Monitoring report form for CDM project activity
(Version 06.0)

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

MONITORING REPORT		
Title of the project activity	Improving Rural Livelihoods through Carbon Sequestration by Adopting Environment Friendly Technology based Agroforestry Practices	
UNFCCC reference number of the project activity	4531	
Version number of the PDD applicable to this monitoring report	04	
Version number of this monitoring report	01	
Completion date of this monitoring report	05 September 2018	
Monitoring period number	02	
Duration of this monitoring period	01 Sep 2011 – 30 June 2018	
Monitoring report number for this monitoring report	01	
Project participants	VEDA Climate Change Solutions Ltd JK Paper Ltd International Bank for Reconstruction and Development as a Trustee for BioCarbon Fund	
Host Party	Government of India	
Sectoral scopes	14: Afforestation and Reforestation	
Applied methodologies and standardized baselines	AR-AM0004 ver. 3 – Reforestation or afforestation of land currently under agricultural use	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
		60,949
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	147, 434	

SECTION A. Description of project activity

A.1. General description of project activity

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

The A/R CDM project activity mobilized resource-poor farmers to raise tree plantations on farmlands. It links farmers and end users of wood products in order to optimise the land use and to facilitate the co-ordination of wood producers, agronomists, financial institutions and non-governmental organizations to improve the livelihood opportunities of rural households.

The project activity has been implemented on the degraded farmlands or lands used for rainfed subsistence agriculture in the two states of India: Orissa and Andhra Pradesh. The project area includes small landholders spread over a total of six districts: Rayagada, Koraput and Kalahandi districts in Orissa and the districts of Visakhapatnam, Srikakulam, and Vizianagaram in Andhra Pradesh. These districts have a pre-dominance of indigenous population, notified as Scheduled Tribes and Scheduled Castes in India, with the majority of them being poor.

The participation of small and marginal farmers representing indigenous communities and their organization as part of the CDM A/R makes this project unique in contributing to their land use choice, improvement of livelihood opportunities and in promoting their capacity to organize and implement climate change mitigation initiatives.

The specific objectives of the project include:

- To pilot reforestation activities for generating high-quality greenhouse gas removals by sinks that can be measured, monitored and verified;
- To develop plantation and agro forestry models, which can provide multiple benefits to farmers in terms of timber, firewood and non-wood forest products;
- To provide additional income and to promote livelihoods of resource poor farmers through carbon revenues.
- To reforest degraded lands to control soil and water erosion and reclaim lands.
- To reduce the dependence of industry on natural forests thereby conserving biodiversity.
- To build capacity of various stakeholders to benefit from global mechanisms.

The project has implemented reforestation on 1607.7 ha of land belonging to 1590 farmers in the states of Andhra Pradesh and Orissa.

Table A.1.1 - Year-wise area planted in the project area in ha

Year of Plantation	Total Area(Ha)
2004	179.29
2005	350.03
2006	384.50
2007	693.90
TOTAL	1607.7

A Monitoring Committee comprising the representatives of VCCSL and JKPL, as well as provision of audited records, ensures that the share of the benefits from the sale of carbon credits due to the participating farmers will effectively go to them. A joint escrow account between VCCSL and JKPL is the institutional mechanism for channelling carbon revenues to the farmers. Therefore, the carbon sequestration benefits of the project serve the roles of climate change mitigation and as a source of alternate income to farmers to meet the operation and maintenance expenses for reforestation of degraded lands.

2. Brief description of the installed technology and equipments;

One of the main technologies employed in this project is reforestation through direct planting with environmental-friendly techniques on less productive and degraded lands and provision of Eucalyptus seedlings raised from clonal technology to the farmers to raise plantations. JK Paper Limited has embarked on a research & development programme to increase productivity of farm forestry. To fulfil the objectives of research and development programme, state of the art technology and infrastructure such as Greenhouses, Hardening Chambers, Nurseries and Laboratories have been developed. Please refer Section A.4 for further details of the technology and equipment used.

3. Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.).

Table A.1.2: Chronology of events related to the development of the project

Timeline (date/month/yr)	**Description of Events**
25/06/2004	Project Start date
Nov 2006 onwards	Signing of tri-partite agreements (JKPL, VEDA MACS and Farmers)
10/1/2007	Letter from JKPL to their field staff giving guidelines for identification of farmers.
8/5/2007	Signing of ERPA between VEDA MACS, VCCSL and JKPL
4/4/2009	Letter to DNA, requesting replacement of VEDA MACS with VCCSL and inclusion of JKPL in revised LOA
15/07/2009	Revised LOA issued by India DNA, jointly to VCCSL and JKPL, based on the old PDD submission
24/09/2012	Issuance of tCERs for project after 1st verification

4. Total emission reductions achieved in this monitoring period.

Table A.1.3: The total ERs achieved in the monitoring period of 01 September 2011 till 30 June 2018 are tabulated as follows:

Period	Total net anthropogenic GHG removals by sinks	Remarks
01/09/2011 to 30/06/2018	**60,949**	Please refer to Section E for further details

A.2. Location of project activity

The A/R CDM project activity is located in Koraput, Kalahandi and Rayagada districts of Odisha and Visakhapatnam, Vizianagaram and Srikakulam districts of Andhra Pradesh in India.

Table A.3.1: Details of land under the project

District	*Villages*	*Blocks/ Mandals*	*Land under project (in ha)*	*Number of parcels*	*Average land under project per farmer (in ha)*
Vizianagaram	151	30	620.68	444	1.48
Srikakulam	107	20	232.01	473	0.51
Rayagada	78	12	269.29	247	1.24
Koraput	29	06	140.65	107	1.60
Kalahandi	80	10	178.01	279	0.70
Visakhapatnam	56	19	167.08	158	1.07
	501	**97**	**1607.72**	**1708**	**1.01**

The project boundary includes all discrete parcels of lands owned by different farmers in the blocks/ mandals (an administrative block) of the six districts. Each of these parcels of land is identified through GPS coordinates. The GPS coordinates reflect the delineation of land parcels on the ground. Additionally, each parcel of land is also identified using official documents and maps of the Land Administration/Revenue Department.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	VEDA Climate Change Solutions Ltd JK Paper Ltd	No
Italy	Government of Italy – Ministry of Environment, Land and Sea	Yes
Spain	Kingdom of Spain- Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness	Yes
Luxembourg	Ministry of Sustainable Development and Infrastructure	Yes
France	Eco-Carbone S.A.S	No
Japan	Idemitsu Kosan Co.,Ltd. ; Japan Iron and Steel Federation (JISF) ; Japan Petroleum Exploration Co.,Ltd. (JAPEX) ; The Okinawa Electric Power Co.,Inc. ; Sumitomo Chemical ; Sumitomo Joint Electric Power Co.,Ltd ; Suntory Holdings Limited ; The Tokyo Electric Power Co., Inc.	No

A.4. Reference to applied methodologies and standardized baselines

Title: Reforestation or Afforestation of Land Currently under Agricultural Use

Reference: AR-AM0004; Version-03

Tools: The A/R methodological tools applied are noted below.

1. Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities, version 01.0.1 (Annex 24, EB 67).

2. Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities, version 01.0.0 (Annex 28, EB 65).

A.5. Crediting period type and duration

The project activity has a fixed crediting period of 30 years from the project start date i.e., June 25, 2004

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The project activity has been implemented on the degraded farmlands or lands used for rain-fed subsistence agriculture in the two states of India: Orissa and Andhra Pradesh. The project area includes small landholders spread over a total of six districts: Rayagada, Koraput and Kalahandi districts in Orissa and the districts of Visakhapatnam, Srikakulam, and Vizianagaram in Andhra Pradesh. These districts have a pre-dominance of indigenous population, notified as Scheduled Tribes and Scheduled Castes in India, with the majority of them being poor.

The participation of small and marginal farmers representing indigenous communities and their organization as part of the CDM A/R makes this project unique in contributing to their land use choice, improvement of livelihood opportunities and in promoting their capacity to organize and implement climate change mitigation initiatives.

B.2. Post-registration changes

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

As per the “Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents” (Version 02.0) (Annex 24, EB 66), the types of changes from the project description of the A/R CDM project activity in the PDD as listed below are identified as minor in nature. The changes have not impacted the baseline scenario and additionality of the project. The changes applicable to the project to be confirmed by the designated operational entity at the verification stage without the need for submitting a notification of changes to the PDD or a request for revision to the monitoring plan.

Table B.2.1 Types of changes from the description in the registered PDD as outlined in the guidelines (Annex 24, EB66) and their applicability to the project.

No.	Types of changes from the project description in the PDD of an A/R CDM project activity	Applicability to the project
a)	Changes in year-wise areas planted, possibly resulting in a part of the project area not being planted;	Yes
b)	Changes in species composition, if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage;	No. The species composition of the project is consistent with the baseline identification and additionality demonstration made at the validation stage

c)	Changes in stocking density, if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage;	No. The standing density is consistent with the baseline identification and additionality demonstration made at the validation stage.
d)	Changes in timing and choice of silvicultural operations;	Yes, farmers conducted silvicultural operations as per their convenience
e)	Changes in timing of harvest occurring before the second verification;	Yes, farmers harvested plots as per their harvest schedule.
f)	Changes related to collection of non-timber forest products;	No
g)	Changes in tree/shrubs propagation method;	No
h)	Changes in post-harvest re-planting/regeneration methods;	Yes, changes in the post harvest replanting/regeneration methods are observed
i)	Changes in technology employed;	No
j)	Changes in inputs (e.g. fertilizers, certified seeds, watering);	No
k)	Changes in stratification for sampling;	Yes, ex post stratification has been implemented taking into account the changes to ex-ante strata.
l)	Changes in type of sample plots (e.g. temporary, permanent, point-sampling);	No
m)	Changes in number of sample plots and their allocation to strata;	Yes, as a follow up to ex post stratification, the calculation of number sample plots and their allocation has been revised.
n)	Changes in the project boundary (limited to reduction in project area), if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage;	No.
o)	Changes in quality assurance/quality control (QA/QC) procedures, where it can be demonstrated that the changed QA/QC procedures are used by the National Forest Inventory or were applied in another registered A/R CDM project activity;	Yes, Changes in quality assurance/quality control procedures are consistent with procedures used by the national forest inventory and other registered A/R project activities.
p)	Changes in parameters, equations, or methods used in tree biomass estimation, if the applicability of the changed parameters, equations, or methods is demonstrated at verification using the Tool for demonstration of applicability of allometric equations and volume equations in A/R CDM project activities" when available, or if the changed parameters, equations, or methods do not result in a decrease in precision of the estimate of tree biomass;	Yes, Changes in parameters, equations, or methods used in tree biomass estimation are consistent with A/R Tool – "Tool for demonstration of applicability of allometric equations and volume equations in A/R CDM project activities"
q)	Changes from provisions regarding shifting of pre-project activities, if the related emissions are estimated at verification using the tool	Yes, monitoring is done to assess leakage

	"Changes from provisions regarding shifting of pre-project activities, if the related emissions are estimated at verification using the tool "Estimation of the increase in greenhouse gas (GHG) emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity". and are accounted for as leakage;	
r)	Changes in use of fire in site preparation, if the related emissions are estimated at verification using the tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" and are accounted for as project emissions;	Not Applicable
s)	Changes in extent of soil disturbance in site preparation, if the related emissions are estimated at verification using Equation (2) of the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" and are accounted for as project emissions;	Not applicable
t)	Changes in methods of estimation of changes in any carbon pool, if the method applied at verification uses the latest version of the relevant approved tool and the applicability conditions of the methodology applied are consistent with the applicability conditions of the tool.	Yes.

B.2.2. Corrections

No

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

No

B.2.4. Inclusion of monitoring plan

As per the monitoring framework

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

No

B.2.6. Changes to project design

No

SECTION C. Description of monitoring system

Stratification

Taking into account the species planted and technology proposed for implementation, the project was organised into five ex-ante strata. The details of *ex-ante* stratification outlined in the PDD are noted below.

***Ex ante* stratification**

The five *ex ante* strata adopted at the start of the project implementation.

i. AP – Eu (clonal) [AEC]
ii. AP – Eu (seed) [AES]
iii. AP – Casuarina [ACA]
iv. Orissa – Eu (clonal) [OEC]
v. Orissa – Eu (seed) [OES]

Table C1: Strata under *ex ante* stratification of the project (area by strata in ha)

	AEC	AES	ACA	OEC	OES	Total
Area	**587.03**	**51.93**	**381.45**	**380.65**	**206.66**	**1607.72**

As part of the project implementation, areas of the strata that are harvested are expected to be regenerated through coppice or replanting methods in case of Eucalyptus and through replanting method in Casuarina.

Considering the differences in the carbon stock status of areas with standing stock of trees and of areas proposed for regeneration on the project strata, the ex post stratification of the project is undertaken to ensure carbon stock measurement reflects the project implemented on the ground.

Table C2: Area by strata in standing stock and regeneration categories

Category	AEC	AES	ACA	OEC	OES	Total
I. Standing stock strata - Area regenerated (coppice/replanting) and measurable (>2.5 cm dia)	**130.32**	**4.65**	**23.62**	**370.16**	**197.43**	**726.18**
II. Regeneration strata - Area harvested and not replanted and standing stock not measurable (<2.5 cm dia)	456.74	47.30	357.84	10.44	9.25	881.54
Total project area	**587.03**	**51.93**	**381.45**	**380.65**	**206.66**	**1607.72**

***Ex post* stratification at the time of Second Verification**

As part of the *ex post* stratification, area of each *ex ante* stratum is divided into strata representing the following categories.

I. Strata with **standing stock** (i.e., includes trees of above 2.5 cm DBH eligible for measurement). It includes area with standing trees and area of regeneration through coppice or replanting in or before 2016.
II. Strata of **regeneration** after harvest through coppice or replanting (including the coppice area that have standing stock below 2.5 cm DBH and therefore not measurable). It also includes area that is harvested but not replanted; and area of regeneration through coppice or replanting in 2017 and 2018.

The strata resulting from the ex post stratification are presented in the table C6. below.

Table C3: Strata under ex post stratification of the project

Ex ante strata	Ex post strata

	Standing stock (ss)	Regeneration (rg)
AEC	**AECss**	**AECrg**
AES	**AECss**	**AECrg**
ACA	**ACAss**	**ACArg**
OEC	**OECss**	**OECrg**
OES	**OESss**	**OESrg**

It is anticipated that the areas harvested as part of the project implementation will be replanted during the project period. As a consequence, project area under standing stock and regeneration is expected to vary between monitoring/verification periods. The *ex post* stratification is intended to account for the bi-directional transition in the area of standing stock and area proposed for regeneration between the monitoring/verification periods of the project.

Based on the criteria of the *ex post* stratification, 10 strata have been identified in the second monitoring/verification period. The strata and their area is noted in the Table C7 below.

Table C4: Strata as per the ex post stratification

S.No	Ex post strata	Area
	Strata with standing stock	
1	AECss	130.32
2	AESss	4.65
3	ACAss	23.62
4	OECss	370.17
5	OESss	197.43
	Strata with regeneration	
6	AECrg	456.74
7	AESrg	47.27
8	ACArg	357.84
9	OECrg	10.44
10	OESrg	9.25
	Total project area	**1607.72**

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data/Parameter	$BEF_{2,j}$
Unit	
Description	Biomass expansion factor for conversion of stem biomass to above-ground biomass for tree species j
Source of data	GPG LULUCF (2003)
Value(s) applied	*Eucalyptus clone* – 2.00 *Eucalyptus seed* – 2.00
Choice of data or measurement methods and procedures	Carbon stock in living biomass of trees under the project scenario
Purpose of data/parameter	To quantify carbon sequestration in stem biomass to above-ground biomass for tree species j
Additional comments	

Data/Parameter	D_j
Unit	t d.m. m^{-3}
Description	Basic wood density for tree species *j*
Source of data	GPG LULUCF (2003)
Value(s) applied	*Eucalyptus clone* – 0.34 *Eucalyptus seed* – 0.34
Choice of data or measurement methods and procedures	Carbon stock in living biomass of trees under the project scenario
Purpose of data/parameter	To quantify carbon sequestration in stem biomass to above-ground biomass for tree species j
Additional comments	

Data/Parameter	R_j
Unit	
Description	Root-shoot ratio for tree species *j*
Source of data	GHG inventory in LULUCF sector for national communication on GHG inventory
Value(s) applied	*Eucalyptus clone* – 0.35 *Eucalyptus seed* – 0.35 Casuarina – 0.32
Choice of data or measurement methods and procedures	Carbon stock in living biomass of trees under the project scenario
Purpose of data/parameter	To quantify carbon sequestration in tree biomass to below-ground biomass for tree species j
Additional comments	

<table>
<tr><td>Data/Parameter</td><td colspan="2">V_{ijt}</td></tr>
<tr><td>Unit</td><td colspan="2">m^3/tree</td></tr>
<tr><td>Description</td><td colspan="2">Stem volume of trees of species j in sample plot p of stratum i at a point of time in year t, estimated by using the tree dimension(s) as entry data into a volume table or volume equation</td></tr>
<tr><td>Source of data</td><td colspan="2">1. Chaturvedi, A.N. (1995): Volume tables and the regression equation for clonal plants, Tata Energy Research Institute, New Delhi.

2. Chaturvedi, A.N (1974): Tree quality volume tables for Eucalyptus Hybrid, Indian Forester, Vol. 100, No. 10, pages 595-600.</td></tr>
<tr><td rowspan="2">Value(s) applied</td><td colspan="2">Tree species – V_{ijt}</td></tr>
<tr><td>Eucalyptus clone
Eucalyptus seed</td><td>$V = 0.00258 + 0.0281\, g^2 * H$
$V = -0.37767 + 0.032996 * D^2 * H$</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td colspan="2">Carbon stock in living biomass of trees under the project scenario.</td></tr>
<tr><td>Purpose of data/parameter</td><td colspan="2">To quantify carbon sequestration in tree biomass to above-ground biomass for tree species j</td></tr>
<tr><td>Additional comments</td><td colspan="2"></td></tr>
</table>

ID number	E.4.1.1.42(PDD parameter)
Data/Parameter	*fj(DBH,H)*
Description / Unit	Allometric equation for species *j* linking aboveground tree biomass (kg tree-1) to diameter at breast height (DBH) and tree height (H) measured on plots for stratum *i*, species *j*, time *t*
Value:	B= -0.37767 + 0.032996*(D^2)*H kg $tree^{-1}$
Source of data:	B. Mohan Kumar, Suman Jacob George, V. Jamaludeen and T.K. Suresh (1998). Comparison of biomass production, tree allometry and nutrient use efficiency of multipurpose trees grown in woodlot and silvopastoral experiments in Kerela, India. Forest Ecology and Management (112) pp. 145-163.
Recording Frequency	Once per species
Justification of choice / Measurement procedures (if any):	for all major species or group of species
Any Comment:	

Data/Parameter	CF_j
Unit	
Description	Carbon fraction of tree biomass
Source of data	IPCC Default
Value(s) applied	0.5
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Carbon stock in living biomass of trees under the project scenario.
Purpose of data/parameter	To quantify carbon sequestration in tree biomass to above-ground biomass for tree species j
Additional comments	

ID number	E.5.1.44(PDD parameter)
Data/Parameter	*NaBL*
Description of animals / Unit	E*ex ante* estimated pre-project number of animals from the different livestock groups that would be grazing in the project area under the baseline scenario
Value:	Dimensionless
Source of data:	AR-CDM-PDD
Recording Frequency	*Ex ante* in AR-CDMPDD
Justification of choice / Measurement procedures (if any):	The summation of the livestock of pre-project land parcels of all six districts resulted in the livestock estimate of the baseline scenario NaBL=1943 used in equation 36 of the methodology. We have also taken the baseline from the actual survey from 120 sample farmers from six strata.
Any Comment:	This estimate is fixed for the entire crediting period and is specified in the AR-CDM-PDD

D.2. Data and parameters monitored

(Copy this table for each data or parameter.)

ID number	E.4.1.1.03(PDD parameter)
Data/Parameter	PL_{ID}
Unit	
Description	Sample plot ID
Measured/calculated/ default	alpha numeric
Source of data	Project and plot map, GIS
Value(s) of monitored parameter	Alpha numeric
Monitoring equipment	Datasheets
Measuring/reading/recording frequency	Prior to start of project and during monitoring period
Calculation method (if applicable)	
QA/QC procedures	
Purpose of data/parameter	Sample plot identification for monitoring purpose
Additional comments	The project does not have any permanent sample plots as the rotation of plantation happens on continuous basis.

ID number	E.4.1.1.04(PDD parameter)
Data/Parameter	PLik
Unit	
Description	Total number of plots in stratum i, stand model k
Measured/calculated/ default	alpha numeric
Source of data	Field measurement
Value(s) of monitored parameter	Alpha numeric
Monitoring equipment	Datasheets
Measuring/reading/recording frequency	Defined
Calculation method (if applicable)	
QA/QC procedures	
Purpose of data/parameter	Total number of plots were recorded for each stratum
Additional comments	

ID number	E.4.1.1.10 (PDD parameter)
Data/Parameter	A
Unit	Ha
Description	Total of all strata (A), e.g. the total project area
Measured/calculated/ default	Measured
Source of data	Records of project monitoring

Value(s) of monitored parameter	Numeric (area in ha)
Monitoring equipment	GIS analysis and revenue documents of farmers
Measuring/reading/recording frequency	Prior to start of project & updated during each monitoring period
Calculation method (if applicable)	
QA/QC procedures	
Purpose of data/parameter	For monitoring the total area currently under plantation
Additional comments	Total area of the project is A=1607.72ha

ID number	E.4.1.1.11(PDD parameter)
Data/Parameter	*Ai*
Unit	Ha
Description	Area of each stratum
Measured/calculated/ default	Calculated
Source of data	Records of project monitoring
Value(s) of monitored parameter	Area in ha
Monitoring equipment	GIS analysis and revenue documents of farmers
Measuring/reading/recording frequency	Prior to start of project & updated during each monitoring period
Calculation method (if applicable)	
QA/QC procedures	
Purpose of data/parameter	For monitoring area under each stratum
Additional comments	

ID number	E.4.1.1.13 (PDD parameter)
Data/Parameter	*Aikt*
Unit	Ha
Description	Area of stratum *i*, stand model *k*, at time
Measured/calculated/ default	Calculated
Source of data	Project records
Value(s) of monitored parameter	Area in ha
Monitoring equipment	GIS analysis and revenue documents of farmers
Measuring/reading/recording frequency	Measured in each Monitoring period
Calculation method (if applicable)	Ex post stratification, see Table C.7
QA/QC procedures	
Purpose of data/parameter	For monitoring area under each stratum
Additional comments	Measured for different strata and Stands

ID number	E.4.1.1.15 (PDD parameter)
Data/Parameter	*AP*
Unit	Ha
Description	Sample plot area
Measured/calculated/ default	Measured
Source of data	Field measurement
Value(s) of monitored parameter	0.0256 Ha
Monitoring equipment	Measuring tape and GPS coordinates
Measuring/reading/recording frequency	Measurement in each monitoring period
Calculation method (if applicable)	Ex post stratification, see Table C.7
QA/QC procedures	
Purpose of data/parameter	For monitoring area under each stratum
Additional comments	Measured for different strata and Stands

ID number	E.4.1.1.28 (PDD parameter)
Data/Parameter	*DBH*
Unit	Cms
Description	Diameter at breast height of living and standing dead trees
Measured/calculated/ default	Measured
Source of data	Plot measurement
Monitoring equipment	Measuring tape and GPS coordinates
Measuring/reading/recording frequency	Measurement in each monitoring period
Calculation method (if applicable)	Values are available in the inventory system. The data from sample plots is available in the spreadsheet for calculations of net GHG removals
QA/QC procedures	
Purpose of data/parameter	For monitoring biomass in living and standing dead trees
Additional comments	Measuring at each monitoring time per sampling method

ID number	E.4.1.1.65 (PDD parameter)
Data/Parameter	*H*
Unit	Meters
Description	Tree height in meters
Measured/calculated/ default	Measured
Source of data	Field measurement
Value(s) of monitored parameter	Values available from the tree measurements on sample plots

Monitoring equipment	Type: Ravi altimeter Accuracy class: 1 meter
Measuring/reading/recording frequency	Measurement in each monitoring period
Calculation method (if applicable)	
QA/QC procedures	Calibration frequency: When in usage, every half yearly when not in usage, immediately before using it. a Dates of last calibration: Mar 2018 Validity: 6 months if in use
Purpose of data/parameter	For measuring the tree height
Additional comments	Measured for different strata and Stands

ID number	E.4.1.1.64 (PDD parameter)
Data/Parameter	*nTRPLikt*
Unit	Number of trees
Description	Number of trees in the sample plot
Measured/calculated/ default	Counted
Source of data	Plot measurement
Value(s) of monitored parameter	Number
Monitoring equipment	Physical counting
Measuring/reading/recording frequency	Measurement in each monitoring period
Calculation method (if applicable)	
QA/QC procedures	
Purpose of data/parameter	100% trees in plots / Measured Recorded is maintained.
Additional comments	Counted in plot measurement

ID number	E.5.1.43(PDD parameter)
Data/Parameter	*NaAR,t*
Unit	Number of animals
Description	Monitored number of animals present in the project area at year *t*
Measured/calculated/ default	Counted
Source of data	Field measurement
Value(s) of monitored parameter	
Monitoring equipment	Physical counting
Measuring/reading/recording frequency	Yearly
Calculation method (if applicable)	

QA/QC procedures	
Purpose of data/parameter	For the Ex ante estimation on the number of animals that the project supports, the fodder production capacity of project lands was assessed from the sample survey of 120 farmers 20 from each strata.
Additional comments	

D.3. Implementation of sampling plan

Procedure for calculation of number of sample plots:

The methodology AR AM0004 version 3 presents equations to assess the number of sample plots required for monitoring to keep a maximum permissible error of ±10% of the mean, at a 95% confidence level. The “Guidelines on application of specified versions of A/R CDM methodologies in verification of registered A/R CDM project activities” (Version 01.0), revised the sampling requirements to meet the required permissible error of ±10% of the mean and a 90% confidence level, which are adopted for the calculation of the number of sample plots required for monitoring of the project. The following equations of the methodology were used to calculate the number of sample plots required under *ex post* stratification.

Equation 67 of AR AM0004, Version 3

$$n = \frac{\left[\sum_{h=1}^{L} N_i \cdot st_i\right]^2}{\left(N \cdot \frac{E_1}{z_{\alpha/2}}\right)^2 + \sum_{i=1}^{L} N_i \cdot (st_i)^2}$$

Equation 68 of AR AM0004, Version 3

$$n_i = \frac{\sum_{i=1}^{L} N_i \cdot st_i}{\left(N \cdot \frac{E_1}{z_{\alpha/2}}\right)^2 + \sum_{i=1}^{L} N_i \cdot (st_i)^2} \cdot N_i \cdot st_i$$

Where

L = total number of strata
z = z value for a confidence level (90%)
E = allowable error (±10% of the mean), E = Q * DLP;
st_i = standard deviation of stratum i
n_i= number of samples per stratum allocated
N = number of total sample units (all stratum), $N = \sum N_i$
N_i= number of sample units for stratum i, calculated by dividing the area of stratum i by the area of the sample plot of 256 m^2 (16 x 16 meter).

Q = Approximate average value of the estimated quantity *Q*, (e.g. wood volume); e.g. m^3ha^{-1}

DLP = Desired level of precision (e.g. 10%); dimensionless

The parameters of the strata in terms of their area, mean carbon stock, and standard deviation under the ex post stratification are used for calculation of the number of sample plots.

Area of strata: The area of the strata reflect the area with **standing stock** and **regeneration** at the end of the monitoring period.

Mean carbon stock of strata (Qi): Mean carbon stock of a stratum reflects the quantity of biomass present on the land parcels of the strata. Because of the changes in area of standing stock and area of regeneration subsequent to harvests, the mean carbon stock of strata could vary between monitoring periods.

Standard deviation of the carbon stock of strata (sti): Standard deviation in the carbon stock of strata is expected to vary because of the differences in the growth rates of stands on different lands parcels, and harvest and regeneration decisions of farmers.

Coefficient of variation (CV): Coefficient of variation as the ratio of standard deviation and mean carbon stock of a stratum expressed in percent reflects the variability of carbon stock of different strata of the project.

Table C.5 presents the parameters in the calculation of number sample plots required for calculation of carbon stock change during the first monitoring period. The area of strata indicates the area of standing stock and regeneration during this period. The mean carbon stock and standard deviation are based on the measurements conducted on the sample plots laid out on the project land parcels.

The mean carbon stock and standard deviation of the carbon stock of strata under **regeneration** are considered zero as these strata have land parcels/stands that have been harvested but not planted or replanted/regenerated through coppice but have tree vegetation below the measurable threshold of 2.5 cm DBH. Therefore, mean stock and standard deviation of the mean carbon stock of these strata are zero.

Table D.1: Parameters supporting calculation of number of sample plots

Strata	Units	AECss	AESss	ACAss	OECss	OESss	AECrg	AESrg	ACArg	OECrg	OESrg
Stratum i	Ha	130.32	4.65	23.62	370.17	197.43	456.74	47.27	357.84	10.44	9.25
Mean Qi	t C/ha	19.73	10.22	76.48	18.43	8.77	0	0	0	0	0
Sti	t C/ha	6.19	0.20	0.20	7.04	6.22	0	0	0	0	0
Coef.var	%	31.37	1.96	0.26	38.20	70.92	0	0	0	0	0
N	Integer	28,637	28,637	28,637	28,637	28,637	0	0	0	0	0
Ni	integer	5,091	182	923	14,460	7,712	0	0	0	0	0
Z α/2	integer	1.645	1.645	1.645	1.645	1.645	0	0	0	0	0

The number of sample plots by strata calculated based on mean carbon stock and standard deviation of the carbon stock based on the sample plot measurements to meet the permissible error limit of 10% of the mean and a confidence interval of 90% is presented in Table C6. The sample plot calculation sheet is attached as Annex 2 (separate file).

Table D.2: Sample plots in project area by strata.

Strata	Sample plots required to meet 90% confidence interval and 10% precision	Sample plots established in the project strata

AECss	6	10
AESss	0	1
ACAss	0	1
OECss	19	32
OESss	9	11
AESpr	**0**	**0**
AESpr	**0**	**0**
ACApr	**0**	**0**
OECpr	**0**	**0**
OESpr	**0**	**0**
Total	**35**	**55**

Location of sample plots

To avoid subjective choice of plot locations, the permanent sample plots are located following simple random sampling. For the purpose all discrete land parcels/stands within the project's boundary are listed in Annex 1[1]. From the land parcels/stands of strata, the sample plots are randomly picked and sample plot IDs were assigned to them. This has been repeated for each strata to get the required number of sample plots.

All sample plots, their GPS coordinates, location of stand, name of farmer, village name, district name and the state recorded and archived in the project database. Each plot is given a sample plot ID and this has also been plotted on a map and the project documents.

<u>Procedure for data collection on sample plots</u>

Carbon stock changes over time are calculated as per the steps below.

i) Procedure for measurement of tree biomass

Tree diameter: Measurements for diameter at breast height (1.37 m) were conducted. The minimum diameter measured was 2.5 cm. The trees with DBH greater than 2.5 cm on sample plots were measured.

Tree height - Height of all trees on a sample plots were measured with altimeter. Calibration of altimeter was conducted prior to conducting tree height measurements on each sample plot.

Measurements and data recording and processing were carried out in accordance with QA/QC procedures.

ii) Calculation of volume, carbon stock and carbon stock change

Data to assess the change in aboveground carbon stock is based on the measurements of sample plots. Carbon stock changes over time is calculated following the stock change approach.

For strata with Eucalyptus, the volume per tree of the aboveground biomass corresponding to the measured diameters is assessed from the volume equations. The volume is then multiplied by number of trees on the sample plot to obtain volume per sample plot. Volume per plot is calculated as a product of volume per hectare and sample plot area. From the volume of trees, carbon stock in CO_2 is calculated using the parameters on wood density, biomass expansion factor (BEF), and carbon fraction (CF).

[1] Attached as separate file.

For stratum with Casuarina, allometric equation method is used to calculate the carbon stock change. The biomass estimated from allometric equation is then multiplied by number of trees on the sample plot to obtain above ground biomass per sample plot and hectare. From the aboveground biomass of trees, carbon stock in CO_2 is calculated using the parameters on root shoot ratio, wood density, biomass expansion factor (BEF), and carbon fraction (CF).

iii) Monitoring of project emissions by sources

There were no GHG emissions associated with the implementation of the project as there was no biomass burning involved in the site preparation and site preparation and planting activities were carried out using manual methods. Therefore, project emissions are considered zero. The monitoring activity covers natural fires. No fire has occurred during the current monitoring period. Records evidencing the non-occurrence of fire are maintained at the JKPL office and will be shared at the time of verification.

iv) Monitoring leakage

Displacement of grazing - The ex ante assessment indicated that the displacement of grazing is not expected to occur as a result of the project as additional fodder is produced in the project area. During project implementation number of animals in the project area were estimated using household survey and converted to number of animal equivalent units supported by the project (NaAR,t). Random sample of animal owner households whose land parcels are the discrete areas of the project was used to conduct survey. The survey of the 120 households out of 1590 project households was conducted on sample basis (20 farmers from each district. The results of the surveys showed that no animals were displaced out of the project area. Therefore, leakage associated with the displacement of grazing is zero

Displacement of fuel-wood collection - Lands under the project do not contain any tree growth in the baseline scenario. As mentioned in the PDD (Section 5.1.3), FGBL <FGAR,t holds throughout the project crediting period. As the project produces more fuel-wood in comparison to the baseline, there has been no fuel-wood leakage. Hence as stated in the PDD, no monitoring of the leakage from displacement of fuel-wood collection outside the project is required in the project.

Organisational Structure:

A Project Management Unit (PMU) has been formed and it comprises of an Executive Body and an Advisory Board. Members belong to both VCCSL and JKPL. The Advisory Board consists of Dr. M. Satyanarayana (IFS Retd.), VCCSL and Mr. P. K.Suri (EVP (Works) JKPL.

The Executive Body is consisting of Mr. B.P. Ratho (GM RMP,JKPL), Mr. Biswajeet Deb (GM Accts JKPM,JKPL), Mr. N. Sai Kishore (Executive Director, VCCSL), AshutoshMahana (Asst Manager Pl JKPM,JKPL), Mr.Sushanta Behuria(Dy Manager Accounts, JKPM, JKPL), and , Mr. Ch. Suresh Babu, (Business Development Executive, VCCSL), & Ms. Chinnamamba (Statistician, VCCSL).

The PMU is supported by two Project Implementation Units (PIUs) at Kakinada and Rayagada which are under the charge of Mr. Suresh Babu and Mr. Ashutosh Mahana respectively.

Roles and Responsibilities:

Management

1. Mr. Sai Kishore (Executive Director, VCCSL): He is the Project Director. He holds the overall responsibility of the PMU and coordinates with the World Bank, VCCSL and JKPL.

2. Mr. B.P.Ratho (GM (Forest) JKPL): He is responsible for overall co-ordination with field staff and provides guidance for implementation of the monitoring process.

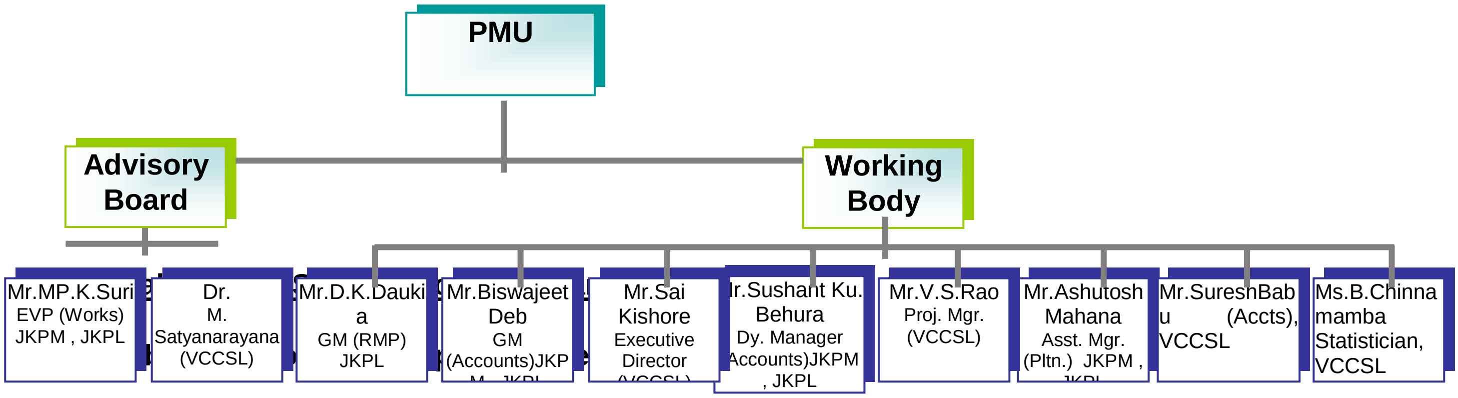
<u>Account Keeping</u>

1. Mr. Biswajit Deb (GM (Accounts) JKPM, JKPL): He is responsible for and oversees project account keeping and regular audit of statements.
2. Mr. SushanataKu.Behura (Dy Manger (Accounts) JKPM, JKPL): He maintains information on project expenses related to PIU, Rayagada. He is responsible for proper account keepings of the PIU at Rayagada.
3. Mr. SureshBabu (VCCSL): He is responsible for proper account keeping of the PIU and PMU at Visakhapatnam

<u>Operations & MRV</u>

2. Mr.Ashutosh Mahana (Asst. Manager (Pl) JKPM, JKPL): He is the Project Manager for PIU at Rayagada. He is responsible for all the documentation aspects including monitoring which are to be maintained at PIU level at Rayagada. He is also responsible for administration of staff and community training for the monitoring systems and data management and storage of data collected during field work. He assists the Project Director for operations of the PMU.

3. Ms. B.Chinnamamba (Statistician, VCCSL): She assists the PMU / PIUs in monitoring, verification and data management and will also be responsible for Quality Assurance / Quality control measures like verifying field data collected.



Task and Responsibility	Method Used	Frequency	Responsible Role	Contact details
Staff training for monitoring systems		Annually and as new staff and community members are recruited	JKPL Manager	Mr.AshutoshMahana (Asst. Manager (Pl) JKPM, JKPL) ashutosh@jkpm.jkmail.com
Operation of monitoring equipment	As per equipment instructions	Review annually	JKPL Manager	Mr.AshutoshMahana (Asst. Manager (Pl) JKPM, JKPL) ashutosh@jkpm.jkmail.com
Quality control of monitoring	Manual of monitoring	Annual	JKPL Manager	Mr.AshutoshMahana (Asst. Manager (Pl) JKPM, JKPL)

equipment				ashutosh@jkpm.jkmail.com
Coordination of field data collection	Manual of monitoring	Annual	JKPL Manager	Mr.AshutoshMahana (Asst. Manager (PI) JKPM, JKPL) ashutosh@jkpm.jkmail.com
Data cross-check of field measurements	Manual of monitoring	Annual	VCCSL Project Manager	Mr. Sai Kishore (Executive Director, (VCCSL) nellore_kishore@hotmail.com
Calculation of emissions reductions and deviations from projections	SMART forms	Annual	VCCSL Statistician	Mrs.Chinnamamba (Statistician – VCCSL) chinna@vccslindia.org
Coordination of Quality Assurance / control		Annual	VCCSL Project Manager	Mr. Sai Kishore (Executive Director) (VCCSL) Nellore_kishore@hotmail.com
Sign off of monitoring reports and ER calculations		Annual	VCCSL and JKPL Project Manager	Mr. Ashutosh Mahana (Asst. Manager (PI) JKPM, JKPL) ashutosh@jkpm.jkmail.com and Mr. Sai Kishore (Executive Director) (VCCSL)
Verifying and comparing the ERs with the projections made in PDD		Annual	VCCSL	Mr. Sai Kishore, Executive Director, VCCSL Nellore_kishore@hotmail.com

Emergency Procedures:

Procedures to assess the GHG emissions due to fire in the boundary

The project depends on local communities for implementing the fire management plan. The fire prevention measures such as establishment of fire lines, reduction of fuel load, clearance of brushwood and dry vegetation close to the project parcels have been implemented.

In case of accidental fires, the area and carbon stock affected would be assessed using field surveys and measurement. No fire has occurred during the current monitoring period. Records evidencing the non-occurrence of fire are maintained at the JKPL office and will be shared at the time of verification.

Procedures to assess the impact of pest infestation on the carbon stock of the project

In case of pest damage, monitoring team assesses the area affected and the carbon stock of the pest affected area and implement pest management measures to minimize negative impacts on the remaining carbon stock in the project boundary and to prevent the spread of infestation to areas outside project boundary. There have been no major instances of pest infestation under the project.

Impact of weather related disturbances on carbon stocks in the project boundary

Procedures have been implemented to assess the weather-related disturbances events such as droughts and floods in the project area and survival of plantations in the affected areas. The data from field surveys of the affected areas is used to assess the impact of droughts and floods on the carbon stock of the project. No weather-related disturbances have been noticed in the project boundary.

<u>Quality Assurance and Quality Control (QAQC) Measures:</u>

To reduce uncertainty while monitoring the carbon stock changes in the project context and to ensure that the net anthropogenic GHG removals by sinks are measured and monitored precisely, credibly, verifiably and transparently, a quality assurance and quality control (QA/QC) procedure has been implemented:

a) Reliable field measurements

To ensure reliable field measurements,

Standard Operating Procedures (SOPs) for each step of the field measurements, including all detail phases of the field measurements and provisions for documentation for verification purposes have been prepared.

Training courses on the field data collection and data analyses have been held for persons involved in the field measurements. The training courses ensure that each field-team member is fully aware of all procedures and the importance of collecting data as accurately as possible.

Table D.3 List of trainings held for project team members.

Sl. No.	Date	Training Programme	Persons attended
1	6/4/2015	GPS Use for boundary demarcation of plantation field	10 persons 8 from JKPL & 2 from VCCSL
2	14/12/2015	GPS Use for boundary demarcation of plantation field	5 persons from JKPL.
3	15/04/2016	Monitoring & Evaluation along with roles & responsibility	10 persons 8 from JKPL & 2 from VCCSL
4	21/12/2016	Leakage concept & monitoring of sample plots	5 persons from JKPL.
5	01/03/2017	Monitoring & Evaluation along with roles & responsibility	10 persons 8 from JKPL & 2 from VCCSL
6	06/02/2018	GPS Usage and Sample plot tree measurement	10 persons 8 from JKPL & 2 from VCCSL

- 15 Project staffs both of JKPL & VCCSL were given training on using the GPS meters for taking the coordinates of the project boundaries.
- 20 project staff both of VCCSL & JKPL were trained in monitoring and evaluation, with the goal of clarifying monitoring requirements of the project, and assigning clear roles and responsibilities for all stakeholders.
- 15 project staff including both of JKPL & VCCSL was trained in leakage concept, monitoring and management of sample plot.

b) Verification of field data

Sample plots have been established and the measurements were taken periodically. Randomly selected plots were re-measured by teams other than those that were involved in measurements in the previous round of data collection and measurements. - The selected sample plots were monitored throughout the year. After the schedule was finalized, the inventory teams were able to go into the field and start the measurement process. In the measurement process four key items were checked and recorded (1) sample plot geographical position (using a GPS); (2) area of the sample plot; (3) tree height of all trees; and (4) the diameter at breast height (DBH). Where a deviation of more than ± 5% was found the field team has to re-measure once again to correct the

mistake. The non-conformities procedures, depending on the seriousness, can vary from a report to the re-training of the inventory team.

c) Verification of data entry and analysis

To minimize the possible errors in the process of data entry, the entry of both field data data were reviewed by an independent project team. The data entered was checked by VCCSL representative and the same was further verified by the project manager to cross- check the validity of data entry. 10% of the data is rechecked by VCCSL representative on a sample basis. Signed copies of the same are available with the PMU for verification.

d) Data maintenance and archiving

Data has been archived in both electronic and paper forms, and copies of data has been provided to all participating farmers. All electronic data and reports are also copied on durable media such as CDs and copies of the CDs are stored in multiple locations. The archives include:

Copies of all original field measurement data, laboratory data, data analysis spreadsheet;

GPS coordinates and other spatial data;

Estimates of the carbon stock changes in all pools and non-CO2 GHG and corresponding calculation spreadsheets;

Copies of the measuring and monitoring reports.

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

The lands under the project are all discrete parcels owned by individual farmers. Dry land agriculture has been practiced on these lands for a long period. The subsistence agriculture on laterite and sandy soils in semi-arid climate with short rainy and prolonged dry seasons contributed to steep decline in the productivity of lands. These lands are expected to remain under subsistence agriculture or as fallow lands in the absence of the project. Considering the use of lands for agriculture, the pre-existing vegetation is also either absent or insignificant.

According to the methodology, the baseline carbon stock changes do not need to be monitored because the accepted baseline approach 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.

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

According to the PDD the project is not expected to result in emissions for the following reasons:

Most of the lands under the project are barren and do not contain any tree growth. The grass and herbaceous vegetation (present in insignificant quantities as the lands are under subsistence agriculture or short-term fallow lands) is cleared through manual ploughing to prepare land for planting activity. The farmers do not practice biomass burning in site preparation; as a consequence, emissions from biomass burning are zero. The project also does not use machinery in site preparation, thinning and harvesting. Therefore, there are no emissions associated with the use of machinery in site preparation and logging. Additionally, as per the decision of paragraph 37 of EB44, the GHG emissions associated with fertilizers, removal of herbaceous vegetation and transportation are insignificant and can be ignored.

Considering that no project GHG emissions are expected to be significant, the project emissions are considered **zero**. The only GHG emissions relevant for the project are the GHG emissions associated with the natural fires, which are proposed to be monitored and recorded for the *ex post* calculations.

$GHG_E = 0$

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

E.3. Calculation of leakage emissions

Leakage due to fencing: The fencing is done by using thin branches, twigs etc., by tying with jute rope and after a period of one year i.e. once the plantation attains manageable height, these are used as fuel wood. The activity displacement due to use of this fuel wood for fencing is negligible as the total acreage under the plantation in comparison to average land under CDM per village is negligible.

Leakage due to fuel wood collection: Lands under the project do not contain any tree growth in the baseline scenario. Only grass and herbaceous vegetation is present in insignificant quantities. As a consequence, the pre-project annual fuel-wood gathering in the project area is **zero**.

$FG_{BL} = 0$

Leakage due to displacement for fuel-wood collection is set as zero ($LK_{fuel\text{-}wood} = 0$) as the information gathered from the actual material harvested from the plantation and is monitored regularly by field staffs. The harvesting data of the project indicate that the fuel-wood production is increased significantly as result of the project. Consequently, $FG_{BL} < FG_{AR,t}$ will hold throughout the project crediting period. Therefore, **no** monitoring of the leakage from displacement of fuel-wood collection outside the project is required in the project as also stated in section 5.1.3 of the PDD.

Leakage due to vehicle emission: As per the paragraph 35, EB 42 report, emissions associated with transportation are considered insignificant and can be neglected. Therefore, emissions from the transport of personnel to areas outside the project boundary and products to the market are not required to be monitored.

Leakage due to animal displacement: We are monitoring the animal population year wise of the household of the farmers on sample basis (20 Farmers from each district), a total of 120 farmers out of 1590 farmers of the total area. The result shows a marginal increase in the animal population of the households.

Following table depicts animal trend:

Animal	No. of Farmers	2011	2012	2013	2014	2015	2016	2017	2018	Chang
Cow	1590	142	143	143	144	144	145	145	145	3
Buffalo		116	117	117	120	122	123	123	125	9
Bullock		140	140	141	141	142	143	143	144	4
Goat		185	188	194	197	201	205	220	225	40
Sheep		40	43	48	54	57	61	64	70	30
G Total (AEU) for sample farmers		443	446.2	449.4	455.2	459.6	464.2	467.8	473	30
G Total (AEU) FOR 1590 FARMERS		5344.01	5364.01	5387.38	5421.00	5475.10	5524.05	5566.89	5628.78	285.8

The following steps are followed in order to calculate leakage associated with displacement of grazing activities.

Step 1: Data collection from 20 farmers from each district.

Step 2: Extrapolate the data for the same district based on the number of farmers in that districts.
Step 3: Year wise compilation of animal equivalent for 1590 farmers.

The livestock population in the region includes cow, bullocks, sheep, and goat considering the differences in the biomass intake of different categories of livestock, they are expressed in animal equivalent units (AEU) to assess the fodder requirements during the pre- project period.

The units of conversion for estimating the animal equivalent units (AEU) are as below.
Cow, bullock, and buffalo = 1 AEU
Goat = 0.2 AEU
Sheep = 0.2 AEU

The above table shows the change in the Animal Equivalent Units (AEU) for each district. As seen in the table the change in AEU from baseline scenario for each district is around 5.5%, which is insignificant. The fodder production on the farms is adequate to meet the fodder requirement of these livestock. Thus we can conclude that there is virtually no animal displacement out of the project area and leakage due to animal displacement can be considered as zero.

Summing of all these above points, leakage from fuel wood collection, fencing and vehicle emissions and animal displacement is identified as zero.

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

The emission reductions are calculated applying the equations of the methodology to the data collected from the measurement of trees on the sample plots located on the discrete areas of the project.

The verifiable changes in carbon stock represent the carbon stock changes in above-ground biomass and below-ground biomass within the project boundary, estimated using the equations:

$$\Delta C_{P,LB_T} = \sum_{t=1}^{t^*} \sum_{i=1}^{S_{ps}} \sum_{k=1}^{K} \Delta C_{P,ikt}$$

(Equation 65 of the methodology)

Where:

$\Delta C_{P,LB}$	Sum of the changes in living biomass carbon stocks (above- and below-ground); t CO_2-e
$\Delta C_{P,ikt}$	Annual carbon stock change in living biomass for stratum *i*, stand model *k*, time *t;* t CO_2-e yr^{-1}
i	1, 2, 3, ... S_{ps} strata of the project activity
k	1, 2, 3, … *K* stand models
t	1, 2, 3, ...*t** years elapsed since the start of the A/R project activity

and

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

(Equation 66 of the methodology)

where:

$\Delta C_{P,ikt}$	Annual carbon stock change in living biomass for stratum *i,* stand model *k*, time *t;* t CO_2-e. yr^{-1}
$\Delta C_{AB,ikt}$	Annual carbon stock change in above-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}
$\Delta C_{BB,ikt}$	Annual carbon stock change in below-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}

The mean change in carbon stocks in above-ground biomass and below-ground biomass per unit area are based on the measurements on permanent plots.

Two methods available for the estimation of carbon stock are used to calculate the biomass growth: Biomass Expansion Factors (BEF) method and Allometric Equations method.

As per the Annex 27, EB63, paragraph 3(p), BEF method is used to calculate the carbon stock change of Eucalyptus clone and Eucalyptus seed strata; and allometric equation is used for calculating the carbon stock change of Casuarina.

BEF method

The volume of the commercial component of trees into carbon stock in above-ground biomass and below-ground biomass via basic wood density, BEF root-shoot ratio and carbon fraction, given by:

$$MC_{AB,ijt} = MV_{ijt} \cdot D_j \cdot BEF_j \cdot CF_j$$ **(Equation 67 of the methodology)**

$$MC_{BB,ijt} = MC_{AB,ijt} \cdot R_j$$ **(Equation 68 of the methodology)**

where:

$MC_{AB,ijt}$ Mean carbon stock in above-ground biomass per unit area for stratum *i*, species *j*, time *t;* t C ha^{-1}

$MC_{BB,ijt}$ Mean carbon stock in below-ground biomass per unit area for stratum *i*, species *j*, time *t;* t C ha^{-1}

MV_{ijt} Mean merchantable volume per unit area for stratum *i*, species *j*, time *t;* m^3 ha^{-1}

D_j Volume-weighted average wood density; t d.m. m^{-3} merchantable volume

BEF_j Biomass expansion factor for conversion of biomass of merchantable volume to above-ground biomass; dimensionless

CF_j Carbon fraction; IPCC default value = 0.5; t C $(t\ d.m.)^{-1}$

R_j Root-shoot ratio; dimensionless

The total carbon stock in living biomass for stratum *i,* species *j*, time *t* is calculated from the area for stratum *i,* species *j*, time *t* and the mean carbon stocks in above-ground biomass and below-ground biomass per unit area, as follows:

$$C_{AB,ikt} = A_{ikt} \cdot MC_{AB,ikt}$$ **(Equation 69 of the methodology)**

$$C_{BB,ikt} = A_{ikt} \cdot MC_{BB,ikt}$$ **(Equation 70 of the methodology)**

where:

$\Delta C_{AB,ijt}$ Annual carbon stock change in above-ground biomass for stratum *i*, species *j*, time *t;* t C yr^{-1}

$\Delta C_{BB,ijt}$ Annual carbon stock change in below-ground biomass for stratum *i*, species *j*, time *t;* t C yr^{-1}

A_{ijt} Area of stratum *i*, species *j*, at time *t*; hectare (ha)

<u>Note</u>: The area of a stratum *i* planted with species *j* in stand model *k* has a time notation because stands with species *j* will be established (planted) at different dates.

$MC_{AB,ijt}$ Mean carbon stock in above-ground biomass per unit area for stratum *i,* species *j*, time *t;* t C ha^{-1}

$MC_{BB,ijt}$ t C ha^{-1} Mean carbon stock in below-ground biomass per unit area for stratum *i,* species *j*, time *t;*

The change in carbon stock in living biomass over time is given by:

$$\Delta C_{AB,ikt} = \frac{\sum_{j=1}^{J}(C_{AB,ikt_2} - C_{AB,ikt_1})}{T}$$ **(Equation 71 of the methodology)**

$$\Delta C_{BB,ikt} = \frac{\sum_{j=1}^{J}(C_{BB,ikt_2} - C_{BB,ikt_1})}{T}$$ **(Equation 72 of the methodology)**

where:

$\Delta C_{AB,ikt}$	Annual carbon stock change in above-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}
$\Delta C_{BB,ikt}$	Annual carbon stock change in below-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}
$C_{AB,ijt2}$	Carbon stock in above-ground biomass for stratum *i*, species *j*, calculated at time $t = t_2$; t C
$C_{AB,ijt1}$	Carbon stock in above-ground biomass for stratum *i*, species *j*, calculated at time $t = t_1$; t C
$C_{BB,ijt2}$	Carbon stock in below-ground biomass for stratum *i*, species *j*, calculated at time $t = t_2$; t C
$C_{BB,ijt1}$	Carbon stock in below-ground biomass for stratum *i*, species *j*, calculated at time $t = t_1$; t C
T	Number of years between monitoring time t_2 and t_1 ($T = t_2 - t_1$); years
j	Species *j* (*J* = total number of species)

Allometric equation method

The allometric equation adopted for Casuarina confirms to 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). The steps of the methodology with allometric equation method are applied to calculate the carbon stock change in the stratum ACA, that has areas growing Casuarina.

$$TB_{ABj} = f_j(DBH, H)$$ **(Equation 73 of the methodology)**

where:

TB_{ABj}	Above-ground biomass of a tree; kg tree^{-1}
$f_j(DBH,H)$	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*

The carbon stock in above-ground biomass per tree is calculated by applying the allometric equation to the tree measurements.

$$TC_{ABj} = TB_{ABj} \cdot CF_j$$ **(Equation 74 of the methodology)**

where:

TC_{AB}	Carbon stock in above-ground biomass per tree; kg C tree^{-1}
TB_{ABj}	Above-ground biomass of a tree of species *j*; kg tree^{-1}
CF	Carbon fraction (IPCC default value = 0.5); t C (t d.m.)$^{-1}$

The increment of above-ground biomass carbon accumulation is done by subtracting the biomass carbon at time 2 from the biomass carbon at time 1.

$$\Delta TC_{ABjT} = TC_{ABj,t2} - TC_{ABj,t1}$$ **(Equation 75 of the methodology)**

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 t_2; kg C tree^{-1}
$\Delta TC_{ABj,t1}$	Carbon stock change in above-ground biomass per tree of species *j* at monitoring event t_1; kg C tree^{-1}

The change in biomass carbon per tree within each plot is calculated by multiplying with plot expansion factor which is proportional to the area of the measurement plot.

$$\Delta PC_{ABikT} = \frac{XF \cdot \sum_{tr=1}^{TR} \Delta TC_{ABjT,tr}}{1000}$$ **(Equation 76 of the methodology)**

$$XF = \frac{10{,}000}{AP}$$ **(Equation 77 of the methodology)**

where:

$\Delta PC_{AB,ijT}$	Plot level carbon stock change in above ground biomass in stratum *i*, species *j*, between two monitoring events; t C ha^{-1}
ΔTC_{ABjT}	Carbon stock change in above-ground biomass per tree of species *j* 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)

The mean carbon stock change within each stratum is calculated by averaging across plots in a stratum.

$$\Delta MC_{ABikT} = \frac{\sum_{pl=1}^{PL_{ik}} \sum_{j}^{J} \Delta PC_{ABikT,pl}}{PL_{ik}}$$ **(Equation 78 of the methodology)**

where:

ΔMC_{ABikT}	Mean carbon stock change in above-ground biomass in stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1}.
ΔPC_{ABijT}	Plot level mean carbon stock change in above-ground biomass in stratum *i*, species *j*, between two monitoring events; t C ha^{-1}.
pl	Plot number in stratum *i*, species *j*; dimensionless

PL_{ik}	Total number of plots in stratum *i*, stand model *k*; dimensionless
j	Species *j* (*J* = total number of species)

The carbon stock in below-ground biomass is estimated by applying the root-shoot ratio to the above-ground carbon stock.

$$TC_{BBj} = TC_{ABj} \cdot R_j$$ **(Equation 79 of the methodology)**

$$\Delta TC_{BBjT} = TC_{BBj,t2} - TC_{BBj,t1}$$ **(Equation 80 of the methodology)**

$$\Delta PC_{BB,ikT} = \frac{XF \cdot \sum_{tr=1}^{TR} \Delta TC_{BBjT}}{1000}$$ **(Equation 81 of the methodology)**

$$\Delta MC_{BB,ikT} = \frac{\sum_{pl=1}^{PL_{ik}} \Delta PC_{BBikT,pl}}{PL_{ik}}$$ **(Equation 82 of the methodology)**

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; t C ha^{-1}
XF	Plot expansion factor from per plot values to per hectare values (see equation 80); dimensionless
tr	Tree (*TR* = total number of trees in the plot)
ΔMC_{BBikT}	Mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1}
ΔPC_{BBikT}	Plot level carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; t 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

The annual carbon stock change is calculated by dividing the carbon changes between two monitoring events by the number of years between monitoring events.

$$\Delta MC_{ABikt} = \frac{\Delta MC_{ABikT}}{T}$$ **(Equation 83 of the methodology)**

$$\Delta MC_{BBikt} = \frac{\Delta MC_{BBikT}}{T}$$ **(Equation 84 of the methodology)**

where:

$\Delta MC_{AB,ikt}$	Annual mean carbon stock change in above-ground biomass for stratum *i*, stand model *k*, at year *t*; t 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*; t C ha^{-1} yr^{-1}
ΔMC_{ABikT}	Mean carbon stock change in above-ground biomass for stratum *i*, stand model *k*, between two

monitoring events; t C ha^{-1} yr^{-1}

ΔMC_{BBikT} Mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1} yr^{-1}

T Number of years between two monitoring events which in this methodology is 5 years

The annual carbon stock change in living biomass for each stratum *i*, species *j*, stand model *k*, at time *t* is calculated from the area of each stratum *i*, species *j*, stand model *k*, at time *t* and the annual mean carbon stock change in above-ground biomass and below-ground biomass per unit area.

$$\Delta C_{AB,ikt} = A_{ikt} \cdot \Delta MC_{AB,ikt}$$ **(Equation 85 of the methodology)**

$$\Delta C_{BB,ikt} = A_{ikt} \cdot \Delta MC_{BB,ikt}$$ **(Equation 86 of the methodology)**

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*; t C yr^{-1}

$\Delta C_{BB,ikt}$ Changes in carbon stock in below-ground biomass for stratum *i*, stand model *k*, at time *t*; t 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*; t 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*; t C ha^{-1} yr^{-1}

Note that stand models will most often be one of the strata, and therefore will be included as such rather than as a separate consideration.

Growth data and equations used in the calculation of carbon stock changes

The growth equations used for calculating net GHG removals by sinks in the project area are:

The volume equations of Eucalyptus grown in the northern India relevant to the project region have been adapted to the project. The equations selected conform to the criteria of 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).

1. Volume equation for Eucalyptus clone[2]

V = 0.00258 + 0.0281 g^2 * H or
V = 0.00258 + 0.0281 $(pi*D)^2$ * H

2. Volume equation for Eucalyptus seed[3]

[2] Chaturvedi, A.N. (1995): Volume tables and the regression equation for clonal plants, Tata Energy Research Institute, New Delhi.

[3] Chaturvedi,, A.N (1974): Tree quality volume tables for Eucalyptus Hybrid, Indian Forester, Vol. 100, No. 10, pages 595-600

V = -0.37767 + 0.032996*(D)2*H

Where:
V=Volume per unit area (m^3/ha).
D is diameter at breast height (DBH, at 1.37 m above-ground) for all trees in the permanent sample plots.
H= Height of the tree in permanent the sample plots.
G = Girth, Pi*DBH

The root shoot ratio of Eucalyptus reported in the PDD is 0.35 (Mean values for eucalyptus plantation. based on Table 3A.1.8 of IPCC GPG

Allometric equation[4] used for Casuarina equisetifolia is:

B= **-0.37767 + 0.032996*(D^2) *H**

Where:
B = Aboveground biomass in kg/tree
DBH=Diameter at breast height in cm
H=Height of the tree from permanent the sample plots in meters.

The equation selected for Casuarina conforms to the criteria of 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).

Total project area is 1607.72 ha. The distribution of area in standing, harvested and replanted/under coppice; and harvested and not replanted/coppiced uprooted is shown in Table E.1 as follows:

Table E.1: Distribution of project area in standing, and proposed for regeneration categories.

Strata with standing stock	Strata for proposed regeneration	Total Project Area
(a)	(b)	(c)
726.19	881.54	**1607.72**

Table E.2 represents the net GHG removals by sinks from 809.98 ha that were measurable at time of monitoring (area in columns under (a) and (b) in Table E.1). An area of 491.44 ha was planted and subsequently harvested and uprooted.

[4] B. Mohan Kumar, Suman Jacob George, V. Jamaludeen and T.K. Suresh (1998). Comparison of biomass production, tree allometry and nutrient use efficiency of multipurpose trees grown in woodlot and silvopastoral experiments in Kerela, India. Forest Ecology and Management (112) pp. 145-163.

The actual standing carbon sink is represented in the column (e) of Table E.2, the same is verifiable and standing as of end of June'2018. Net GHG removals were calculated using inputs from SMART forms. The tool calculated the removals from the measured sample plot data and step wise calculation using equations from the methodology. The calculation sheet is attached as Annex 3 (separate file).

Table E.2: Actual net GHG removals by sinks from project area

Strata	Area by stratum (Ha)	Carbon stock change in living biomass of trees (Above ground and below ground) *t CO2-e* per year	Accumulated GHG emissions *t CO2-e*	Actual net GHG removals by sinks *t CO2-e*
(a)	(b)	(c)	(d)	(e) = (c)*6.83 (monitoring period)
Andhra Casuarina (ACA)	**23.62**	**826.27**	**nil**	5643.42
Andhra Eucalyptus Clonal (AEC)	**130.32**	**1864.06**	**nil**	12731.53
Andhra Eucalyptus Seed (AES)	**4.65**	**34.47**	**nil**	235.43
Orissa Eucalyptus Clonal (OEC)	**370.17**	**4944.00**	**nil**	33767.52
Orissa Eucalyptus Seed (OES)	**197.43**	**1254.87**	**nil**	8570.76
Grand Total	**726.19**			60948.67

The net anthropogenic GHG removals by sinks are calculated by subtracting the baseline net GHG removals by sinks and leakage emissions from the actual net GHG removals by sinks minus as per the methodology.

$$C_{AR-CDM} = C_{ACTUAL} - C_{BSL} - LK$$ **(Equation 121 of methodology)**

where:

CAR-CDM = Net anthropogenic greenhouse gas removals by sinks; t CO2-e
CACTUAL = Actual net greenhouse gas removals by sinks; t CO2-e
CBSL = Baseline net greenhouse gas removals by sinks (as pre-determined in the PDD); t CO2-e
LK = Leakage; t CO2-e
Considering that the the baseline net GHG removals by sinks and leakage emissions are zero, the net anthropogenic GHG removals by sinks of the project are same as the actual net GHG removals by sinks.

Net anthropogenic greenhouse gas removals by sinks = 60, 948.67 – 0 – 0

= 60, 948.67

Margin of error in the measurement of net GHG removals by sinks

As per Annex 26 EB63, uncertainty assessment/uncertainty analysis are considered superfluous for accounting for uncertainty and shall not be enforced.

However, as shown in Table E.3 below (included in Annex 3), the margin of error of 8.73% for the carbon stock change at the end of second monitoring period is below 10% precision, which demonstrates that the net GHG removals by sinks calculated in the project are within 10% precision and 90% confidence interval.

Table E.3: Margin of error in the calculation of carbon stock change

Strata	Area of Stratum (ha)	Mean carbon of Stratum (t/ha)	Standard deviation (σ) (t/ha)	S_i^2	Ratio of stratum *i* area to project area (wi)	wi* Mean carbon of Stratum	Number of sample plots	Variance of mean change in carbon per ha	t-value @ 10%, 55 sample plots
A	B	C	D	E= $(D)^2$	F=(B/B-total)	G = (F*C)	H	I = $(F^2*(E/H))$	J
AECss	130.32	26.64	8.37	70.05	0.08	2.1597	10	0.0460	
AESss	4.65	13.81	0.00	0.00	0.00	0.0399	1	0.0000	
ACAss	23.62	65.16	0.00	0.00	0.01	0.9573	1	0.0000	
OECss	370.17	24.88	9.51	90.36	0.23	5.7282	32	0.1497	
OESss	197.43	11.84	8.39	70.46	0.12	1.4539	11	0.0966	
AECrg	456.74	0.00	0.00	0.00	0.28	0			
AESrg	47.27	0.00	0.00	0.00	0.03	0			
ACArg	357.84	0.00	0.00	0.00	0.22	0			
OECrg	10.44	0.00	0.00	0.00	0.01	0			
OESrg	9.24	0.00	0.00	0.00	0.01	0			
Total	**1607.72**					**10.3391**	**55**	**0.2923**	**1.6794**

Table E.4

	Baseline GHG emissions or baseline net GHG removals ($t\ CO_2e$)	Project GHG emissions or actual net GHG removals ($t\ CO_2e$)	Leakage GHG emissions ($t\ CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t\ CO_2e$)		
				Before 30/06/2018	From 01/09/2011	Total amount
Total	0	60,949	0			60,949

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

Amount achieved during this monitoring period ($t\ CO_2e$)	Amount estimated ex ante ($t\ CO_2e$)
60,949	147,434

E.6. Remarks on increase in achieved emission reductions

NA

Document information

Version	Date	Description
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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