *Acacia* sp.
5	* *Ziziphus mauritiana*
6	* *Balanites aegyptiaca*
7	* *Combretum* sp.
8	* *Pterocarpus* sp.
9	* Other species

* If regeneration occurs

2 Column19: diameter in cm at a height of 30cm

3 Column 20: Basal diameter in cm

4 Columns 21-23: tree height in m (columns 21 and 22) with a decimal place (column 23, in yellow)

Annex 10.3 Measurement protocols

**a)   Which diameter(s) should be measured?**

Dbh measurement should be based on recommendations from *Sourcebook for land use, land-use change and forestry projects* published in 2005 by Winrock International and BioCF. Some figures from this publication are presented below. For basal diameter, the same conditions should be followed where applicable.
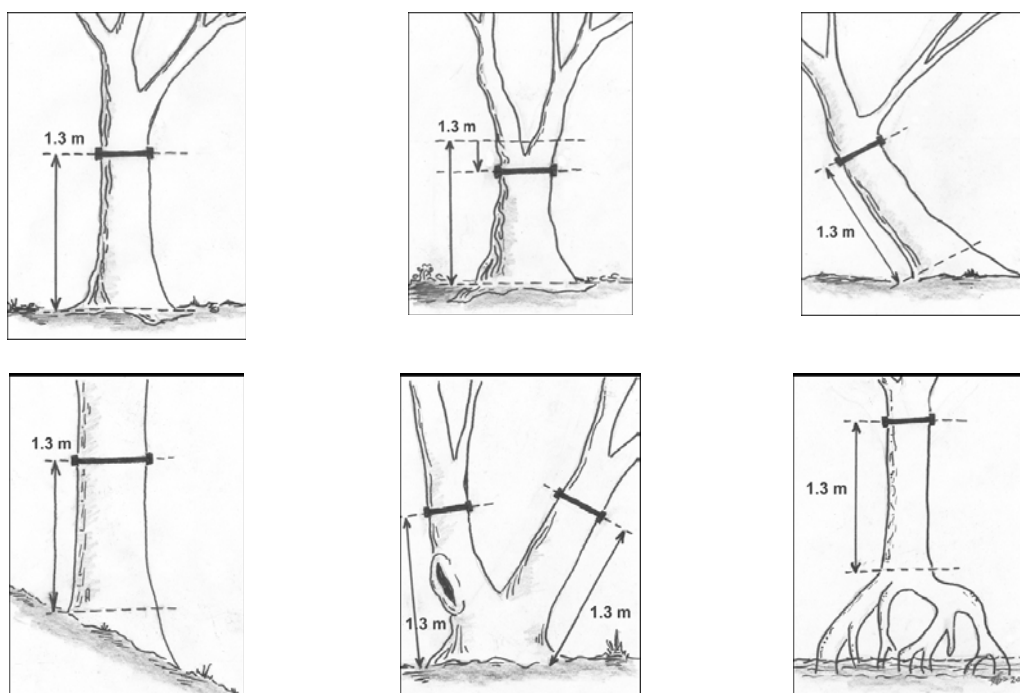
b)   How?

To avoid any bias in measurement (trunk sections are never perfectly circular and have flat sides etc.) the compass will be positioned on the tree in such a way that the "tail" of the compass points to the plot center P.

Section 5.02
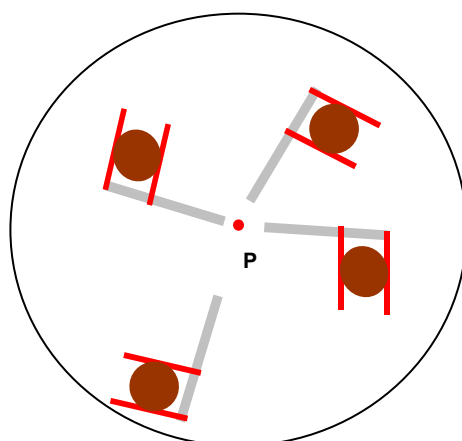
Annex 10.4 Slope correction table for distance between markers on Pardé's rod

Plot surface : 1000 m²	
Gradient in degrees	**Distance between rod markers**
0 °	33.73 cm
1 °	33.74 cm
2 °	33.75 cm
3 °	33.78 cm
4 °	33.81 cm
5 °	**33.86 cm**
6 °	33.92 cm
7 °	33.99 cm
8 °	34.06 cm
9 °	34.15 cm
10 °	**34.25 cm**
11 °	34.36 cm
12 °	34.49 cm
13 °	34.62 cm
14 °	34.76 cm
15 °	**34.92 cm**
16 °	35.09 cm
17 °	35.27 cm
18 °	35.46 cm
19 °	35.66 cm
20 °	**35.88 cm**
21 °	36.11 cm
22 °	36.35 cm
23 °	36.60 cm
24 °	36.87 cm
25 °	**37.15 cm**
26 °	37.45 cm
27 °	37.76 cm
28 °	38.09 cm
29 °	38.43 cm
30 °	**38.78 cm**

Annex 10.5 Slope Correction Table for Progression

Gradient in degrees	Relative adjustment in % on progression length
0 °	+0.00
2 °	+0.06
4 °	+0.24
6 °	+0.55
8 °	+0.98
10 °	**+1.54**
12 °	+2.23
14 °	+3.06
16 °	+4.03
18 °	+5.15
20 °	**+6.42**
22 °	+7.85
24 °	+9.46
26 °	+11.26
28 °	+13.26
30 °	**+15.47**
32 °	+17.92
34 °	+20.62
36 °	+23.61
38 °	+26.90
40 °	**+30.54**
42 °	+34.56
44 °	+39.02
46 °	+43.96
48 °	+49.45
50 °	**+55.57**

	1	2	3
	Region	**Year of plantation**	**Block number**
	AG : Agadez DI : Diffa DO : Dosso MA : Maradi NI: Niamey TA: Tahoua TI: Tillabery ZI: Zinder		1: 2006 plantation 2 : 2007 plantation Etc.
	AG	2006	1

Appendix 6. Summary report of comments received from local stakeholders

This has been summarized in Section F.2.

Appendix 7. Summary of post-registration changes

The changes are the following:
- Sampling framework: a systematic sampling was proposed initially in the PDD. However, given the characteristics of the plantations, in particular the existence of numerous forest stands of variable sizes, a random sampling was followed. This is a permanent change.

Appendix 8. Declaration on small-scale afforestation and reforestation project activity

Not applicable.

Document information

Version	Date	Description
10.0	28 June 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale afforestation and reforestation CDM project activities" (CDM-SSC-AR-PDD-FORM); • Make editorial improvement.
09.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).

Version	Date	Description
08.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
07.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for afforestation and reforestation CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for afforestation and reforestation CDM project activities " (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.8.4 and Appendix 1; • Change the reference number from F-CDM-AR-PDD to CDM-AR-PDD-FORM; • Make editorial improvement.
06.0	13 March 2012	EB 66, Annex 10 Revision required to ensure consistency with the "Guidelines for completing the project design document form for afforestation and reforestation CDM project activities".
05.0	30 July 2010	EB 55, Annex 22 Restructuring to reflect changes applied in the design of approved A/R CDM baseline and monitoring methodologies. Due to the overall modification of the document, no highlights of the changes are provided.
04.0	19 October 2007	EB 35, Annex 20 • Restructuring of section A; • Section "Monitoring of forest establishment and management" replaces sections: "Monitoring of the project boundary", and "Monitoring of forest management"; • Introduced a new section allowing for explicit description of SOPs and quality control/quality assurance (QA/QC) procedures if required by the selected approved methodology; • Change in design of the section "Monitoring of the baseline net GHG removals by sinks" allowing for more efficient presentation of data.
03.0	29 September 2006	EB 26, Annex 19 Revisions in different sections to reflect equivalent forms used by the Meth Panel and facilitating the transparent selection of an approved methodology for the proposed A/R CDM project activity.

Version	Date	Description
02.0	24 February 2006	EB 23, Annex 15a
		Inclusion of a section on the assessment of the eligibility of land and the Sampling design and stratification during monitoring.
01.0	03 September 2004	EB15, Annex 6
		Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: afforestation reforestation, project design document