MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

CONTENTS

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 5: 27/06/2012

Humbo Ethiopia Assisted Natural Regeneration Project
Reference number 2712
Monitoring Period 1 (01/12/2006 - 01/12/2011)

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

1. Purpose of the project activity and the measures taken to reduce greenhouse gas emissions

The afforestation and reforestation activity of the Humbo Ethiopia Assisted Natural Regeneration Project, involves the restoration of indigenous tree species in a mountainous region of South Western Ethiopia. The project zone covers approximately 2728 hectares of land and includes 5 strata. The project contributes to climate change mitigation objectives by creating Greenhouse gas (GHG) sinks through assisted natural regeneration of degraded lands. Furthermore, the project compliments the natural resource management goals of the Ethiopian Agricultural Rural Development and Forestry Coordination Office (ARDFCO), and social development goals of the Ethiopian government, and World Vision Ethiopia, the humanitarian organization implementing the project.

The Humbo Assisted regeneration project has established seven community cooperative societies, which have legal ownership to 2,728 hectares of community land. These groups are managing the areas using the Farmer Managed Natural Regeneration techniques for the purposes of carbon removal, environmental benefits (biodiversity, water quality, and habitat) and income producing activities for the local population. Bylaws agreed upon at project inception form the rules for community cooperative societies to manage the project.

In summary, the implemented project activities are contributing to sustainable development in the following ways:

1. Regeneration of native forest, utilizing the farmer managed natural regeneration (FMNR) and traditional forest establishment techniques.
2. Enhancement of GHG removals by sinks in the project area.
3. Promotion of native vegetation and biodiversity in the project area, which can be utilized as a refuge for local and migratory species and to improve the connectivity of fragmented forest resources.
4. Reduction in soil erosion and flooding and help maintain supply of the subterranean streams to support the region's water supply.
5. Provision of an income stream for communities through sustainable harvesting of forest resources.

The Monitoring Period of this report is from 01/12/2006 to 01/12/2011 (including both days).

2. Brief description of the installed technology and equipment;

The Humbo AR project site was stratified into five strata based on the pre-existing vegetation cover and accordingly the project has been registered with the UNFCCC in December 2009 after it had been validated by the DOE JACO in June 2009.Stratum one up to four refers natural regeneration areas with various status of vegetation coverage, while stratum five was open patchy area expected to be replanted with seedlings. These strata are described below.

a) **Stratum 1**: - is relatively dense area of the site with some big trees found in different parts. It is located at the South end of the site in a Kebele known as Abela Gefeta.

b) **Stratum 2**: - is an area with scattered tree/vegetation cover and open land dominated with grass. It is geographically located in the south-east end of stratum 3 bordered by stratum 1 from south. This stratum has high potential for enrichment planting.

c) **Stratum 3:** -is covered with relatively dense bushes and shrub on hillsides in a Kebele named as Abela Longena, Abala shoya, Bossa, Bolla, Bada and Bongota. Stratum 3 is bound by stratum 2 from east and stratum 4 from North.

d) **Stratum 4**: - is situated extreme north, on opposite hillside of stratum 3. The stratum is characterized by scattered vegetation cover grown on very rocky area that is difficult for planting.

e) **Stratum 5**: this stratum is considered to be open patchy area found scattered in stratum 3 proposed for new plantation.

After four years of intervention, these strata have been revised as significant changes on growth of vegetation have been observed within the same stratum (2, 3, and 4). To address these changes, the project site has been re-stratified using the same strata definitions given above. Some areas within stratum 2 have been moved to stratum 3. Some areas of stratum 3 covered with rocky and scattered vegetation have been removed and included into stratum 4. The fifth stratum (new plantation area) which was estimated to be 500 ha at project inception has been reassessed after plantation activities were completed. As a result, the total size of stratum 5 has been reduced to 50.7 ha from 500 ha estimated for the baseline scenario. The size of each stratum before and after the revision is shown in Table A-1 below.

Table A-1 Reforestation and Forest management practices carried out over the last five years (area closure affects all strata)

S/N	strata	Strata at project inception	Strata after re-stratification
1	stratum 1	234	233.48
2	stratum 2	745	630.71
3	stratum 3	1154	1698.71
4	stratum 4	95	114.41
5	stratum 5	500	50.7
	Total	2728	2728.01

A map of the strata of the project is included below in Figure A-1 Replanted areas are identified as Strata 5.

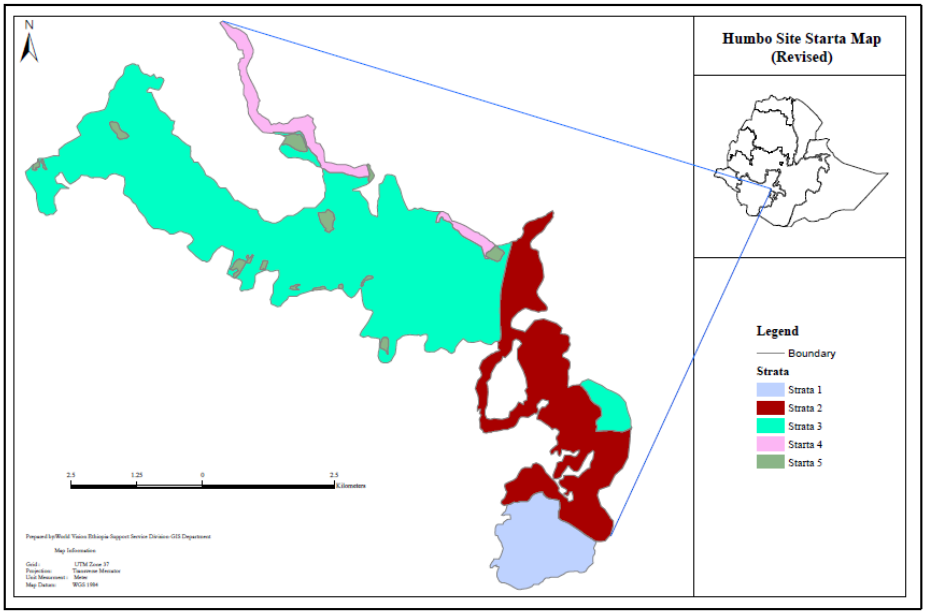


Figure A-1 – Humbo site Strata (revised)

Species endemic to the area are used to restore the forest and sequester carbon from the atmosphere. These include *Acacia* spp., *Aningeria adolfifericii*, *Podocarpus facutus*, *Olea africana*, *Cordia africana*, *Croton macrostachytus*, *Erthrina* spp., *Ficus* spp, among others. The naturalized species such as *Grevillea robusta* and *Eucalyptus globulus* are also utilised for block planting in open spaces where there are no tree stumps and on individual farmers' lands outside of the project boundary to assist in establishment of their own wood lots. Of the 500ha of land expected to be covered by new seedlings from the project site, only 50.7ha has been planted with naturalized species and delineated as stratum 5 and the remaining area (2677.3 ha) is being managed using farmer managed natural regeneration techniques supported by area closure.

Farmer managed natural regeneration (FMNR) was adopted for the endemic species whilst the naturalised species were produced in nurseries over a 5 year period. FMNR involves area closure for a minimum of 2 years, and training on thinning and pruning of rootstock identified as possible to grow into mature trees. A full description of FMNR and nursery operations is provided in Section A.4 of the Monitoring Report.

No genetically modified organisms or invasive alien species have been used in this project.

3. Relevant dates for the project activity

The start date of the project activity was 01/12/2006. However, active management of the forest started on 5/06/2007. The following table depicts the details of annual reforestation activities carried out at stratum 5. The species planted at stratum 5 are *Grevelia robusta* and with a mixture of *Eucalyptus spp* . The remaining part of the project site (2677.3 hectares) has been reforested through farmer managed natural regeneration. The natural regeneration area is stratified into four strata (1, 2, 3 & 4). Table A-2 shows the project activities that have been undertaken since the implementation of the project.

Table A-2 Reforestation and Forest management practices carried out over the last five years (area closure affects all strata)

Pruning/ thinning and planting carried out at d/t strata	2007		2008 ha		2009 Ha		2010 ha		2011 Ha		total	
	Pruning/ Thinning (ha)	Planting (ha)	Pruning/ Thinning (ha)	Planting (ha)	Pruning/ Thinning (ha)	Planting (ha)	Pruning/ Thinning (ha)	Planting (ha)	Pruning/ Thinning(ha)	Planting (ha)	Pruning/ Thinning (ha)	Planting (ha)
Strata-1	0	0	40	0	50	0	25		0		115	0
Strata-2	0	0	0	0	0	0	0		0		0	0
Strata-3	0	0	360	0	453	0	85		116.78		1014.78	0
Strata-4	0	0	0	0	0	0	0		0		0	0
strata-5		11.4	0	22.2	0	7.1	0	4	0	6	0	50.7

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

4. Total emission reductions achieved in this monitoring period

The emission reduction achieved in this monitoring period was 73,339 t CO_2e.

A.2. Project Participants

Name of Party involved (host) indicates host party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Federal Democratic Republic of Ethiopia (host)	World Vision Ethiopia	No
Canada	The International Bank for Reconstruction and Development (IBRD) as Trustee of the BioCarbon Fund (BioCF); Government of Canada – Ministry of Foreign Affairs and International Trade	Yes
Spain	Kingdom of Spain – Ministry of Environment and Rural and Marine Affairs & Ministry of Economy and Finance	Yes
Japan	Japan Petroleum Exploration Co., Ltd.; The Okinawa Electric Power Co., Inc.; Suntory Holdings Limited; Tokyo Electric Power Co., Inc.; Sumitomo Joint Electric Power Co., Ltd.; Japan Iron and Steel Federation (JISF); Sumitomo Chemical; Idemitsu Kosan Co., Ltd.	No
Italy	Government of Italy – Ministry for the Environment Land and Sea	Yes
France	Eco-Carbone S.A.S.	No
Luxembourg	Ministry of Sustainable Development and Infrastructure	Yes

A.3. Location of the project activity:

The project activity is located in the Humbo Woreda, Wolayita zone, Southern Nations Nationalities and Peoples Region (SNNPR), South Western Ethiopia. The closest town is Humbo (Te Bela). Humbo Woreda is approximately 420km south of Addis Ababa, and 195km south-west of Awassa, the capital city of SNNPRS.

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

Figure A-2 Location of the project activity within Ethiopia

The GPS Coordinates of the project site is shown below, and a shape file is available of this polygon. The project extends from latitude 6° 46'48.47 to 6° 41'04.28 N and longitude 37° 48'35.44 to 37° 55'14.51 E. A full list of the GPS coordinates taken at each corner points of project boundary is included in strata boundaries annexed to this monitoring report.

A.4. Technical description of the project

The technology employed in this project is Farmer Managed Natural Regeneration (FMNR), and planting of seedlings raised from nursery stock. The FMNR technique has been developed in Niger Republic, West Africa over 20 years where it is now practiced on over 2 million hectares. The technique has also spread to Chad, Burkina Faso and Senegal. FMNR falls within the definition of afforestation / reforestation in the manner articulated in the approved methodology AR-AM0003 version 04.

Farmer Managed Natural Revegetation (FMNR) is a system of reforestation utilised by rural communities to achieve the objective of forest restoration over a short period. They have rights to forests and their products. Professor Chris Reij, of Vrije University in Amsterdam and Dr. Peter Cunningham, SIM International, have documented the technique, and this work is publicly available[1].

Implementation of FMNR

FMNR can be implemented in areas that have root stock that could resprout under protection and management. It works best where annual rainfall is in excess of 650mm and is not suitable for areas with an annual rainfall of less than 200mm. Root stock from trees cleared as long as 60 years can remain in the soil, resprouting periodically. This root stock will develop new shoots each year, and these can be mistaken for small shrubs or broadleaf groundcover species. On farmland, standard practice for farmers has been to slash this regrowth each year in preparation for planting crops. In non-arable areas, such growth is controlled through regular burning, grazing and fuel wood collection. However with training, the local communities could identify young shoots tend and manage them to regenerate the root stock.

[1] Farmer Managed Natural Regeneration. Impressions of a short field trip. June 9-11, 2004. Reij. C. Vrije Universiteit, Amsterdam; Reforesting the Sahel: Farmer Managed Natural Regeneration. Cunningham P.J and Abas. T.

The proposed Humbo community forest area has been assessed and found suitable for application of the FMNR technique.

FMNR involves area closure for a minimum of 2 years, and training thinning and pruning of rootstock identified as possible to grow into mature trees. In the most basic form of FMNR, all stalks except one are cut from the root stock. Side branches are then pruned half way up the stem. Selecting and pruning five to seven stems can offer more benefits, and this has been the practice in West Africa. Unwanted stems are removed, and the managed stems increase in size each year, protecting the immediate soil environment and providing other useful materials and services such as fodder, humus, habitat, and protection from the wind and shade. On occasions that a stem is harvested, a younger stem is selected to replace it.

Different tree species require different pruning techniques, and these are determined through on site observation. A small handsaw or machete is the only tool used for pruning side branches of young shoots.

Land managers visit the project area every 2-4 months to re-prune as necessary. Heavy equipment is not required as a result there is minimal soil disturbance when this technique is used. Integrated fire management approaches are implemented in cooperation with the local communities. Grazing is prevented during the vulnerable period after pruning. The decision to allow grazing would be depend upon the growth of trees beyond the height that would not be vulnerable to grazing.

Supplemental planting

Supplemental planting was used to augment the FMNR established forests. A nursery was established with capacity to deliver up to 500,000 seedlings per year for the first four years, sufficient to reforest 500 hectares at 1000 stems per hectare. However during project implementation only 50.7 hectares has been planted in stratum 5 not the estimated 500ha of land that was planned for new plantation for the entire project site. A map of the replanted areas, represented as stratum 5, is included in section A1. The nursery was established in a conventional manner. Seedlings were planted in small pits (0.3m x 0.2m), which were pre-dug through the community participation. Seedlings were planted at the start of the rainy season and follow up weed control was undertaken after each planting.

Harvest

The project area is expected to be selectively harvested at years 12, 22 and 31 years. The management plan will maintain 50% of the standing biomass for the benefits of biodiversity, environmental protection and other ongoing services. Forest products are transported by donkey. Therefore, no leakage emission from the transport of harvested produce is expected. The forest products will be processed at the city of Sodo, approximately 40km from the project site.

Plant survival rate monitoring has been conducted every year, three months after planting. Supplemental planting has been undertaken during the rainy season of the second planting season. Replanted areas were remonitored, however no additional survival counts are recorded for replanted areas. Final survival counts will be monitored in 2012 (3 years post planting) as per the PDD.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

>>

This project activity uses the approved baseline methodology AR-AM0003, Version 4, *Afforestation and reforestation of degraded land through tree planting, assisted natural regeneration and control of animal grazing.*

This methodology utilizes *Version 2 of the Tool for the Demonstration and Assessment of Additionally in A/R CDM Project Activities*.

The Monitoring Report utilizes *Version 01.0.0 of the Tool for the Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM Project Activities.*

The Monitoring Report utilizes *Version 02.0 Annex 24 from EB 66. Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents.*

The Monitoring Report utilizes *Version 01.0 Annex 26 from EB 63. Guidelines on application of specified versions of A/R CDM methodologies in verification of registered A/R CDM project activities*

A.6. Registration date of the project activity:

07/12/2009

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

30 years fixed crediting period starting from date 01/12/2006

A.8. Name of responsible person(s)/entity(ies):

Responsible Entity	
World Vision Ethiopia	
Responsible persons	
Organization:	World Vision Ethiopia
Street/P.O.Box:	P.O. Box 3330
Building:	
City:	Addis Ababa
State/Region:	Addis Ababa
Postfix/ZIP:	
Country:	Ethiopia
Telephone:	251-1- 29 33 50
FAX:	251-1- 29 33 46
E-Mail:	
Website URL:	http://www.wvafrica.org/index.php?option=com_content&view=article&id=137&Itemid=154
Represented by:	Mr. Hailu Tefera Ayele
Title:	Project Manager
Salutation:	Mr
Last Name:	Ayele
Middle Name:	Tefera
First Name:	Hailu
Department:	
Mobile phone:	+251-911-059112
Direct FAX:	+251-1- 29 33 46
Direct tel:	+251-11-6293363
Personal e-Mail:	Hailu_Tefera@wvi.org

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

>>

1. The starting date of operation of the project activity

Actual field activity implementation started on 1/12/2006 (coppicing and pruning using the FMNR technique) however plantation activities in stratum 5 started on 05/6/2007 to coincide with World Environment Day. The annual details of the project schedule are delineated in section A1.

2. The information regarding the actual operation of the project activity during this monitoring period, including information on special events, for example overhaul times, downtimes of equipment, exchange of equipment, etc.

1. Plantation activities

The tree species used for supplementary planting have mainly included *Eucalyptus camaldulensis, Eucalyptus Globulus* and *Grevillea robusta*. However, small quantities of native tree species such as *Balanatus egiptica* and *Cordia Africana* and exotic species like *Accacia saligna* have been planted as well. The list of species planted differs slightly from what is stated in the PDD. The reason for planting mostly *Grevillea robusta* species is because it is widely accepted by the community and has been adapted by the community for more than three decade due to its fast growth and adaptability to the local climate. Furthermore some of the seeds listed in the PDD were difficult to obtain and some failed to germinate in the nursery such as the *Podocarpus facutus* due to the poor quality of the seed. Considering the decision by the CDM executive board at meeting EB 66, documented in Annex 24, "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents" paragraph 4, these changes from the PDD are considered minor and can be approved by the DOE at verification. Amendments to the species planted, and an updated stratification plan are presented in this document.

The survival rate monitoring has been carried out three months after plantation. According to the survey result, the survival ranged from 79 to 85% depending on rainfall variability from season to season. However replacement has been done in the following rainy season. Replacement plantings were monitored for survival and further replanting was undertaken in the subsequent year; however no additional survival counts were undertaken, final survival counts are to be undertaken in 2012 (3 years post planting as described in the PDD)

Plantation activities were concluded by 31st August 2011.

2. Forest management

Forest management activities mentioned in the PDD such as pruning/thinning/coppice reduction have been carried out for the last four years through community participation. The practice includes removal of branches, twigs and deformed coppices that suppress the growth of main trees. The materials removed are used as fuel wood by the community living adjacent to the project site. These practices are expected mainly to carry out on natural regeneration areas categorized as stratum 1, 2, 3 and 4. For the last four years, thinning and pruning have been carried out on 1129.78 hectares of land.

3. Community engagement activities

The other major activities being implemented in the project scenario are capacity building activities to enable communities to manage the project over the crediting period in a sustainable manner. In this regard, trainings on forest management, nursery management, soil and water conservation, farmer managed natural regeneration technique (pruning, thinning, coppice reduction and enrichment plantation), livestock management, project management, financial management, leadership, and conflict

resolution have already been conducted. These practices have built the capacity of the communities to undertake the role of project management over the long term and to educate the communities about the benefits of the project ecosystem and to precipitate climate change resilience. A list of training activities and the number of participants involved is included in the Humbo Data Management Template. Moreover, the project is supporting communities to form cooperatives into unions and once the approval of the unions is granted by the concerned Zonal bureau, the role of each party (union, cooperative, World Vision and Government will be agreed) and training on monitoring, reporting and management of the unions will be conducted for the union and cooperative leaders, etc.

Table B.1 Project Activities

Key Event	Date
Project implementation begins with area closure, application of FMNR technology to project site and establishment of forest cooperatives	01/12/2006
Nurseries Established near to project site	01/01/2007
First plantation establishment (118,808 seedlings planted)	05/06/2007
Second plantation establishment (345,158 seedlings planted)	10/07/2008
Third plantation establishment (168, 676 seedlings planted)	30/07/2009
Forth plantation establishment (75,350)	15/07/2010
Fifth plantation establishment (11,365)	20/07/2011

3. Events or situations that occurred during the monitoring period, which may impact the applicability of the methodology and how the issues resulting from these events or situations are being addressed.

No events or situations occurred during the monitoring period which have impacted the applicability of the methodology.

B.2. Revision of the monitoring plan

The monitoring plan has not been revised

B.3. Request for deviation applied to this monitoring period

There has been no request for a deviation of the monitoring period applied to this project

B.4. Notification or request of approval of changes

There has been no request of changes to the registered CDM PDD for this project however considering the minor amendments endorsed as being able to be approved by the DOE at verification by the CDM executive board at meeting EB 66, documented in Annex 24, "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents", minor amendments are proposed at this verification event.

These minor changes include:

Modification	Relevant Guidelines
Changes to the shape and number of hectares planted as part of strata 5	Annex 24, Section 4a
Changes to species planted in strata 5	Annex 24, Section 4b
Calculation of carbon stocks using allometric equations rather than BEF	Annex 24, Section 4p
Precision 10%	Annex 24, Section 4p and Annex 26 of EB63 (consistent with methodology)

Measurement of trees >= 2cm instead or >=4cm	Annex 24, Section 4p
Re-stratification and re-calculation of the number of sample plots	Annex 24, Section 4m
Exclusion of the burning of Fossil Fuels as leakage	Annex 26, Version 01.0, Section 3

SECTION C. Description of the monitoring system

As per the registered PDD, the project proposes monitoring of:

1. Plantation Establishment and Management
    a. Project boundaries
    b. Forest establishment
    c. Forest management
2. GHG emissions by sinks.

The monitoring system as described in the PDD involves the monitoring of parameters which allow the project emissions, boundaries, and GHG reductions to be accurately measured and net GHG reductions to be calculated.

The following diagram C-1 outlines the relevant monitoring points.

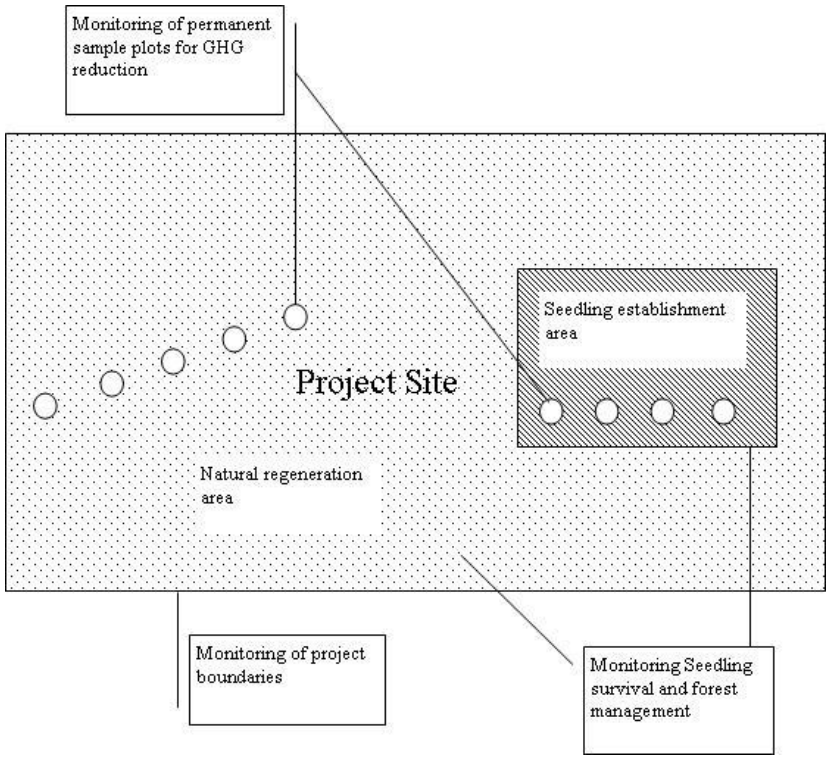


Figure C-1 Diagram of monitoring points

Monitoring of Plantation Establishment and Management

Monitoring of the project boundary

As per the monitoring methodology, a sample of boundary points has been monitored for this monitoring period to ensure accuracy of the project boundary. The PDD requires that 1% of boundary points be monitored, however to increase the quality of the data from this parameter, a sample of 10% of boundary points was monitored. The sample coordinates were selected randomly (from the PDD and the monitoring exercise) and are annexed with this report. It was calculated that 31 of the 85 points showed minor difference from those reported in the PDD, however the differences were both positive and negative (not biased), and all were minor, and most likely due to the quality satellite reception during the original mapping. A summary of the QA process is included in the excel spreadsheet.

Monitoring forest establishment

To ensure the planting quality and forest establishment, the following monitoring activities were conducted in accordance with the monitoring methodology and Table C-1 below:

- Confirmed that site and soil preparation are implemented based on practice documented in section A of the PDD, no slash and burn and widespread tillage was used on the site and soil preparation.
- Survival rate checking, the initial survival rate of planted trees was checked three months after the planting, and re-planting was conducted where the survival rate is lower than 90%. Replanted sites were monitored, but survival counts were not recorded.
- Final survival checking are to be carried out three years after planting.
- Weeding checking to check and confirm that the weeding practice where necessary is implemented.
- Surveying and checking the area of planted species and planting year for each substratum within stratum 5.

Table C-1 Data for monitoring forest establishment

Data variable	**Data Unit**	**Measured (m), calculated (c) estimated (e) or default (d)**	**Recording frequency**	**Number of data points / Other measure of number of collected data**	**Comment**
Site preparation	*Yes / No*	*Measured*	*At planting*	*Open areas allocated for planting*	*This involves preparation of a small pit manually with a size of (0.2mx0.3m) no other site preparation has been undertaken*
Seedling survival	*%*	*Measured*	*3-months after planting, then annually up to year 3*	*Permanent sample plots*	*Checking carried out by counting of 100% of plants from seedling survival sample plots 2007 - 36 plots, 2008 - 75 plots, 2009 - 26 plots, 2010 - 12 plots Each plot has a size of 100m. Replanting has been carried out if less than 90% survival rate is recorded*
Weeding efficacy	*Yes / No*	*Measured*	*Weeding is conducted before the commencement of dry season 2 months after of planting*	*Permanent sample plots*	
Area of planted strata	*Ha*	*Measured*	*At end of year 1*	*All boundaries monitored*	*Boundary is delineated using GPS*

Note: Please see Humbo CDM Data Management Template- discrete area data for detail information and annex- for boundary GPS points

Monitoring of forest management

To ensure the forest management is well implemented the following monitoring activities have been conducted since project implementation:

- Site preparation measures: date, location, area and other measures undertaken;
- Planting: date, location, area, tree species (establishment of the stand models);
- Thinning: date, location, area, tree species, volumes or biomass removed;
- Coppicing: date, location, area, tree species, volumes or biomass removed;
- Fuel wood collection: date, location, area, tree species, volumes or biomass removed;
- Monitoring for disturbances: date, location, area (GPS coordinates and remote sensing, as applicable), tree species, type of disturbance, biomass lost, implemented corrective measures, change in the boundary of strata and stands.

The data required for forest management is shown in table C-2 below.

Table C-2 Data required for monitoring forest management

Data variable	**Data unit**	**Measured (m), calculated (c) estimated (e) or default (d)**	**Recording frequency**	**Number of sample plots at which the data will be monitored / Other measure of number of collected data**	**Comment**
Site preparation – date	*Date*	*Measured*	*Project start*		Humbo CDM Data Management Template
Site preparation – location	*Parcel ID*	*Measured*	*Project start*	*All planted plots*	Humbo CDM Data Management Template
Site preparation – area	*Ha*	*Measured*	*Project start*	*All planted plots*	Humbo CDM Data Management Template
Site preparation – biomass loss	*tonnes*	*estimated*	*Project start*	*NA*	*NA*
Planting/Replanting – date	*Date*	*Measured*	*At each planting event*	*All replanted plots*	*Humbo CDM Data Management Template*
Planting/Replanting – location	*Parcel ID*	*Measured*	*At project start/rotation*	*ID of plots requiring replanting*	*Humbo CDM Data Management Template*
Planting/Replanting	*ha*	*Measured*	*At project*	*Area of plots*	*Humbo CDM*

– area			*start/rotation*	*requiring replanting*	*Data Management Template*
Planting/Replanting – species	*Species*	*Measured*	*At project start/rotation*	*All species planted*	*Humbo CDM Data Management Template*
Management – Thinning/coppicing - date	*Date*	*Measured*	*At project start/rotation*	*At each thinning event*	*Humbo CDM Data Management Template*
Management – Thinning/coppicing - location	*Parcel ID*	*Measured*	*periodic*	*At each thinning event*	*Humbo CDM Data Management Template*
Management – Thinning/coppicing - area	*ha*	*Measured*	*Periodically after each thinning*	*entire area thinned*	
Management – Thinning/coppicing - species	*species*	*Measured*	*Periodically after each thinning*	*Sample of area to determine species thinned*	
Management – Thinning/coppicing - volume	*m^3*	*Measured*	*Periodic*	*Sample*	*Used as fuel wood – see 'Fuel wood collection – volume'*
Fuel wood collection – date	*Date*	*Estimated*	*Periodically during collection*	*Discussion with 7community cooperatives*	*After one week of pruning/thinning activities*
Fuel wood collection – location	*Parcel ID*	*Measured*	*Periodically during collection*	*Discussion with 7community cooperatives*	*Abala longena, shoya, Bossa, Bolla, Bada and Bongota*
Fuel wood collection – area	*ha*	*Estimated*	*Periodically during collection*	*Discussion with 7community cooperatives*	*Fuel wood has been collected from 1129 ha where pruning and thinning has been carried out*
Fuel wood collection – species	*species*	*measured*	*Periodically during collection*	*Discussion with 7community cooperatives*	*Terminalia brownii* *Combretum collinum Terminalia laxiflora Combretum molle R. Br.ex G.Don*
Fuel wood collection – volume	*Tonnes*	*Measured*	*Periodically after one week of pruning*	*Representative areas from each of 7 Cooperatives*	*Measured by taking sample from 5plots with a size of 100m2*

					from each cooperative.
Disturbances - date	*Date*		*At occurrence*	*Sample plots*	*Humbo CDM Data Management Template*
Disturbances - location	*Parcel ID*		*At occurrence*	*sample plots*	*Humbo CDM Data Management Template*
Disturbances - area	*ha*	*Measured*	*At occurrence*	*sample plots*	*Humbo CDM Data Management Template*
Disturbances - species	*species*		*At occurrence*	*sample plots*	*Humbo CDM Data Management Template*
Disturbances type			*At occurrence*	*sample plots*	*Humbo CDM Data Management Template*
Disturbances – biomass loss	*Tonnes*	*Measured*	*At occurrence*	*sample plots*	*Humbo CDM Data Management Template*

Monitoring of GHG emissions by sinks

GHG removals by sinks have been monitored through the establishment of permanent sample plots throughout the project site. These sample plots have been established in accordance with the sampling design developed according to the procedure in the *Sourcebook for LULUCF projects, approved methodology AM0003 version 4* and monitoring manual developed by World Bank and the data monitored have been recorded in the Humbo CDM Data Management Template developed in collaboration with by the BioCarbon fund.

Training

A number of trainings were offered to community groups, WVE field staff and management. See Table C-3 below for details.

Table C-3 Training undertaken by community groups, WVE field staff and management

S.No.	Description of Training	Total No of Participants
1	Train CBOs and FBOs on forest management	505
2	Strengthening and training environmental clubs at schools	540
4	Awareness creation on global warming and GHGs for cooperative members	37

5	Wild animal management training for nearby farmers	107
6	Training forest management& development	435
7	Training on Alternate energy source	77
8	Training on biological and physical soil and water conservation measures	352
10	FMNR Technique	22
11	Training on homestead argo-forestry practice	527
12	Training on forage development	132
13	Training on carbon stock monitoring for community and government	302
14	Training on Community managed project leadership	107
16	Training on ecotourism development	110
17	Training women on non-wood forest production	62
18	Training on improved beekeeping	123
		3,446

Sampling Design

The project site required re-stratification as a result of changes in the size of strata three and five. Once the project strata were revised and the area of each stratum identified, the sampling design was developed following the procedures in the approved methodology AM0003, *Sourcebook for LULUCF projects*, and monitoring manual developed by the World Bank

The sourcebook was used as the procedural guide as it was consistent with the methodology, and at the time when the project team was developing the sampling design, the tool for sample design 'Calculation of the number of sample plots for measurements with A/R CDM Project Activities' had not been developed at the time. Given the sourcebook could be easily adopted by the field staff, it was considered the most appropriate template for the stratification and sampling design.

Once re-stratification and revised map production has been completed, the preliminary 6 sample plots from each stratum has been laid out according to the recommendation on page 15 in the source book for land use, land use and forestry projects (Timothy Pearson, Sarah Walker and Sandra Brown, 2005) employing $\pm$10% precision level from which required tree data to be collected in order to calculate mean carbon stock and standard deviation. These carbon mean stock and standard deviation would enable us to determine the actual number of permanent sample plots required in each stratum and whole project site to meet the targeted precision level within 90% confidence interval as defined in the PDD. These permanent sample plots will be monitored over the crediting period to check the biomass changes throughout the project life time. Preliminary sample plots were located in the respective stratum randomly using software, called 'Hawths analysis tools" working in Arc GIS applying the following procedures:

a) a grid of points with a size equivalent to sample plots size (0.0625ha) have been created throughout the map of the project site

b) a sequential ID has been assigned to each point of grids inside the stratum starting from North to south, west to East

c) Using software operating in ARC GIS, preliminary sample plots locations (6 from each stratum) have been fixed.

d) Nested circular sample plots are used (the smallest circle with 1m; the second 4m, the third 14m and the fourth 20m radius). Since there were no trees found in diameter class >50 cm, the fourth circle was practically omitted.

e) In the first circle, diameter of trees at breast height (DBH) <5 cm; in the second circle, trees with 5-20 cm DBH and in the third, outer circle, trees with 20 - 50cm DBH were measured using calipers and diameter tape. Required tree data (DBH) from the 30 sample plots (6 from each stratum) were taken according to the source book for LULUCF page 15-16 and the data have been recorded - see the DBH collected from 24 sample plots (Annex -Table 1).

Using the dbh data collected from 30 preliminary sample plots, the **mean density** per each stratum was calculated using the formula **(Biomass = $_{10}$(-0.535+log10basal area)** developed for tropical dry lands from page 43 of the Sourcebook for Land Use, Land Use Change, and Forestry Projects (Timothy Pearson, Sarah Walker, and Sandra Brown, Winrock 2005).

Following this procedure, the total sample plots calculated was 77, with 10% contingency the total number of permanent sample plots is 85.

Once the total sample plots required from the project site to meet the targeted precision has been calculated, the next step was to calculate the number of sample plots required to be distributed to each stratum. This is done using the following equation as indicated in page 17 in the sourcebook for Land Use, Land Use Change, and Forestry Projects (Timothy Pearson, Sarah Walker, and Sandra Brown, Winrock 2005). Using this formula, the number of sample plots that have to be allocated to each stratum are 8 in stratum 1, 14 in stratum 2, 57 in stratum 3, 4 in stratum 4 and 2 in stratum 5.

To maintain statistical rigor and avoid subjective choice of plot locations, the permanent sample plots has been located systematically with a random start Using ArcGIS randomization tool in ArcMap, random points are generated for each of the strata using a 25 x 25 m grid. This will be accomplished in the field with the help of a GPS. The geographical position (GPS coordinate), number of stratum and series number of each plot and respective grid number has been recorded and archived. The sampling plots have been evenly distributed and plot locations have been over laid on the map as it is seen from the map below. The first plot in each stratum has been randomly located using a soft ware called 'Hawth's analysis tools" operating in ARC GIS and the next sample plot has been systematically located maintaining equal interval between successive sample plots. The following steps depict all the procedures followed.

1. A grid of points with a size equivalent to sample plots size (0.0625ha) has been created over the map of the project site.
2. A sequential ID has been assigned to each point of grids in side in the map starting from North to south, west to East.
3. The total possible sample plots in each stratum have been identified by archiving from the ARC GIS or by dividing the area of each stratum by the area of sample size see table 2.
4. Interval between each successive sample plots have been identified by dividing the total sampling (grids) points in each stratum to the number of required sample plots. The value is then rounded to the next integer.
5. Using "Hawths analysis tools" a soft ware operating in ARC GIS, the first sampling points in each stratum have been randomly selected and respective grid (ID) number as well as corresponding GPS point has also been recorded.
6. The next sampling point in each stratum has been identified systematically by adding or subtracting the interval to or from the grid (ID) number randomly selected as a first sample point and this has been continued until all the location of required sample plots have been identified.
7. Finally, locations of the sample plots identified from the whole project site have been displayed on the map using their corresponding geographic coordinates. These GPS points have been

recorded to be fixed on the ground through navigation technique once the sampling design is approved.

8. Once the coordinates of each sample plot were identified in the ground, the DBH and tree height within each nested circular sample plots were measured (in 1m radius, tree DBH <5cm; the second 4m radius, DBH 5-20cm and in the third 14m radius, DBH 20-50cm) to estimate the carbon stock change over time. The centre of each circular sample plot was fixed with pointed stone for the time being and will then be replaced with metal bar. The metal bar will be buried 5-10cm below the ground to be detected by magnet during monitoring.

Monitoring Organisation and Responsibilities

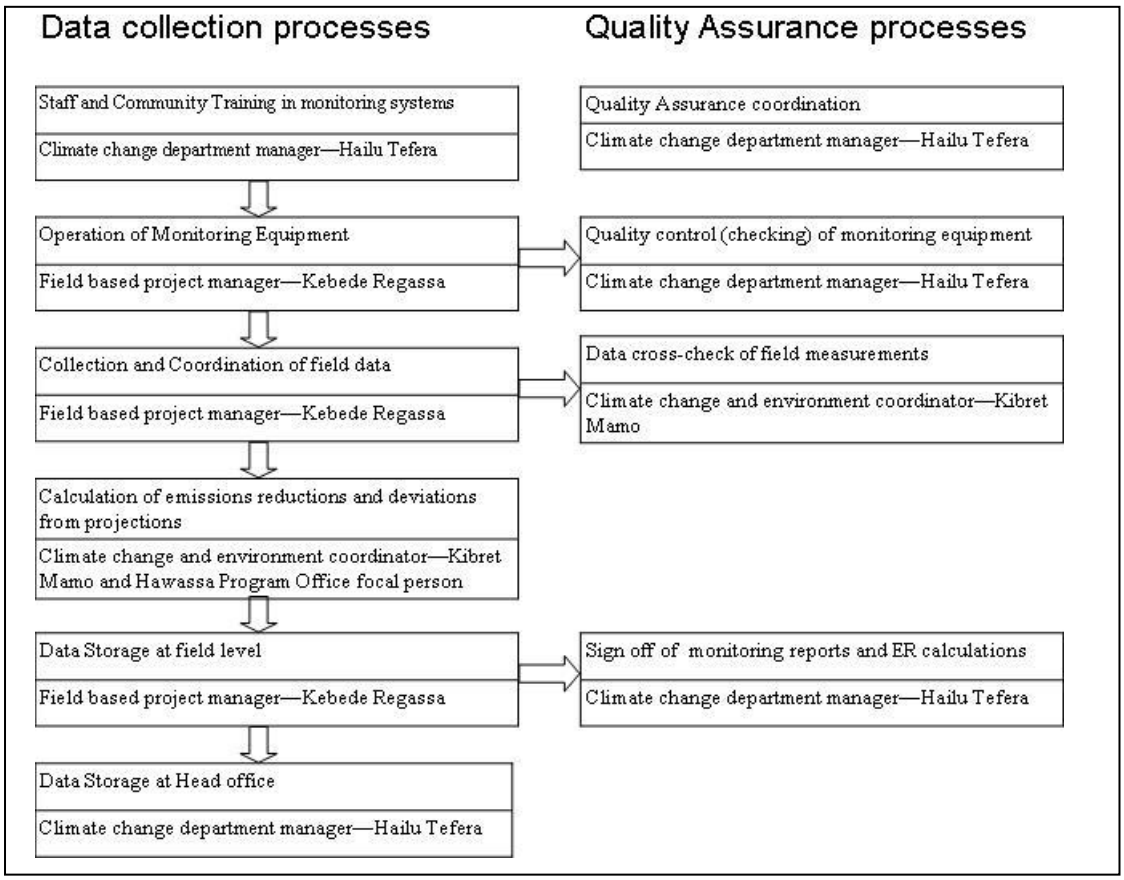
The project manager has designated a monitoring team responsible for implementing the monitoring plan. The structure of this team is outlined in Table C-4 and Figure C-2.

Table C-4 Roles and responsibilities of project team

Task and Area of Responsibility	Method Used	Frequency	Responsible Role	Contact details
Staff and Community Training in monitoring systems	Application of sourcebook and Standard Operating Procedures for Humbo CDM	Annually and as new staff and community members are recruited	Climate change department manager	+251 (0) 11 6293363 Hailu_Tefera@wvi.org
Operation of Monitoring Equipment	As per equipment instructions	Review annually	Field based project manager	+251 (0) 46 119 1121 Kebede_Regassa@yahoo.com
Quality control (checking) of monitoring equipment	Standard Operating Procedures for Humbo CDM	Annual	Climate change and environment coordinator	+251 (0) 11 6293363 Berhanu_Mekonnen@wvi.org
Collection and Coordination of field data	As per sourcebook and Standard Operating Procedures for Humbo CDM	Annual	Field based project manager and/or trained community members	+251 (0) 46 119 1121 Kebede_Regassa@yahoo.com
Calculation of emissions reductions and deviations from projections	Humbo CDM Data Management Template and Standard Operating Procedures for Humbo CDM	Annual	Climate change and environment coordinator and manager,	+251 (0) 11 6293363 Kibret_Mamo@wvi.org
Data cross-check of field measurements	As per sourcebook and Standard Operating Procedures for Humbo CDM	Annual	Climate change and environment coordinator	+251 (0) 11 6293363 Kibret_Mamo@wvi.org
Data Storage at field level	As per Standard Operating Procedures for Humbo CDM (Backup to external hard disk drive and	Annual	Field based project manager	+251 (0) 46 119 1121 Kebede_Regassa@yahoo.com

	hard copy on file)			
Data Storage at Head office	As per Standard Operating Procedures for Humbo CDM (Backup to external hard disk drive, and hard copy on file)	Annual	Climate change department manager	+251 (0) 11 6293363 Hailu_Tefera@wvi.org
Who undertakes Quality Assurance / control	As per sourcebook and SMART template	Annual	Climate change department manager	+251 (0) 11 6293363 Hailu_Tefera@wvi.org
Sign off of monitoring reports and ER calculations	As per sourcebook and SMART template	Annual	Climate change department manager	+251 (0) 11 6293363 Hailu_Tefera@wvi.org

Figure C-2 Structure and responsibilities of the monitoring team



In addition to the above structure developed for quality assessment process, please refer the quality assurance procedure developed and annexed to CDM operational monitoring plan

Emergency procedure for the monitoring system

In the case measuring equipment is damaged and no reliable readings can be recorded, the project owner will purchase replacement equipment and repeat the monitoring procedures.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	C_{BSL}
Data unit:	Numeric
Description:	Baseline net GHG removals by sinks
Source of data used:	Determined in PDD.
Value(s):	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Additional comment:	The accepted baseline approach assumes the continuation of existing changes in carbon stock resulting further loss of regeneration ability hence, assumed to be zero

Data / Parameter:	CF_j
Data unit:	tonnes C
Description:	Carbon fraction of species, j
Source of data used:	Local, national, GPG for LULUCF IPCC
Value(s):	0.5
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission calculations
Additional comment:	IPCC default

Data / Parameter:	*44/12*
Data unit:	Dimensionless
Description:	Ratio of molecular weights of Carbon and CO_2
Source of data used:	Universal constant
Value(s):	44/12
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculation
Additional comment:	-

Data / Parameter:	*Confidence level*
Data unit:	**%**
Description:	*Confidence level*
Source of data used:	Defined
Value(s):	90
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculation
Additional comment:	-

Data / Parameter:	*Fi (DBH, H)*
Data unit:	Kg tree -1
Description:	Allometric equation for species *j* linking above-ground tree biomass (kg tree-1) to diameter at breast height (*DBH*) and possibly tree height (*H*) measured in plots for stratum *i* species *j*, time *t using a published equation applicable to the project*
Source of data used:	The chosen Allometric Equations were selected using the A/R Methodological Tool, Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities (Version 01.0.0). In applying this tool to the project ***Section II, Appropriateness of Allometric Equations***, was used to determine the appropriateness of the equations. Section II identifies that: *For ex ante estimation of aboveground tree biomass in project scenario any allometric equation can be used.* *For ex-post estimation an equation is considered eligible for estimation if it meets **one** of the following criteria.* *(a) The equation is used in the national forest inventory, or the national GHG inventory, of the host Party;* *(b) The equation has been used in commercial forestry sector of the host Party for ten years or more;* *(c) The equation was derived from a data set of at least 30 sample trees, and the value of coefficient of determination (R^2) obtained was not less than 0.85.* The equation used in the ex post calculation (and also in ex ante estimations for biodiversity planting) for this project comes from page 43 of the Sourcebook for Land Use, Land Use Change, and Forestry Projects (Timothy Pearson, Sarah Walker, and Sandra Brown, Winrock 2005). The equation satisfies criteria (c), as it was based on a data set of over 500 trees, and the value of coefficient of determination (R^2) was 0.97. Data for the development of this dry tropical equation was collated by Sandra Brown of Winrock International. The equation is: Aboveground Biomass = 0.2035*(DBH^2.3196) As none of the eucalyptus or grevillea stems were large enough to be measured, the total GHG emissions reductions from sinks from these areas was zero. The equation to be used in subsequent verifications for Eucalyptus was developed for *E. Globulus* in Ethiopia by Fantu, Nuruddin, Haris and Ab Malik and is: Log_{10} Aboveground biomass = -1.189 +1.391($logDBH^2$) The equations chosen for Grevillea was developed by Jangra, Gupta, Kumar and Singh and is: log_{10} Aboveground biomss bole = -0.2055 + 1.221 log_{10} X log_{10} Aboveground biomss branches = -1.9583 + 1.9585 log_{10} X where X = circumference at breast height (cm), N= 30 (number of trees

	felled)
Value(s):	Natural Regeneration Above ground Biomass = 0.2035*(DBH^2.3196) Grevillea $\log_{10}$ Aboveground biomss bole = -0.2055 + 1.221 $\log_{10}$ X $\log_{10}$ Aboveground biomss branches = -1.9583 + 1.9585 $\log_{10}$ X Eucalyptus Log_{10} Aboveground biomass = -1.189 +1.391($logDBH^2$)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions calculation
Additional comment:	

Data / Parameter:	i_{ID}
Data unit:	Alpha numeric
Description:	Stratum ID
Source of data used:	Stand Map, GIS
Value(s):	Strata A1, A2, A3, A4, A5 See Humbo CDM Data Management Template.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculation
Additional comment:	

Data / Parameter:	*ID ikt*
Data unit:	Alpha numeric
Description:	Stand ID
Source of data used:	Stand Map, GIS
Value(s):	See Humbo CDM Data Management Template to see the GPS coordinates and identify area of each stand for (natural regeneration –stand model-1 and plantation stand model-2)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculation
Additional comment:	

Data / Parameter:	k ID
Data unit:	Alpha numeric
Description:	Stand model ID
Source of data used:	AR-CDM-PDD and ex-post adjusted strata.
Value(s):	
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Additional comment:	The project area has been re-stratified following the baseline stratification

Data / Parameter:	N
Data unit:	Numeric
Description:	Maximum possible number of sample plots in the project area
Source of data used:	Calculated
Value(s):	43,644
Indicate what the data are used for (Baseline/ Project/	Project emission calculation

Leakage emission calculations)	
Additional comment:	

Data / Parameter:	NaBL
Data unit:	
Description:	Pre-project number of animals from different livestock groups
Source of data used:	Estimated at project start
Value(s):	3,990
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emission calculations
Additional comment:	Ex-ante estimation – the estimate is fixed for the entire crediting period

Data / Parameter:	Ni
Data unit:	Numeric
Description:	Maximum possible number of sample plots in stratum *i*
Source of data used:	Calculated
Value(s):	N1=3737, N2=10079, N3=27090, N4=1819, N5=919
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Additional comment:	This can be adjusted every 5 years

Data / Parameter:	P
Data unit:	**%**
Description:	Desired level of precision
Source of data used:	Defined
Value(s):	10%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions calculation
Additional comment:	For the purpose of QA/QC and measuring and monitoring precision control. PDD implied both 5% and 10% precision, however the methodology clearly states that 10% precision is required.

Data / Parameter:	Bijt
Data unit:	Tonnes Dry matter per Hectare
Description:	Average above ground biomass stock before burning for stratum i, species j, time t
Source of data used:	NA as there is no burning in the project scenario
Value(s):	NA as there is no burning in the project scenario
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA as there is no burning in the project scenario
Additional comment:	

Data / Parameter:	AN ikt
Data unit:	-
Description:	Area of with N applied in stratum i, stand model k, at time t
Source of data used:	NA as there is no nitrogen used in t project

Value(s):	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA as there is no nitrogen used in t project
Additional comment:	

Data / Parameter:	GWPCH4
Data unit:	-
Description:	Global warming potential for CH4
Source of data used:	Not Monitored
Value(s):	Not Monitored
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA as there is no biomass burning in the project
Additional comment:	
Data / Parameter:	*XF*
Data unit:	Dimensionless
Description:	Plot expansion factor from per plot values to per hectare values for plots 1m, 4m, 14m and 20m in diameter.
Source of data used:	Calculations
Value(s):	Plot expansion factors are made using formula 10,000 / (π * radius^2) 1m plot = 10000/ (π * 1 * 1) = 10000/ 3.142m^2. = 3183 4m plot = 10000/ (π * 4 * 4) = 10000/ 50.265m^2. = 198.9 14m plot = 10000/ (π * 14 * 14) = 10000/ 615.75m^2. = 16.2 20m plot = 10000/ (π * 20 * 20) = 10000/ 1256.63m^2. = 8.0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Additional comment:	

Data / Parameter:	*Za/2*
Data unit:	Dimensionless
Description:	Value of the statistic *z* (normal probability density function) for$\alpha=0.05$ (implying a 95% confidence interval)
Source of data used:	*Sourcebook for LULUCF projects* Timothy Pearson, Sarah Walker and Sandra Brown, 2005)
Value(s):	1.96
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Additional comment:	

D.2.	**Data and parameters monitored**
	(Copy this table for each data and parameter. To report multiple values, a table may be used)
Data / Parameter:	Sti
Data unit:	-
Description:	Standard deviation for each stratum, i
Measured /Calculated /Default:	Calculated

Source of data used:	Calculated
Value(s) of monitored parameter:	SD for each stratum has been calculated based on precision level of 10%. Refer the value from sampling design attached
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	Before the start of the project and adjusted there after every 5-years
Calculation method (if applicable):	
Additional comment:	Used for estimating numbers of sample plots of each stratum and stand, as necessary.

Data / Parameter:	A
Data unit:	Hectares
Description:	Total size of all strata
Measured /Calculated /Default:	Measured
Source of data:	GIS and / or GPS
Value(s) of monitored parameter:	2,728
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	GIS and GPS
Measuring/ Reading/ Recording frequency:	Before the start of the project and adjusted there after every 5-years
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	

Data / Parameter:	Area of planted strata
Data unit:	Ha
Description:	
Measured /Calculated /Default:	Measured
Source of data:	GIS calculations
Value(s) of monitored parameter:	See Data Management Template Stratum 1 233.48 Ha Stratum 2 630.71 Ha Stratum 3 1698.71 Ha Stratum 4 114.41 Ha Stratum 5 50.7 Ha
Indicate what the data are used for (Baseline/ Project/	Emissions calculations

Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	GPS
Measuring/ Reading/ Recording frequency:	At the end of planting activities
Calculation method (if applicable):	Using GIS software
QA/QC procedures applied:	

Data / Parameter:	Ai
Data unit:	Hectares
Description:	Area of stratum i
Measured /Calculated /Default:	Measured
Source of data:	GIS and / or GPS
Value(s) of monitored parameter:	A1 = 233.48; A2 = 630.71; A3 = 1698.71; A4 = 114.41; A5 = 50.7
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	GIS and GPS
Measuring/ Reading/ Recording frequency:	Before the start of the project and adjusted thereafter every 5-years
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	

Data / Parameter:	AB, ijt
Data unit:	Hectares
Description:	Area of slash and burn stratum i, species j, at time t
Measured /Calculated /Default:	Measured
Source of data:	Measurement
Value(s) of monitored parameter:	Zero (there has been no slash and burn for site preparation)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	GPS (Not applicable as no areas need to be measured)
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if	Not applicable

applicable):	
QA/QC procedures applied:	Not applicable

Data / Parameter:	AP
Data unit:	m^2
Description:	Sample Plot area
Measured /Calculated /Default:	Measured
Source of data:	Field measurements using nested plots with radius of 1m 4m 14m and 20m. Plots are measured with a fibreglass tape from a fixed central point according to the process commonly used in forest inventories.
Value(s) of monitored parameter:	3.142m^2, 50.265m^2, 615.75m^2 and 1256.36m^2
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Fibreglass tape (Craftech 30m/100ft) and Bouncing RABIT 50/165ft Zhongya measuring tape) Fibreglass tapes are checked for accuracy before undertaking field measurements against a new fibreglass tape.
Measuring/ Reading/ Recording frequency:	5 yearly
Calculation method (if applicable):	Measured not calculated
QA/QC procedures applied:	Review of measured data carried out as and when data is collected

Data / Parameter:	DBH
Data unit:	cm (living/dead)
Description:	Diameter at breast height of living and standing dead trees
Measured /Calculated /Default:	Measured using a calliper or diameter tape, with 1.3m being measured with a fixed 1.3m measuring implement. Minimum DBH is 2 cm
Source of data:	Plot measurements
Value(s) of monitored parameter:	See data in permanent sample plots, Humbo data management template
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Diameter tape (Forestry suppliers, 160cm DBH, Cloth), equipment checked for accuracy against steel tape before measurements were undertaken in November 2011. Calliper (metal Forestry Supplies 20cm diameter) checked for accuracy against steel tape before measurements were undertaken in November 2011.
Measuring/ Reading/ Recording frequency:	5 year
Calculation method (if applicable):	
QA/QC procedures applied:	Review of measured data carried out as and when data is collected

Data / Parameter:	Hj
Data unit:	M
Description:	Height of species, j
Measured /Calculated	Measured

/Default:	
Source of data:	Plot measurements
Value(s) of monitored parameter:	As per EB 66 decision on minor amendments to AR projects, the Humbo project has modified the project design from BEF to the use of allometric equations therefore this parameter is not monitored. See Humbo CDM Data Management Template
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Measurement stick marked at 1cm intervals.
Measuring/ Reading/ Recording frequency:	5 year
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Data reviewed by project manager after data collection has occurred

Data / Parameter:	*T* ID
Data unit:	Years
Description:	Age of plantation
Measured /Calculated /Default:	Calculated - counted since tree planted. Trees have different ages as they are planted at different years (2007=118,808, 2008=345,158, 2009= 168,676, 2010=75,350, 2011=17,365)
Source of data:	Date of establishment
Value(s) of monitored parameter:	See Humbo CDM Data Management Template
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	At stand establishment
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Data reviewed by project manager after data collection has occurred

Data / Parameter:	*Volume of Fuel wood utilised from thinning and pruning*
Data unit:	tonnes
Description:	Annually utilised volume of fuel wood *t.*
Measured /Calculated /Default:	Measured from sample plots
Source of data:	Sample plots of Fuel wood utilised from pruning and thinning
Value(s) of monitored parameter:	No timber has been harvested, however pruning and thinning generated as a result of the project have been utilised for fuel wood. Sample plots calculations show that between 5.1 and 6.1t of fuel wood has been harvested per hectare per year, and this is evenly distributed across all strata and species. See Humbo CDM Data Management Template and section E below.
Indicate what the data are	Emissions calculation

used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	To estimate the amount of fuel wood that has been collected per hectare, sample plots of $100m^2$ have been taken randomly from four cooperative areas. The randomly selected cooperatives are Abela Longena, Bossa Wanche, Hobicha Bada and Hobicha Bongota. Five plots from each site have been taken for measurement. Branches and twigs removed as a result of this forest management has been collected into a bundle and measured separately. Finally, the average is computed for each cooperative site and converted in to hectare. See the value in table E1.
QA/QC procedures applied:	Data reviewed by project manager after data collection has occurred

Data / Parameter:	*J*
Data unit:	Latin name
Description:	Tree species.
Measured /Calculated /Default:	Measured
Source of data:	Project List
Value(s) of monitored parameter:	See Humbo CDM Data Management Template
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	5 years
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Data cross checked against literature and species identified in Addis Ababa university by project manager after data collection

Data / Parameter:	*lat / long*
Data unit:	
Description:	Plot location
Measured /Calculated /Default:	Measured
Source of data:	Project and plot map and GPS Locating, GIS
Value(s) of monitored parameter:	X, Y coordinates, see excel sheet permanent sample plot attached See Humbo CDM Data Management Template
Indicate what the data are used for (Baseline/ Project/ Leakage emission	Emissions calculations

calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	GPS equipment Model (Garmin GPS 60) adjusted in WSG 84 projection Not able to be calibrated
Measuring/ Reading/ Recording frequency:	5 years
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Re-measurement of 10% of sample plots

Data / Parameter:	nTR_{PLikt}
Data unit:	Numeric
Description:	Number of trees in the sample plot
Measured /Calculated /Default:	Measured
Source of data:	Plot measurement
Value(s) of monitored parameter:	See Humbo CDM Data Management Template
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Chalk used to mark trees that have been measured to avoid double counting. No calibration needed.
Measuring/ Reading/ Recording frequency:	5 year
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Data is crosschecked with 10% of sample plots re-measured by an independent team.

Data / Parameter:	dNa_{EGL}
Data unit:	Dimensionless
Description:	Number of animals displaced in *EGL* areas at time *t*
Measured /Calculated /Default:	Calculated
Source of data:	Government Statistics on livestock numbers
Value(s) of monitored parameter:	Zero, no animals have been displaced in EGL areas at time t. See Humbo CDM Data Management Template
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	5 yearly
Calculation method (if	

applicable):	
QA/QC procedures applied:	

Data / Parameter:	*Na EGL t*
Data unit:	Dimensionless
Description:	Number of animals present in the sampled *EGL* areas at time *t*
Measured /Calculated /Default:	Measured
Source of data:	Government staff has collected data on the number of animals from the entire households in the project area. Number of animals has been taken from the government census results.
Value(s) of monitored parameter:	Survey data attached "no of animals' taken from government statistics, (15491) see section E.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	5 yearly
Calculation method (if applicable):	
QA/QC procedures applied:	Data to be reviewed by project manager after data collection has occurred

Data / Parameter:	*PLi k*
Data unit:	Dimensionless
Description:	Total number of plots in stratum i , stand model k
Measured /Calculated /Default:	Measured
Source of data:	Field measurements
Value(s) of monitored parameter:	ST1= 8, ST2=14, ST3= 57, ST4= 4, ST5 = 2. See sampling design attached to this monitoring report
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not Applicable
Measuring/ Reading/ Recording frequency:	5 year
Calculation method (if applicable):	See Sampling design document
QA/QC procedures applied:	Data reviewed by project manager after data collection has occurred

Data / Parameter:	Project boundaries
Data unit:	**%**
Description:	GPS points to be re-measured to ensure accuracy of project boundaries
Measured /Calculated /Default:	Measured

Source of data:	Field measurements
Value(s) of monitored parameter:	See excel sheet 'QA boundary'
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Garmin GPS 60 Accuracy • Position: < 15m, 95% typical • Velocity: 0.05m/sec steady state Garmin GPS 60 Cannot be calibrated
Measuring/ Reading/ Recording frequency:	At each verification
Calculation method (if applicable):	NA
QA/QC procedures applied:	A random sample of 10% of original GPS points has been monitored at this monitoring period to ensure accuracy of project boundaries.

Data / Parameter:	Seedling Survival
Data unit:	%
Description:	% of seedlings relative to target stocking density
Measured /Calculated /Default:	Measured
Source of data:	Field measurements
Value(s) of monitored parameter:	See SMART template 02.7 Survival rates are 2007: 79% 2008: 79% 2009: 67 % 2010: 85 %
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not Applicable
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not Applicable
Measuring/ Reading/ Recording frequency:	3 months after planting then annually
Calculation method (if applicable):	Number of seedlings surviving / target stocking density
QA/QC procedures applied:	Replanting required if less than 90% survival

Data / Parameter:	Site preparation/pitting/
Data unit:	Yes/No
Description:	Sites that were disturbed during pit preparation (725,357 pits)
Measured /Calculated /Default:	Measured
Source of data:	Field measurements
Value(s) of monitored parameter:	(0.2*0.3) m2 *725357=4.35ha
Indicate what the data are	Base line emissions calculations

used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	At vegetation removal
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Data reviewed by project manager after data has been collected

Data / Parameter:	Weeding efficacy
Data unit:	%
Description:	Efficacy of weeding
Measured /Calculated /Default:	Measured
Source of data:	Field measurements
Value(s) of monitored parameter:	Weeding have been carried out in all trees planted (100%)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is only used in project management, to determine whether additional weeding is necessary
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	Quarterly year 1, then annually
Calculation method (if applicable):	Number of seedlings with insufficient weeding/number of seedlings measured
QA/QC procedures applied:	NA

Data / Parameter:	*Ri*
Data unit:	Dimensionless
Description:	Root to shoot ratio
Source of data used:	IPCC 2003, GPG LULUCF – Annex 3.A1, Table 3A.1.8 Average Belowground to Aboveground Biomass ratio in Natural Regeneration by broad category, page 3.168
Value(s):	Natural regeneration by broad category 0.27 *Eucalyptus* spp. 0.29 *Grevillea* spp. 0.27 As per validated PDD.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Additional comment:	The Root to Shoot ratio will only be updated where third party peered reviewed studies have been undertaken

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

According to the methodology, the baseline carbon stock changes do not need to be monitored because the accepted baseline approach 22(a) assumes continuation of existing changes in carbon stock resulting in its further loss of regeneration ability. Baseline emissions are conservatively estimated at zero in the PDD based on the formula[2]:

$$C_{BSL} = 0 \ \ for\ all\ t^* \leq t_{cp} \qquad (1)$$

where:
C_{BSL} = baseline net greenhouse gas removals by sinks; tonnes CO_2-e.
t^* = number of years elapsed since the start of the AR project activity; yr
t_{cp} = year at which the first crediting period ends; yr

Verification Period	Baseline Emissions
01/12/2006 – 01/12/2011	0

E.2. Project emissions calculation

According to the PDD the project is not expected to result in emissions. Several potential emissions sources were considered for the project including burning of fossil fuels and clearance of vegetation for site preparation and fertiliser application as per the methodology (equation 22).

$$GHG_E = E_{FuelBurn} + E_{BiomassBurn} \qquad (22)$$

where:
GHG_E = increase in GHG emission as a result of the implementation of the proposed AR CDM project activity within the project boundary; tonnes CO_2-e.
$E_{FuelBurn}$ = increase in GHG emission as a result of burning of fossil fuels within the project boundary; tonnes CO_2-e.
$E_{BiomassBurn}$ = increase in GHG emission as a result of biomass burning within the project boundary; tonnes CO_2-e.

However manual methods are used for carrying out the project tasks, therefore, minimal emissions associated with the use of fossil fuels are relevant for the project. Further to this, the recent decision at EB 63 Annex 26 page 3 states that, regarding estimation and accounting of emissions from burning of fossil fuel both within and outside the project boundary,: 'The project participant shall not be required to monitor data and parameters related to these emissions.'

There is no clearance or burning of vegetation for site preparation. The only emission expected was due to pit preparation for new plantation. The area disturbed while preparing 725,357 pits is only 4.35ha as described above which is below 2% of the actual net green house removals by sinks and therefore considered insignificant.

To summarise, project emissions are expected to be negligible because:

- Biomass burning is not undertaken in the project.
- The project does not use fertilizers
- Live fences are used for fencing. Therefore, wood from project area is not used as the fencing material.

[2] Equation numbering follows AR-AM0003 v4.

Given these criteria have been met in the monitoring period; the project emissions are identified to be zero.

Verification Period	Project Emissions
01/12/2006 – 01/12/2011	0

E.3. Leakage calculation

According to the methodology leakage is possible from several sources, and can be calculated from the formula:

$$LK = LK_{Activity\,Displacement} + LK_{fencing} \quad (28)$$

Leakage due to activity displacement (fuel wood collection and grazing) outside project boundary

To determine the amount of fuel wood being collected by the community from the project area is adequate or not, sample plots of $100m^2$ have been taken randomly from four cooperative areas. The randomly selected cooperatives are Abela Longena, Bossa Wanche, Hobicha Bada and Hobicha Bongota .Five plots from each site have been taken for measurement except for 2008, where only four sample plots from each cooperative were taken. Branches and twigs removed as a result of this forest management have been collected into a bundle and measured (by weight (kilograms)) separately. Finally, the average fuel wood collected per each year/ha is computed for each cooperative site and converted in to hectare see table E-1.The type of species pruned and collected include *Maytenus senegalensis, Terminalia brownie, Acacia brevispica, Grewia bicolour, Euclea racemosa, Balanites aegyptica, Combretum molle, Syzygium guineese.*

Table E-1 Fuel wood collected over the last four years

Year	Abella Longena (t/ha)	Bossa Wanche (t/ha)	Hibicha Bada (t/ha)	Hobicha Bongota (t/ha)	Total (t/ha)	Average (t/ha)
2008	4.2	4.9	5.45	5.85	20.4	5.1 t/ha
2009	4.37	4.97	5.94	5.99	21.27	5.3t/ha
2010	4.71	5.16	5.81	6.50	22.19	5.5t/ha
2011	4.97	5.48	6.97	7.07	24.50	6.1t/ha

From this table we can understand that leakage due to fuel wood displacement is zero as per the condition $FG_{BL}<FG_{AR,\,t}$, described on page 78 of AM0003-V4 where FG_{BLt} is average pre-project annual volume of fuel wood gathering in the project estimated ex ante and specified in the AR-CDM-PDD; tonnes yr^{-1} and $FG_{AR,t}$ is fuel wood gathered in the project area according to the monitoring result. As it is indicated in the PDD the pre-project annual volume of fuel wood gathering in the project area was 4.3 tonnes/ha. However, as shown in the table above, the fuel wood being collected in the project scenario is greater than pre-project volume of fuel wood collected.

Leakage due to livestock displacement is also considered through census results obtained from government statistics. The number of existing animals grazing on the non-project area before the project was 8,684 cow/ox/bulls and 2,288 goats. The current number of animals after the five-year project intervention is 11,383 (cow/ox/bulls/heifer/donkey) and 4,108 goats according to the government statistics shown in table E-2. The data shows farmers are increasing the number of livestock in the

project scenario. The reason is that there was extra existing grazing land under the control of animal owners as described in the PDD that has been used to maintain the displaced animals, better management of the existing land due to various capacity building training events given to the farmers on this sector and ample amount of grass being harvested from the project site since the closure. Some of the farmers are even selling grass harvested from the closed project site and generate income out of it. This evidence shows the project activity has not displaced the grazing animal population and leakage due to conversion of land to grazing land can be set as zero and no further monitoring step is needed as the condition $Na_{BL}<Na_{ARt}$ specified on page 76 of AM0003-V4 is met.

Table E-2 Livestock census of project area during the monitoring period

S/No	KA	Type of livestock									Total
		Ox	Cow	Heifer	Bull	Calf	Goat	Sheep	Donkey	Mule	
1	Abela Longena	459	410	231	258	333	543	598	248	0	**3080**
2	Abela Shoya	428	390	230	60	187	236	232	276	6	**2045**
3	Abela Gefeta	423	484	250	313	305	546	282	514	3	**3120**
4	Bosa Wanchie	287	0	1	120	195	203	183	42	0	**1031**
5	Bola Wanchie	190	178	112	90	42	103	120	153	2	**990**
6	Hobicha Badda	490	182	323	377	271	34	112	63	8	**1860**
7	Hobicha Bongota	585	513	421	277	214	526	390	432	7	**3365**
	Total	**2862**	**2157**	**1568**	**1495**	**1547**	**2191**	**1917**	**1728**	**26**	**15491**

Emissions from fencing material

The project does not use any fencing material, only live fences and rocks delineating the project boundary have been used for fencing. Therefore leakage resulting from fencing is considered to be zero.

Verification Period	Emissions from Leakage
01/12/2006 – 01/12/2011	0

E.4. Emission reductions calculation / table

This section shall include the formulae used to calculate the emission reductions and the total of the emission reductions achieved during the monitoring period
The project emission reductions calculation is calculated using the methodology (AR-AM0003 version 4).
The project uses the Stock Change method, and within the method, tree dimensions are converted to tree biomass by applying allometric equations. The process uses equations 60-61 and 68-81. The process is followed in the spreadsheet 'Sample plot data – biomass – ARAM0003' as part of the data management template.

$$\Delta C_{P,LB} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{PS}} \sum_{k=1}^{K} \Delta C_{P,ikt} \qquad (60)$$

Where:
$\Delta C_{P,LB}$ = sum of the changes in living biomass carbon stocks in the project scenario (above- and below-ground); tonnes CO2-e.

$\Delta C_{P,ikt}$ = annual carbon stock change in living biomass in the project scenario for stratum *i*, stand model *k*, time *t;* tonnes CO2-e. yr^{-1}
i = 1, 2, 3, ... *mPS* ex-post strata
k = 1, 2, 3, … *K* stand models
t = 1, 2, 3, ...*t** years elapsed since the start of the AR project activity

$$\Delta C_{P,ikt} = (\Delta C_{AB,ikt} + \Delta C_{BB,ikt}) \cdot \frac{44}{12} \quad \textbf{(61)}$$

where:
$\Delta C_{P,ikt}$ = annual carbon stock change in living biomass for stratum *i*, stand model *k*, time *t;* tonnes CO2-e. yr^{-1}
$\Delta C_{AB,ik\,t}$ = annual carbon stock change in above-ground biomass for stratum *i*, stand model *k*, time *t;* tonnes C yr^{-1}
$\Delta C_{BB,ikt}$ = annual carbon stock change in below-ground biomass for stratum *i*, stand model *k*, time *t;* tonnes C yr^{-1}

In accordance with the methodology, the estimation of $\Delta C_{P,LB}$ (changes in living biomass carbon stocks in the project scenario) needs to take into account the treatment of pre-existing non-tree and tree vegetation. Where existing non-tree vegetation is significant, it is assumed to disappear in the year of site preparation. The carbon stock decrease is estimated as follows:

$$E_{biomassloss} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{PS}} \sum_{k=1}^{K} A_{ikt} \cdot B_{non-tree,ikt} \cdot CF_{non-tree} \cdot \frac{44}{12} \quad \textbf{(14)}$$

Where:
$E_{biomassloss}$ = Decrease in the carbon stock in the living biomass carbon pools of non-tree vegetation in the year of site preparation, up to time t*; tonnes $CO_{2\text{-}e}$
A_{ikt} = Area of stratum stratum i, stand model k, time t; ha
$B_{non\text{-}tree,ikt}$ = Average non-tree biomass stock on land to be planted before the start of a proposed A/R CDM project activity for stratum i, stand model k, time t; tonnes d.m. ha^{-1}
$CF_{non\text{-}tree}$ = Carbon fraction of dry biomass in non-tree vegetation, tonnes C (tonnes d.m.)$^{-1}$
i = 1, 2, 3, …mps strata in the project scenario
k = 1, 2, 3, …K stand model in the project scenario
t = 1, 2, 3, … t* years elapsed since the start of the A/R project activity

In accordance with the registered PDD, $E_{biomassloss}$ is estimated as 43,711.7 tonnes $CO_{2\text{-}e}$

Allometric method

Step 1 of the allometric method requires diameter at breast height (DBH) to be measured at 1.3m above ground.

Step 2 – Establish appropriate allometric equations

$$TB_{ABj} = f_j(DBH, H) \quad \textbf{(68)}$$

TB_{ABj} = above-ground biomass of a tree of species *j*; kg $tree^{-1}$
fj(DBH,H) = an allometric equation for species *j* linking above-ground tree biomass (kg $tree^{-1}$) to diameter at breast height (DBH) and possibly tree height (H) measured in plots for stratum *i*, species *j*, time *t*.

Step 3 - Once above ground biomass has been estimated using selected allometric equations in Step 2, the carbon stock in above ground biomass is estimated using equation 69.

$$TC_{AB} = TB_{ABj} \cdot CF_j \quad (69)$$

where:
TC_{ABj} = carbon stock in above-ground biomass per tree; tonnes kg C tree^{-1}
TB_{ABj} = above-ground biomass of a tree of species *j*; kg tree^{-1}
CF_j = carbon fraction of species *j*, tonnes C (tonne d.m.)$^{-1}$, IPCC default value = 0.5

Step 4 - Calculate the increment of above-ground biomass carbon accumulation at the tree level as per equation 70

$$\Delta TC_{ABjT} = TC_{ABj,t2} - TC_{ABj,t1} \quad (70)$$

where:
ΔTC_{ABjT} = carbon stock change in above-ground biomass per tree of species *j* between two monitoring events; kg C tree^{-1}
$\Delta TC_{ABj,t2}$ = carbon stock change in above-ground biomass per tree of species *j* at monitoring event *t2*; kg C tree^{-1}
$\Delta TC_{ABj,t1}$ = carbon stock change in above-ground biomass per tree of species *j* at monitoring event *t1*; kg C tree^{-1}

Step 5 - Calculate the increment in above-ground biomass carbon of a tree species per plot on a per area basis.

$$\Delta PC_{AB,ijT} = \frac{\left(\sum_{tr=1}^{TR} \Delta TC_{ABjT} \cdot XF\right)}{1000} \quad (71)$$

$$XF = \frac{10{,}000}{AP} \quad (72)$$

where:
$\Delta PC_{AB,ijT}$ = plot level mean carbon stock change in above-ground biomass in stratum *i*, species *j*, between two monitoring events; tonnes C ha^{-1}.
ΔTC_{ABjT} = carbon stock change in above-ground biomass per tree between two monitoring events; kg C tree^{-1}
XF = plot expansion factor from per plot values to per hectare values
AP = plot area; m^2
tr = tree (TR = total number of trees in the plot)

Step 6 - Calculate mean carbon stock change within each stratum and stand model.

$$\Delta MC_{AB,ikT} = \frac{\sum_{pl=1}^{PL_{ik}} \sum_{j}^{J} \Delta PC_{AB,ijT}}{PL_{ik}} \quad (73)$$

where:
$\Delta MC_{AB,ikT}$ = mean carbon stock change in above-ground biomass in stratum *i*, stand model *k*, between two monitoring events; tonnes C ha^{-1}
$\Delta PC_{AB,ijT}$ = plot level mean carbon stock change in above-ground biomass in stratum *i*, species *j*, between two monitoring events; tonnes C ha^{-1}
pl = plot number in stratum *i*, stand model *k*; dimensionless
PL_{ik} = total number of plots in stratum *i*, stand model *k*; dimensionless

Step 7 - Estimate carbon stock in below-ground biomass using root-shoot ratios and above-ground carbon stock and apply steps 4 and 5 to below-ground biomass for single trees of a species.

$$TC_{BBj} = TC_{ABj} \cdot R_j \quad (74)$$

$$\Delta TC_{BBjT} = TC_{BBj,t2} - TC_{BBj,t1} \quad (75)$$

$$\Delta PC_{BB,ijT} = \frac{\left(\sum_{tr=1}^{TR} \Delta TC_{BBjT} \cdot XF \right)}{1000} \quad (76)$$

$$\Delta MC_{BB,ikT} = \frac{\sum_{pl=1}^{PL_{ik}} \sum_{j}^{J} \Delta PC_{BB,ijT}}{PL_{ik}} \quad (77)$$

where:
TC_{BBj} = carbon stock in below-ground biomass per tree of species *j*; kg C tree^{-1}
TC_{ABj} = carbon stock in above-ground biomass per tree of species *j* as calculated in step 1; kg C tree^{-1}
R_j = root-shoot ratio appropriate to increments for species *j*; dimensionless
ΔTC_{BBjT} = carbon stock change in below-ground biomass per tree of species *j* between two monitoring events; kg C tree^{-1}
$\Delta PC_{BB,ijT}$ = plot level carbon stock change in below-ground biomass of species *j* between two monitoring events; tonnes C ha^{-1}
XF = plot expansion factor from per plot values to per hectare values; dimensionless
tr = tree (TR = total number of trees in the plot)
$\Delta MC_{BB,ikT}$ = mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; tonnes C ha^{-1}
$\Delta PC_{BB,ijT}$ = plot level carbon stock change in below-ground biomass for stratum *i*, species *j*, between two monitoring events; tonnes C ha^{-1}
pl = plot number in stratum *i*, stand model *k*; dimensionless
PL_{ik} = total number of plots in stratum *i*, stand model *k*; dimensionless

Step 8 - Calculate the annual carbon stock change by dividing by the number of years between monitoring events.

$$\Delta MC_{AB,ikt} = \frac{\Delta MC_{AB,ikT}}{T} \quad (78)$$

$$\Delta MC_{BB,ikt} = \frac{\Delta MC_{BB,ikT}}{T} \quad (79)$$

$\Delta MC_{AB,ikt}$ = annual mean carbon stock change in above-ground biomass for stratum *i*, stand model *k*, at year *t*; tonnes C ha^{-1} yr^{-1}
$\Delta MC_{BB,ikt}$ = annual mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, at year *t*; tonnes C ha^{-1} yr^{-1}
ΔMC_{ABikT} = mean carbon stock change in above-ground biomass for stratum *i*, stand models *k*, between two monitoring events; tonnes C ha^{-1}
ΔMC_{BBikT} = mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; tonnes C ha^{-1}
T = number of years between two monitoring events which in this methodology is 5 years

Step 9 - The annual carbon stock change in living biomass for each stratum i, species j at time t is calculated from the area of each stratum i, species j at time t and the annual mean carbon stock change in above-ground biomass and below-ground biomass per unit area, given by:

$$\Delta C_{AB,ikt} = A_{ikt} \cdot \Delta MC_{AB,ikt} \quad (80)$$

$$\Delta C_{BB,ikt} = A_{ikt} \cdot \Delta MC_{BB,ijt} \quad (81)$$

where:
A_{ikt} = area of stratum *i*, stand model *k*, at time *t*; hectare (ha)
$\Delta C_{AB,ikt}$ = changes in carbon stock in above-ground biomass for stratum *i*, stand model *k*, at time *t*; tonnes C yr^{-1}
$\Delta C_{BB,ikt}$ = changes in carbon stock in below-ground biomass for stratum *i*, stand model *k*, at time *t*; tonnes C yr^{-1}
$\Delta MC_{AB,ikt}$ = annual mean carbon stock change in above-ground biomass for stratum *i*, stand model *k*, at year *t*; tonnes C ha^{-1} yr^{-1}
$\Delta MC_{BB,ikt}$ = annual mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, at year *t*; tonnes C ha^{-1} yr^{-1}

Actual net GHG removals by sinks therefore can be calculated by taking the pre-existing biomass from the project, established at validation (43,711.7 tonnes of CO_2e), and subtracting this from the total biomass calculated from the permanent sample plots (117,051). Since there are no project emissions, the total actual net GHG removal by sinks is 73,339.

The above process is followed in the spreadsheet 'Sample plot data – biomass – ARAM0003' with the estimation of net anthropogenic GHG removals by sink summarised in Table E-3.

Table E-3 estimation of net anthropogenic GHG removals by sinks

Sum of the changes in living biomass carbon stocks in the project scenario (above- and below-ground); tonnes CO_{2-e}	Decrease in the carbon stock in the living biomass carbon pools of non-tree vegetation in the year of site preparation, up to time t*; tonnes CO_{2-e}	Sum of the increases in non-CO_2 GHG emissions by sources within the project boundary as a result of the implementation of an A/R CDM project activitytCO_2e	Estimation of actual net GHG removals by sinks tCO_2e	Baseline net greenhouse gas removals by sinks tCO_2e	Estimation of Leakage tCO_2e	Estimation of net anthropogenic GHG removals by sinks tCO_2e
117,051.35	-43,711.7	0	73,339.65	0	0	73,339.65

Calculation of tCERs
The amount of CERs that can be issued at time t*= t2 (the date of verification) for the monitoring period T is calculated as:

$$tCERs = C_{AR\text{-}CDM,t2} \quad (102)$$

Where:
tCERs = Number of units of temporary Certified Emission Reductions
$C_{AR\text{-}CDM,t2}$ = Net anthropogenic greenhouse gas removals by sinks, as estimated for $t^* = t_2$; tonnes $CO_{2\text{-}e}$

Therefore, the tCERs accrued from the project activity in this monitoring period is 73,339 tCO_2e.

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

This section shall include a comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	69,868	73,339

E.6. Remarks on difference from estimated value in the PDD

>>
Emissions reductions are higher in the MR than were anticipated *ex ante* in the registered CDM PDD. Several factors have influenced changes in emission reductions these include:

- An increase in emission reductions due to the minimum DBH being modified from 4 cm to 2 cm as per the methodology.
- A decrease in emission reductions due to none of the trees in Stratum 5 having reached the minimum DBH.
- An increase due to Stratum 3 being larger than predicted *ex ante* and Stratum 5 being smaller than predicted *ex ante.*

These increases and decreases have lead to an overall increase in emissions reductions of approximately 5%.

- - - - -

History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		