

**MONITORING REPORT FORM (CDM-MR) for Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices**

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**MONITORING REPORT**  
**First Version – November 13, 2011**

**Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly  
Technology based Agroforestry Practices**

**Reference number - 4531**  
**Monitoring period (25/06/04 – 31/08/11)**

**SECTION A. General Description of the project activity**

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

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

The A/R CDM project activity mobilizes 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 is implemented on the degraded farmlands or lands used for rainfed subsistence agriculture.

The project is implemented 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**

<b>Year of Plantation</b>	<b>Total Area(Ha)</b>
2004	180.25
2005	348.99
2006	386.86
2007	691.62

TOTAL	1607.7
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A Monitoring Committee comprising the representatives of VCCSL and JKPL, as well as provision of audited records, will ensure 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 will be 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 for 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

4. Total emission reductions achieved in this monitoring period.

**Table A.1.3:** The total ERs achieved in the monitoring period of 25 June 2004 till 31 August 2011 are tabulated as follows:

Period	Total net anthropogenic GHG removals by sinks	Remarks
25/06/04 to 31/08/11	175,833.74	Please refer to Section E for further details

**A.2. Project Participants**

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<b>Name of Party involved (*) (host) indicates a host Party)</b>	<b>Private and/or public entity(ies) project participants (*) (as applicable)</b>	<b>Indicate if the Party involved wishes to be considered as a project participant (Yes/No)</b>
Government of India (host)	<ul style="list-style-type: none"> <li>• VEDA Climate Change Solutions Ltd.</li> <li>• JK Paper Ltd</li> </ul>	No
Government of Canada	International Bank for Reconstruction and Development as a trustee for BioCarbon Fund	Yes

**A.3. Location of the project activity:**

&gt;&gt;

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

**Table A.3.1:** Details of land proposed under the project

<i>District</i>	<i>Villages</i>	<i>Blocks/ Mandals</i>	<i>Land under project (in ha)</i>	<i>Number of parcels</i>	<i>Average land under project per farmer (in ha)</i>
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
	<b>501</b>	<b>97</b>	<b>1607.72</b>	<b>1708</b>	<b>1.01</b>

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.4. Technical description of the project**

&gt;&gt;

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. The Agro-Economic Research Centre (AERC) in southern Orissa is involved in disseminating modern agriculture practices to farmers, as is JKPL.

**Site preparation**

To prevent soil erosion, reduce GHG emissions and protect the existing carbon stocks, site burning and overall tillage was not carried out during the site preparation. The soil profile, pH and electric conductivity of soils in the region are studied. The land is prepared for planting by minimal site disturbance. For sloping areas ploughing is done across the slope to prevent erosion.

The pits ranging from 0.015 – 0.0283 m<sup>3</sup> are dug along the contour and most of the original vegetation is kept intact. The site preparation is conducted in the winter season. The soil was treated with termiticides (in case of Eucalyptus). An integrated pest management plan was incorporated in the Environment Management Framework developed for the project. Weeding operations were carried out manually. The plantations do not require any access roads, as they are located near villages.

### **Planting stock development and nursery technology**

The planting stock used in the project has been developed from Candidate trees of Eucalyptus and Casuarina selected from stands (Eucalyptus - Araku valley, Visakhapatnam, Aguru in Rayagada district; Casuarina – selected stands in the districts of Vizianagaram and Visakhapatnam) located around the project area and from clonal material developed from mother plants that grow under similar conditions.

- **Clonal Eucalyptus:** The clones of Eucalyptus are genetically superior, fast growing, grow uniformly and contribute to increased productivity (i.e. 2 to 3 times higher than normal seed route plantations). The clones also ensure improved productivity of coppice crops and compensates for low productivity of soils. The clones are produced following macro-propagation (mist propagation) technique. The method consists of collecting coppice sprouts that are just beginning to harden and keeping them constantly moist while 2-leaf-pair cuttings are prepared and end-dipped in rooting hormone. The cuttings are placed under intermittent mist in individual containers. For successful clonal propagation JKPL has an R & D centre with 14 mist chambers covering an area of 3700 m<sup>2</sup>, hardening area of 1200 m<sup>2</sup> and open nursery area of 10,000 m<sup>2</sup>. The clonal technology with root trainers has contributed to the production of quality planting stock. The root development is better in root trainers than in polypots as multiple roots seldom form in the root trainers and root coiling is avoided. The out planting results are quite high thereby increasing survival and productivity. The quality parameters for saplings are developed and delivery of planting material is made after due quality inspection.

To sustain production of selected clones, JKPL has established mother orchards from which cuttings are prepared and are treated with fungicide solution (Bavistin) and growth hormone, IBA. The seedlings are transplanted in root trainer blocks containing vermiculite. These are then placed inside the state of art greenhouses where required conditions for conducive growth are created through automatic temperature and humidity control systems. After about 35-40 days when the shoots and roots emerge from the cuttings they are shifted to the acclimatization chamber and are kept for 10-15 days to harden and subsequently shifted to the sunlight with controlled irrigation for 2 months, during this period they attain a height of about 45 cm and are ready for planting in the fields.

- **Seed origin Eucalyptus:** For Eucalyptus based on seed propagation, saplings are raised in decentralized nurseries across the districts in different locations for easy delivery of saplings to resource poor farmers. Generally, the nursery capacity ranges from 100,000 to 150,000 seedlings. In the nursery, genetically superior seeds from multiple sources such as Forest Research Institute (FRI) Dehradun, Western India Match Company (WIMCO) and Seed Production Areas (SPA) at Aguru, Jaykaypur in Orissa are used for planting stock production.
- **Casuarina seedling production:** Casuarina saplings are also raised in decentralized nurseries in the coastal areas of Andhra Pradesh.

### **Planting Technique and spacing**

Planting is done in pits of 30 X 30 X 30 cm. Bag plants are used after removing the polythene cover carefully, without disturbing the soil in the bag. To ensure good growth, weeds are removed manually

three times a year during the first year. Survival is checked within three months time and mortality if any is replanted.

In seed route plantations (*Eucalyptus globulus*), the number of seedlings required per ha is 2,500 with spacing of 3 m x 1.33 m. The coppicing cycle of the species is 5/6 years and the expected fuel wood from the branches and bark per ha is about 10 tonnes.

Casuarina is propagated through seedlings. Spacing of 1 m x 1 m is maintained. The pits are filled with organic manure. About 1/3rd of the plant from the base is pruned during the 2nd year of plantation to stimulate growth and to avoid crowding.

### **Plantation management - Eucalyptus**

The plantations have been raised by resource poor farmers in rainfed conditions. The organizers enumerated the plantations every year during the months of January and February. A third party carried out a sample check to verify the authenticity of this enumeration. The plantations are kept weed free by manual weeding. Fire line tracing was done during the summer months all across the plots.

In order to impart the technical know-how of the clonal technology, the farmers were provided with training/awareness on clonal propagation, planting, and plantation management through by JK Field Staff who are well qualified in Forestry, Agriculture and allied Science and also supported by M/s Veda Climate Change Solutions Staff. Such programmes were conducted periodically to upgrade the knowledge of the beneficiaries.

Eucalyptus is managed with a 5-year rotation period. The plantations are felled and debarked manually. The cutting was done using a manual saw. The branches and twigs are retained by farmer for firewood. The main stem is debarked and cut to smaller lengths for transporting by truck, tractors, tucks or carts depending upon the distance.

Coppicing: Eucalyptus spp. regenerates naturally by coppicing, thus avoiding site preparation and soil disturbance in the second rotation. After harvesting, Eucalyptus is regenerated through coppicing. As many shoots regenerate through natural means, only two or three strong shoots are allowed to grow by cutting the remaining shoots.

### **Plantation management – Casuarina**

Casuarina is a large fast growing evergreen tree. It grows well in both southwest and northeast monsoon and grows well in loose fine coastal sands. It is a good pulpwood species and its major uses are fuel wood, timber and some medicinal purposes.

Ploughing: The land was ploughed with traditional plough or mould board plough. Generally ploughing was done manually and in very few cases farmers adopt mechanical ploughs.

Fertilization: A dose of super phosphate and muriate of potash at 8 kg per hectare was applied two months after the planting.

Pruning: In the 2nd year branches were pruned flush to the stem up to 1/3rd of the stem height. This will induce 1/3rd of height, growth and clean stems.

Harvesting: The Casuarina plantations are felled, debarked and loaded on to the truck manually and transported by tractors or trucks. The harvested sites are kept intact for further regeneration for next coppice crop. Thus by using this technology the degraded /subsistence agriculture lands could be converted to carbon sinks over multiple rotations.

In order to impart the technical know-how felling & transportation, the farmers were provided with training/awareness on size & length of billets and relevant procedures by JK paper Mills Plantation Officers. Such programmes are conducted periodically to upgrade the knowledge of the beneficiaries.

The company also maintains a robust management system supported by manuals and procedures by detailing the critical operations, training requirements and competency needs

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

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Title: Reforestation or Afforestation of Land Currently under Agricultural Use

Reference: AR-AM0004; Version-03

**A.6. Registration date of the project activity:**

The registration date of the project was February 28, 2011

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

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

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

Veda Climate Change Solutions Limited and JK Paper Mills Limited are jointly responsible for completing the monitoring report form (CDM-MR).

**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.**

Plantation activities started on 25/06/2004. The year wise details of plantation are provided in Tables B.1.1 and B.1.2

Table B.1.1: Year wise plantation schedule by strata

Year of plantation	Districts of Andhra Pradesh			Districts of Orissa		Total
	AEC	AES	ACA	OEC	OES	
2004	17.31	9.25	49.12	76.84	27.73	180.25
2005	130.95	7.57	108.71	72.45	29.31	348.99
2006	210.44	8.46	95.11	32.09	40.76	386.86
2007	227.14	26.64	129.07	198.81	109.96	691.62
<b>TOTAL</b>	<b>585.84</b>	<b>51.92</b>	<b>382.01</b>	<b>380.19</b>	<b>207.76</b>	<b>1607.7</b>

Table B.1.2. Year wise unharvested project area by strata

	Year-2007	2008	2009	2010	2011-upto July
<b>Strata</b>					
<b>AEC</b>	585.84	584.96	525.08	340.89	268.22
<b>AES</b>	51.92	49.88	35.6	30.57	15.37
<b>ACA</b>	381.94	341.15	247.31	42.9	6.15
<b>OEC</b>	380.19	362.79	325.01	231.26	204.07
<b>OES</b>	207.76	206.57	193.95	176.81	175.93
<b>Grand Total</b>	1607.65	1545.35	1326.95	822.43	669.74

**2. The information regarding the actual operation of the project activity during this monitoring period, including information on special events.**

Measurements were carried out for 100% plants by JKPL in all the sample plots selected. Special events such as death of plants are recorded in the measurement register. Harvesting is carried out after completion of 5 year felling cycle and details of harvesting is also monitored for all the sample plots.

**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.**

There has been no event or situation during the monitoring period which may impact the applicability of the methodology.

**B.2. Revision of the monitoring plan**

The Monitoring Plan has not been revised since registration of the project activity.

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

There has been no request for a deviation for this monitoring period.

**B.4. Notification or request of approval of changes**

There has been no request of changes to the registered CDM PDD for this project.

**SECTION C. Description of the monitoring system**

**Data Collection Procedures:**

Carbon stock changes over time are estimated using data for biomass growth. The biomass growth has been calculated as a function of volume growth.

The biomass estimation consists of the following steps:

- 1) Determination of the location of sample plots.
- 2) Measurement of DBH of all trees with DBH greater than 2.5 cm and tree height for all trees.
- 3) The volume per tree of the aboveground biomass corresponding to average diameter is assessed from the allometric and volume equations.
- 4) For each species, the volume is multiplied by number of trees on the sample plot to obtain volume per sample plot.
- 5) Volume per plot is calculated as a product of volume per hectare and sample plot area.

**Procedure for Calculation of Number of Sample Plots:**

To avoid subjective choice of plot locations, the permanent sample plots are located systematically with a simple random sampling. The project areas were grouped into five strata taking into account soil,



topography and regional characteristics. All stands within the project's boundary are listed in Annex 1<sup>1</sup>. From the identified strata we have randomly picked the number of sample plots, using Discrete IDs assigned to the plots. The randomly drawn plots do not all fall into a single cluster (Samples are drawn without replacement) This has been repeated for each strata to get the required number of sample plots as per the methodology AR AM0004 Method I (samples drawn without replacement) of the A/R Methodological Tool.

The methodology included an equation to assess the minimum number of sample plots required for monitoring to keep a maximum permissible error of  $\pm 10\%$  of the mean, at a 95% confidence level. Accordingly, the following equations were used

**Equation 5 of the Tool/Equation 67 of AR AM0004 (Version 3)**

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

**Equation 6 of the Tool/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 (95%)

E = allowable error ( $\pm 10\%$  of the mean),  $E = Q \cdot DLP$ ;

$st_i$  = 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<sup>2</sup> (16 x 16 meter).

Q = Approximate average value of the estimated quantity Q, (e.g. wood volume); e.g. m<sup>3</sup>ha<sup>-1</sup>

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

After applying the above mentioned equations for calculating the number of sample plots required for monitoring, the resultant figure of 77 is achieved.

**Table C.1: Parameters used for the calculation of the number of sample plots.**

Strata	Integer	1	2	3	4	5
Area of stratum i	Ha	585.84	51.92	382.01	380.19	207.76
Mean Qi	t C/ha	119.91	71.28	73.02	106.14	37.83
Sti	t C/ha	39.43	28.66	63.55	37.83	19.48
Coeff.of variation –	%	32.88%	40.21%	87.03%	35.64%	51.49%

<sup>1</sup> Attached as separate file.

CV						
N	Integer	64,309	64,309	64,309	64,309	64,309
Ni	Integer	23,434	2,077	15,280	15,208	8,310
Z $\alpha/2$	-	1.9599	1.9599	1.9599	1.9599	1.9599

**The list of sample plots and location on the land parcels in each district has been recorded and archived in the project database.**

Location of Sample plots: All sample plots of the Project are referenced & documented in an excel sheet with the GPS locations along with the village name, district name and the state. Each plot is given a sample plot id and this has also been plotted on a map and the document will be shared with the DOE so that they can identify & locate the sample plots in the field.

Degree of level of precision (error)	Total no. of sample plots	Andhra Pradesh			Orissa	
		AEC	AES	ACA	OEC	OES
10%	77	26	2	28	16	5
Additional 30% plots to insure against risk of loss of plots	23	8	1	8	5	1
	100	34	3	36	21	6

The methodology equation determined a minimum number of sample plots of 77 to allow for the permissible error limit of 10% of the mean and a confidence interval of 90%.

**Table C.2: Location of sample plots in standing and harvested areas.**

Strata	Standing No. of Sample plots	Harvested but replanted / Coppiced No. of Sample plots	Harvested but not replanted / coppiced - Uprooted No. of Sample plots	Total Sample Plots
AEC	23	9	4	36
AES	1	1	1	3
ACA	3	1	24	28
OEC	15	3	1	19
OES	6	0	1	7
<b>Grand Total</b>	<b>48</b>	<b>14</b>	<b>31<sup>2</sup></b>	<b>93</b>

The number of sample plots were re-estimated based on variance in observed measurements from sample plots. Additional plots were established in selected strata as follows to ensure that permissible error limit of 10% of the mean and a confidence interval of 90% was met. The sample plot calculation sheet is attached as Annex 2 (separate file).

<sup>2</sup> No measurements were made in these sample plots.

**Table C.4: Sample plots in project area by strata.**

<b>Strata</b>	<b>Total Sample plots in planted and coppiced/replanted areas required as per sampling tool</b>	<b>Total Sample plots in planted and coppiced/replanted areas established</b>
<b>AEC</b>	18	23
<b>AES</b>	2	1
<b>ACA</b>	3	3
<b>OEC</b>	24	30
<b>OES</b>	14	12
<b>Grand Total</b>	<b>60</b>	<b>69</b>

The guidance in EB 63, Annex 26 Guidelines on application of specified versions of A/R CDM methodologies in verification of registered A/R CDM project activities has been used to calculate the number of sample plots required to meet the error limit of  $\pm 10\%$  at 90% confidence interval. As a result of this revision the number of sample plots required is calculated at 60 and the total number of plots established is 69. This is sufficient to meet the error limit of 10% of the mean and a confidence interval of 90%.

#### **Procedures for measurement of tree biomass**

- Tree diameter: Measurements for diameter at breast height (1.37 m) were conducted using standard procedures. The minimum diameter measured was 2.5 cm.
- Tree height - Height of all trees in a sample plot have been measured and recorded using standard procedures.
- Measurements and data recording and processing were carried out in accordance with QA/QC procedures.

#### **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 will be calculated using data on biomass growth. From the volume of trees, carbon stock in CO<sub>2</sub> is calculated (density, CF, BEF, CO<sub>2</sub>/C).

#### **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.

#### **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. Survey on the animal population of the 120 households out of 1590 project households was conducted on sample basis (20 farmers from each district. The results show an increase of animal population by 5% which is not significant. Even with the increased animal population the total number of animals in the project area is still below the carrying capacity. Thus we can conclude that no animal is displaced out of the project area and that leakage is zero

- Displacement of 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 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, therefore, 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 JKPL and VCCSL. The Advisory Board consists of Mr.M.C.Goel (EVP (Works) JKPL) and Mr.C.A.Rao (MD, VCCSL).

The Executive Body is consisting of Mr.DharmendraDaukia (GM RMP,JKPL), Mr.Biswajeet Deb (GM Accts JKPM,JKPL), Mr. N. Sai Kishore (Executive Director, VCCSL) Ms. Pragya Gupta (Carbon Finance Specialist, VCCSL), AshutoshMahana (Asst Manager PI JKPM,JKPL), Mr.SushantaBehuria(Dy Manager Accounts, JKPM, JKPL), and Mr.V.ShanmukhaRao (CDM Project Manager VCCSL), Mr. Ch. Suresh Babu, (Business Development Executive, VCCSL), Mr.D.Madhav Krishna (Manager Accounts, VCCSL) &Ms.Chinnamamba (Statistician, VCCSL).

The PMU is supported by two Project Implementation Units (PIUs) at Visakhapatnam and Rayagada which are under the charge of Mr.V.ShanmukhaRao and Mr.AsutoshMahana 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.DharmendraDaukia (GM (RMP) JKPL): He is the advisor for the project implementation at the ground level. He provides inputs for management of the PMU.
3. Ms. Pragya Gupta (Carbon Finance Specialist, (VCCSL)): She is responsible for co-ordinating the project monitoring and financial reporting.
4. 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.

#### **Account Keeping**

1. Mr.Biswajit Deb (GM (Accounts) JKPM, JKPL): He is responsible for and oversees project account keeping and regular audit of statements.
2. Ms.Pragya Gupta, Carbon Finance Specialist (VCCSL): She is responsible for and oversees financial reporting to the World Bank.
3. 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.

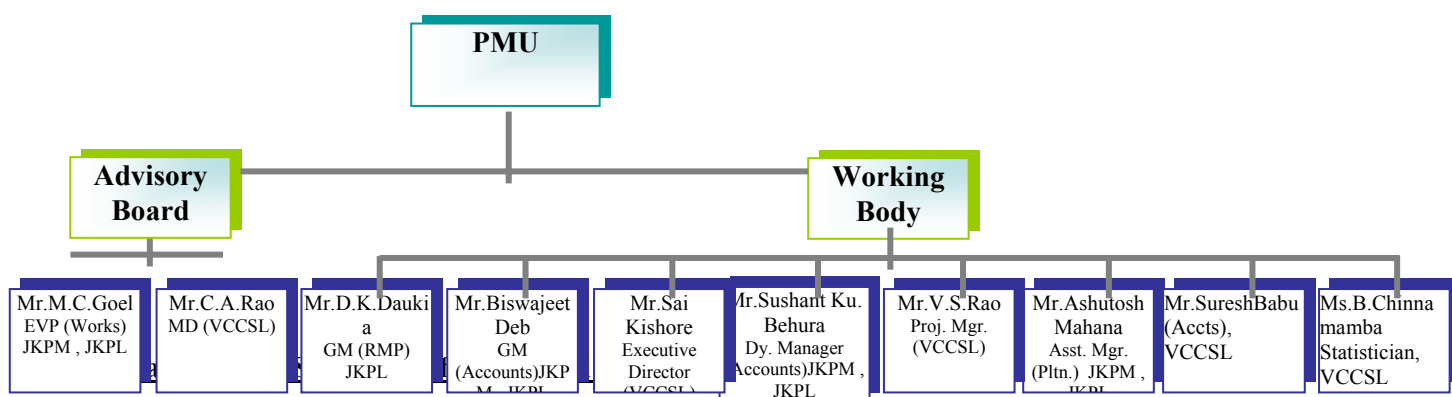
4. Mr.Ch.SureshBabu (VCCSL): He is responsible for proper account keeping of the PIU and PMU at Visakhapatnam
5. Mr.D.Madhav Krishna (Manager (Accounts), VCCSL): He maintains information on project expenses related to PIU and PMU at Visakhapatnam.

### **Operations & MRV**

1. Mr.V. Shanmukha Rao (Project Manager (VCCSL)): He is the Project Manager for the PIU at Visakhapatnam. He is responsible for coordinating with the PIU situated at Rayagada. He is responsible Quality Assurance / Quality control measures like cross checking of field data.

2. Mr.AshutoshMahana (Asst. Manager (PI) 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.



**Table C.5: Role and responsibilities of project team.**

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

Coordination of field data collection	Manual of monitoring	Annual	JKPL Manager	Mr.AshutoshMahana (Asst. Manager (PI) JKPM, JKPL ) <a href="mailto:ashutosh@jkpm.jkmail.com">ashutosh@jkpm.jkmail.com</a>
Data cross-check of field measurements	Manual of monitoring	Annual	VCCSL Project Manager	Mr.SanmukhaRao (Project Manager (VCCSL ) vsrao_vedamac@yahoo.co.in
Calculation of emissions reductions and deviations from projections	SMART forms	Annual	VCCSL Statistician	Mrs.Chinnamamba (Statistician – VCCSL) <a href="mailto:chinna@vccslindia.org">chinna@vccslindia.org</a>
Coordination of Quality Assurance / control		Annual	VCCSL Project Manager	Mr.SanmukhaRao (Project Manager (VCCSL ) vsrao_vedamac@yahoo.co.in
Sign off of monitoring reports and ER calculations		Annual	VCCSL and JKPL Project Manager	Mr.AshutoshMahana (Asst. Manager (PI) JKPM, JKPL ) <a href="mailto:ashutosh@jkpm.jkmail.com">ashutosh@jkpm.jkmail.com</a> and Mr.SanmukhaRao (Project Manager (VCCSL ) vsrao_vedamac@yahoo.co.in
Verifying and comparing the ERs with the projections made in PDD		Annual	VCCSL Carbon Finance Specialist	Ms. Pragya Gupta (Carbon Finance Specialist, VCCSL) <a href="mailto:pragya1.gupta@gmail.com">pragya1.gupta@gmail.com</a>

### **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.

### **Quality Assurance and Quality Control (QAQC) Measures:**

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 C.6: List of trainings held for project team members.**

<b>Sl. No.</b>	<b>Date</b>	<b>Training Programme</b>	<b>Persons attended</b>
1	5/2/2007	GPS Use for boundary demarcation of plantation field	10 persons 8 from JKPL & 2 from VCCSL
2	16/03/2008	GPS Use for boundary demarcation of plantation field	5 persons from JKPL.
3	10/1/2009	Leakage concept & monitoring of sample	5 persons from JKPL.
4	15/05/2009	Monitoring & Evaluation along with roles & responsibility	10 persons 8 from JKPL & 2 from VCCSL
5	12/8/2010	Monitoring & Evaluation along with roles & responsibility	10 persons 8 from JKPL & 2 from VCCSL
6	25/08/2010	Leakage concept & monitoring of sample plots	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  $\pm 5\%$  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 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 D. Data and parameters

### D.2. Data and parameters monitored

*(Copy this table for each data and parameter. To report multiple values, a table may be used)*

<b>ID number</b>	E.4.1.1.65 (PDD parameter)
<b>Data / Parameter:</b>	H
Description/unit:	Tree height in meters
Value applied:	(Values available in the data management system. This is not inserted as an annex due to the huge amount of data. Values are included in Annex 3.
Source of data:	Plot measurement
<b>Recording frequency</b>	5 year, Measurement in each monitoring period
Justification of choice / Measurement procedures (if any):	Type: Hypsometer Accuracy class: 0,1 meter Calibration frequency: when in usage, every trimester; when not in usage, immediately before using it.
Any comment:	

<b>ID number</b>	E.5.1.43 (PDD parameter)
<b>Data / Parameter:</b>	$NaAR,t$
Description/unit:	Monitored number of animals present in the project area at year $t$
Value applied:	Dimensionless
Source of data:	Field measurements
<b>Recording frequency</b>	Yearly
Justification of choice / Measurement procedures (if any):	<i>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.</i>
Any comment:	

<b>ID number</b>	E.5.1.44(PDD parameter)
<b>Data / Parameter:</b>	$NaBL$
Description of	<i>ex ante</i> estimated pre-project number of animals from the different livestock



animals /unit:	groups that would be grazing in the project area under the baseline scenario
Value applied:	Dimensionless
Source of data:	AR-CDM-PDD
<b>Recording frequency</b>	<i>Ex ante</i> in AR-CDMPDD
Justification of choice / Measurement procedures (if any):	<i>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.</i>
Any comment:	This estimate is fixed for the entire crediting period and is specified in the AR-CDM-PDD

<b>ID number</b>	E.5.1.45 (PDD parameter)
<b>Data / Parameter:</b>	<i>NaEGL,t</i>
Description/unit:	Number of animals present in the sampled <i>EGL</i> areas at time <i>t</i>
Value applied:	Dimensionless
Source of data:	Field measurement
<b>Recording frequency</b>	Yearly
Justification of choice / Measurement procedures (if any):	<i>As per the ex-ante estimation (clear description is given in the PDD Section D.2)there is no activity displacement, so this variable is not applicable.</i>
Any comment:	NA

<b>Data / Parameter:</b>	<b>E.4.1.1.50 (PDD parameter)</b>
Data unit:	<i>iID</i>
Description:	Stratum identification Alphanumeric
Measured /Calculated /Default:	Defined at stand establishment
Source of data:	Project Records
Value(s) of monitored parameter:	Na
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	To indicate GHG removals by sinks by strata
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	Every 5 years
Calculation method (if applicable):	NA
QA/QC procedures applied:	Each stand has a particular year to be planted under each stratum.

<b>ID number</b>	E.4.1.1.03(PDD parameter)
<b>Data / Parameter:</b>	PL <sub>ID</sub>
Description/unit:	Sample plot ID
Value applied:	alpha numeric
Source of data:	Project and plot map, GIS
<b>Recording frequency</b>	Prior to start of project
Justification of choice / Measurement procedures (if any):	Defined
Any comment:	Numeric ID to be assigned to each permanent sample plot

<b>ID number</b>	E.4.1.1.04(PDD parameter)
<b>Data / Parameter:</b>	PL <sub>ik</sub>
Description/unit:	Total number of plots in stratum i, stand model k
Value applied:	Dimensionless
Source of data:	Field measurement
Justification of choice / Measurement procedures (if any):	Total number of plots were recorded for each stratum
Any comment:	>>

<b>ID number</b>	E.4.1.1.10 (PDD parameter)
<b>Data / Parameter:</b>	A
Description/unit:	Total size of all strata (A), e.g. the total project area
Value applied:	Ha
Source of data:	GIS or/and GPS
<b>Recording frequency</b>	Prior to start of project & adjusted at every 5 years
Justification of choice / Measurement procedures (if any):	Measured Total area of the project is A=1607.7ha
Any comment:	

<b>ID number</b>	E.4.1.1.11(PDD parameter)								
<b>Data / Parameter:</b>	<i>A<sub>i</sub></i>								
Description/unit:	Area of each stratum								
Value applied:	Ha								
Source of data:	GIS or/and GPS								
<b>Recording frequency</b>	Prior to start of project & adjusted at every 5 years								
Justification of choice / Measurement procedures (if any):	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>AEC</td> <td>585.84</td> </tr> <tr> <td>AES</td> <td>51.92</td> </tr> <tr> <td>ACA</td> <td>382.01</td> </tr> <tr> <td>OEC</td> <td>380.19</td> </tr> </table>	AEC	585.84	AES	51.92	ACA	382.01	OEC	380.19
AEC	585.84								
AES	51.92								
ACA	382.01								
OEC	380.19								

		OES	207.76	
Any comment:				

<b>ID number</b>	E.4.1.1.13 (PDD parameter)						
<b>Data / Parameter:</b>	<i>Aikt</i>						
Description/unit:	Area of stratum <i>i</i> , stand model <i>k</i> , at time						
Value applied:	Ha						
Source of data:	Project Records						
<b>Recording frequency</b>	Measured -Yearly/Monitoring period						
Justification of choice / Measurement procedures (if any):	Age class	AEC	AES	ACA	OEC	OES	Total
	2004	17.31	9.25	49.12	76.84	27.73	180.25
	2005	130.95	7.57	108.71	72.45	29.31	348.99
	2006	210.44	8.46	95.11	32.09	40.76	386.86
	2007	227.14	26.64	129.07	198.81	109.96	691.62
Any comment:	Measured for different strata and Stands						

<b>ID number</b>	E.4.1.1.15 (PDD parameter)						
<b>Data / Parameter:</b>	<i>AP</i>						
Description/unit:	Sample plot area						
Value applied:	Ha						
Source of data:	Field measurement						
<b>Recording frequency</b>	5-year						
Justification of choice / Measurement procedures (if any):	Project Record						
Any comment:							

<b>ID number</b>	E.4.1.1.28 (PDD parameter)						
<b>Data / Parameter:</b>	<i>DBH</i>						
Description/unit:	Diameter at breast height of living trees						
Value applied:	cm						
Source of data:	Plot measurement						
<b>Recording frequency</b>	100% trees on sample Plots						
Justification of choice / Measurement procedures (if any):	5 year Values are available in the inventory system. This is not inserted as an annex due to the huge amount of data. The data from sample plots is available in the spreadsheet for calculations of net GHG removals						
Any comment:	Measuring at each monitoring time per sampling method						

<b>ID number</b>	E.4.1.1.42(PDD parameter)
<b>Data / Parameter:</b>	$f_j(DBH, H)$
Description/unit:	Allometric equation for species $j$ linking aboveground 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 $t$
Value applied:	kg tree-1
Source of data:	Literature and/or field measurements
<b>Recording frequency</b>	Once per Species
Justification of choice / Measurement procedures (if any):	for all major species or group of species
Any comment:	Use local/global equations validated for local conditions

<b>ID number</b>	E.4.1.1.51(PDD parameter)
<b>Data / Parameter:</b>	$ID_{ikt}$
Description/unit:	Stand ID
Value applied:	Alpha numeric
Source of data:	Stand map, GIS
<b>Recording frequency</b>	At stand Establishment
Justification of choice / Measurement procedures (if any):	100% /Defined
Any comment:	Each stand has a particular year $t$ to be planted under each stratum

<b>ID number</b>	E.4.1.1.52 (PDD parameter)
<b>Data / Parameter:</b>	$lat/long$
Description/unit:	Plot location
Value applied:	
Source of data:	Project and plot map and GPS locating, GIS
<b>Recording frequency</b>	5 years
Justification of choice / Measurement procedures (if any):	100% / Measured
Any comment:	Using GPS to locate before start of the project and at time of each field measurement

<b>ID number</b>	E.4.1.1.55 (PDD parameter)
<b>Data / Parameter:</b>	$MV_{ijt}$
Description/unit:	Mean merchantable volume per unit area for stratum $I$ species $j$ , time $t$
Value applied:	m <sup>3</sup> ha <sup>-1</sup>
Source of data:	

<b>Recording frequency</b>	5 years
Justification of choice / Measurement procedures (if any):	100% of sampling plots. Values are available in the inventory system. This is not inserted as an annex due to the huge amount of data.
Any comment:	Calculated from directly measured (Diameter and height )by field instruments

<b>ID number</b>	E.4.1.1.64 (PDD parametr)
<b>Data / Parameter:</b>	<i>nTRPLikt</i>
Description/unit:	Number of trees in the sample plot
Value applied:	Number
Source of data:	Plot measurement
<b>Recording frequency</b>	5 years
Justification of choice / Measurement procedures (if any):	100% trees in plots / Measured Recorded is maintained.
Any comment:	Counted in plot measurement

<b>ID number</b>	E.4.1.1.72 (PDD parameter)										
<b>Data / Parameter:</b>	<i>Sti</i>										
Description/unit:	Standard deviation for each stratum <i>i</i> ; dimensionless										
Value applied:											
Source of data:											
<b>Recording frequency</b>	At each monitoring event										
Justification of choice / Measurement procedures (if any):	Standard deviation is calculated for each stratum based on weighted mean value and area of the stratum. <table border="1" data-bbox="778 1227 1157 1406"> <tr> <td>AEC</td> <td>39.43</td> </tr> <tr> <td>AES</td> <td>28.66</td> </tr> <tr> <td>ACA</td> <td>63.55</td> </tr> <tr> <td>OEC</td> <td>37.83</td> </tr> <tr> <td>OES</td> <td>19.48</td> </tr> </table>	AEC	39.43	AES	28.66	ACA	63.55	OEC	37.83	OES	19.48
AEC	39.43										
AES	28.66										
ACA	63.55										
OEC	37.83										
OES	19.48										
Any comment:	Used for estimating numbers of sample plots of each stratum and stand, as necessary										

<b>ID number</b>	E.4.1.1.75 (PDD parameter)
<b>Data / Parameter:</b>	<i>tID</i>
Description/unit:	Age of plantation (1, 2, 3,... years)
Value applied:	Year
Source of data:	GIS
<b>Recording frequency</b>	At stand establishment
Justification of choice / Measurement procedures (if any):	100% / Measured
Any comment:	Counted since the planted year

<b>ID number</b>	E.4.1.1.76 (PDD Parameter)
<b>Data / Parameter:</b>	<i>trID</i>

Description/unit:	Tree ID (1, 2, 3, ... tr ...TR = total number of trees in the plot
Value applied:	Dimensionless
Source of data:	Field measurement
<b>Recording frequency</b>	5 years
Justification of choice / Measurement procedures (if any):	100% / Measured
Any comment:	

## SECTION E. Emission reductions calculation

### E.1. Baseline emissions calculation

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.

Verification Period	Baseline Emissions
25/06/04 to 31/08/11	0

### E.2. Project emissions calculation

>> 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.

Verification Period	Project Emissions
25/06/04 to 31/08/11	0

### E.3. Leakage calculation

>>

**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<sub>BL</sub> = 0**

Leakage due to displacement for fuel-wood collection is set as zero ( $LK_{\text{fuel-wood}} = 0$ ) 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,  $FG_{BL} < FG_{AR,i}$  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	2005	2006	2007	2008	2009	2010	Change
Cow	1590	139	139	143	141	141	142	3
Buffalo		106	106	109	110	114	115	9
Bullock		136	138	138	140	140	140	4
Goat		141	153	168	172	180	183	42
Sheep		19	19	31	37	38	39	20
<b>G Total (AEU) for sample farmers</b>		413	417.4	429.8	432.8	438.6	441.4	28.4
<b>G Total (AEU) FOR 1590 FARMERS</b>		<b>4982.11</b>	<b>5017.79</b>	<b>5152.42</b>	<b>5154.24</b>	<b>5224.93</b>	<b>5252.73</b>	<b>270.62</b>

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 5.4%, which is insignificant. The fodder production on the farms is adequate to meet the fodder requirement of the 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. Emission reductions calculation / table**

>>

The carbon stock changes in pools of soil organic carbon, litter and dead wood are ignored, thus, the verifiable changes in carbon stock equal to the carbon stock changes in aboveground biomass and below-ground biomass within the project boundary, estimated using the (Biomass Expansion method)

$t^*_{psk}$

$$\Delta C_{pLB} = \sum_{t=1} \sum_{i=1} \sum_{k=1} \Delta C_{Pikt}$$

where;

$\Delta C_{P,LB}$  = Sum of the changes in living biomass carbon stocks (above- and below-ground); t CO<sub>2</sub>-e

$\Delta C_{P,ikt}$  = Annual carbon stock change in living biomass for stratum *i*, stand model *k*, time *t*;

t CO<sub>2</sub>-e. yr<sup>-1</sup>

*i* = 1, 2, 3, ... *S<sub>ps</sub>* 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

The mean change in carbon stocks in above-ground biomass and below-ground biomass per unit area are estimated based on field measurements on permanent plots. Using the BEF method;

- Measured the diameter at breast height (DBH, at 1.37 m above-ground)
- Estimate the volume of the commercial component of trees based on locally derived equations, then sum for all trees within a plot and express as volume per unit area (e.g., m<sup>3</sup>/ha).
- Converting the volume of the commercial component of trees into carbon stock in aboveground biomass and below-ground biomass via basic wood density, BEF root-shoot ratio and carbon fraction, given by:

$$MC_{AB_{ijt}} = MV_{ijt} * D_j * BEF_j * CF_j$$

$$MC_{BB_{ijt}} = MC_{AB_{ijt}} * R_j$$

where:



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

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

$MV_{ijt}$ = Mean merchantable volume per unit area for stratum  $i$ , species  $j$ , time  $t$ ; m<sup>3</sup> ha<sup>-1</sup>

$D_j$ = Volume-weighted average wood density; t d.m. m<sup>-3</sup> merchantable volume (IPCC 2006)

$BEF_j$ = Biomass expansion factor for conversion of biomass of merchantable volume to aboveground biomass; dimensionless (3A.1 Table 3A.1.10 of IPCC GPG LULUCF)

$CF_j$ = Carbon fraction; IPCC default value = 0.5; t C (t d.m.)<sup>-1</sup>

$R_j$ = Root-shoot ratio; dimensionless (: IPCC 2003 table 3.A.1.8)

**Detailed Calculations: The following procedure is implemented for calculating net GHG removals by sinks generated in the project area:**

### Eucalyptus

**Step1:** Volume per tree in sample plot is calculated by using the following Equation:

(a) Volume equation<sup>3</sup> used for Eucalyptus is

$$V = 0.00258 + 0.0281 (\pi * DBH)^2 * H \quad (1)$$

The above equation for Eucalyptus is from northern India and is considered applicable to the project region.

Where:

$v$ =Volume per tree ( m<sup>3</sup>).

DBH is diameter at breast height (DBH, at 1.37 m above-ground) for all the trees in the permanent sample plots (m)

H= Height of the tree from permanent the sample plots (m)

$\pi * DBH$ = Girth (m)

(b) Volume per tree ( $v$ ) is converted to volume per ha ( $V$ ) as follows:

The volume calculated for each trees as per Equation 1 was summed for all trees within a sample plot and expressed as volume per unit area  $V$  ( m<sup>3</sup>/ha).

Stepwise calculations are included in Annex 3.

The volumes per hectare were converted to biomass as follows:

**Step 2:** Estimation of Above ground biomass for Eucalyptus:

$$AGB = V * W.D * BEF \quad (2)$$

Where

AGB=Above ground biomass (t d.m per ha)

$V$ =Volume per unit area (e.g., m<sup>3</sup>/ha).

W.D=Basic Wood density (t d.m/m<sup>3</sup>) used for Eucalyptus=0.34 (from table 3A.1.9.2 of IPCCGPG LULUCF)

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<sup>3</sup> Chaturvedi, A.N. (1983). Eucalyptus for Farming. U.P. forest bulletin No: 48. U.P. Forest department, Lucknow, Uttar Pradesh

BEF=Biomass expansion factor for conversion of biomass of volume to aboveground biomass;  
dimensionless

We have used BEF for Eucalyptus=2 (minimum value for broadleaf), from Table 3A.1.10 of IPCC GPG LULUCF.

### **Casuarina**

Biomass per ha for Casuarina was estimated as follows:

**Step 1:** For **Casuarina** the following allometric equation<sup>4</sup> has been used where:

$$\text{Aboveground biomass (AGB)} = -2.49409 + 2.285804 \text{ Ln (DBH)} + 0.438090 \text{ Ln(H)} \quad (2)$$

AGB=Above ground biomass (kg.d.m per tree). This has been converted to t.d.m per tree in column h (sheet Field tree data) of Annex 3

DBH=Diameter at breast height (cm)

H=Height of the tree from permanent the sample plots.(m)

**Step 2:** The aboveground biomass per tree is summed for all trees in the sample plot and converted to biomass per hectare (t d.m per ha)

**Step 3:** Estimation of Below ground biomass for Eucalyptus and Casuarina

$$\text{BGB} = \text{AGB} * R_j$$

Where

BGB=Below ground biomass

AGB=Above ground biomass

R<sub>j</sub>=Root to shoot Ratio

The root shoot ratios have been adopted from Table 3A.1.8 of IPCC GPG LULUCF as follows:

Eucalyptus=0.35 (Mean values for eucalyptus plantation) and,

Casuarina=0.32(Mean values for conifer plantation)

**Step 4:** The calculated above ground and below ground biomass is converted into Carbon where  
Carbon=Biomass/2

**Step 5:** The total Carbon is then converted to tonnes of CO<sub>2</sub> equivalent by multiplying by 44/12 or 3.67.

Where 44/12 is Ratio of molecular weights of carbon and CO<sub>2</sub>; dimensionless (Universal constant).

**Step 6:** The GHG removals for each strata was calculated separately as detailed in step: 1-5.Finally the mean change in carbon stock per unit area is then multiplied by the area of the strata.

Total project area is 1607.91 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:

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<sup>4</sup> 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.

**Table E.1: Distribution of project area in standing, coppice and harvested categories.**

Area under first rotation plantation (ha)	Area harvested but replanted /coppice (ha)		Total area replanted/ coppice	Area harvested but not replanted / coppiced-uprooted	Total Project Area
	Coppice of 2008, 2009 (b)	Coppice of 2010, 2011 (c)			
(a)	(b)	(c)	(d)	(e)	(f)
669.74	140.24	306.62	446.84	491.44	<b>1607.91</b>

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.

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 August'2011. 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) <i>t CO<sub>2</sub>-e</i> per ha	Accumulated GHG emissions <i>t CO<sub>2</sub>-e</i>	Actual net GHG removals by sinks <i>t CO<sub>2</sub>-e</i>
(a)	(b)	(c)	(d)	(e) = (b) * (c)
Andhra Casuarina (ACA)	25.96	159.93	nil	4151.81
Andhra Eucalyptus Clonal (AEC)	311.75	106.99	nil	33,352.58
Andhra Eucalyptus Sees (AES)	23.22	81.85	nil	1900.58
Orissa Eucalyptus Clonal (OEC)	259.25	97.46	nil	25,267.53
Orissa Eucalyptus Seed (OES)	189.80	93.4	nil	17,733.58
<b>Grand Total</b>	<b>809.98</b>			<b>82,406.08</b>

**Table E.3: Carbon stock change in areas that were (a) harvested and subsequently replanted and (b) harvested and not replanted again – till the time of harvest**

**a) Area Harvested and Subsequently replanted / Coppice existing**

		Harvested but replanted / Coppiced									
Year of Harvest		2008		2009		2010		2011		Total	
Relevant No of years		4		5		6		7			
Strata	Annual Carbon stock change in living biomass for stratum (tCO <sub>2</sub> e per ha per year)	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals
a	b	c	d = b*c*4	e	f=b*e*5	g	h=b*g*6	i	j=b*i*7	k=c+e+g+i	l=d+f+h+j
AEC	14.93	-	-	43.53	3,248.96	94.85	8,495.20	62.72	6,553.74	201.10	18,297.90
AES	11.42	0.76	34.72	7.09	323.89	5.03	344.67	1.92	153.49	14.80	856.77
ACA	22.31	12.20	1,088.97	7.61	679.27	5.72	765.85	-	-	25.53	2,534.08
OEC	13.60	17.40	946.49	37.78	2,055.08	92.66	7,560.50	25.74	2,450.27	173.58	13,012.34
OES	13.04	1.19	62.05	12.62	658.09	17.14	1,340.68	0.88	80.31	31.83	2,141.13
<b>Total</b>		<b>31.55</b>	<b>2,132.23</b>	<b>108.63</b>	<b>6,965.28</b>	<b>215.40</b>	<b>18,506.91</b>	<b>91.26</b>	<b>9,237.81</b>	<b>446.84</b>	<b>36,842.22</b>

b) Area Harvested but not replanted / Coppiced – Uprooted

		Harvested but not replanted / coppiced-Uprooted									
Year of Harvest		2008		2009		2010		2011		Total	
Relevant No of years		4		5		6		7			
Strata	Annual Carbon stock change in living biomass for stratum (tCO <sub>2</sub> e per ha per year)	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals	Area(ha)	Actual net GHG removals (tCO <sub>2</sub> e)
a	b	c	d = b*c*4	e	f=b*e*5	g	h=b*g*6	i	j=b*i*7	k=c+e+g+i	l=d+f+h+j
AEC	14.93	0.88	52.54	16.35	1,220.32	89.32	7,999.91	9.95	1,039.70	116.50	10,312.47
AES	11.42	1.28	58.47	7.19	410.57	-	-	13.28	1,061.66	21.75	1,530.70
ACA	22.31	28.58	2,551.04	86.22	9,619.95	198.70	26,603.81	36.75	5,740.51	350.25	44,515.31
OEC	13.60	-	-	-	-	1.09	88.94	1.45	138.03	2.54	226.97
OES	13.04	-	-	-	-	-	-	-	-	-	-
<b>Total</b>		<b>30.74</b>	<b>2,662.06</b>	<b>109.76</b>	<b>11,250.84</b>	<b>289.11</b>	<b>34,692.66</b>	<b>61.43</b>	<b>7,979.89</b>	<b>491.04</b>	<b>56,585.44</b>

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

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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.

<b>Item</b>	<b>Values applied in ex-ante calculation of the registered CDM-PDD</b>	<b>Actual values reached during the monitoring period</b>
<b>Emission reductions (tCO<sub>2</sub>e)</b>	<b>175,011</b>	<b>175,833.74</b>

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

The variance that is observed in the estimated and the actual net GHG removals by sinks is due to the time difference in the monitoring process. Additionally ex-ante projections are based on estimates while the actual measurements from the sample plots are the basis for actual calculation of net GHG removals.

**History of the document**

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