Final Project Report

EVALUATION OF TELANGANA STATE FOREST DEVELOPMENT CORPORATION PLANTATIONS IN KOTHAGUDEM, PALONCHA AND SATHUPALLI DIVISIONS FOR TOTAL CARBON STOCK AND CARBON FOOTPRINT

Submitted To
Telangana State Forest Development Corporation

BY

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Abstract of the report

The current investigation titled as "Evaluation of Telangana state forest development corporation plantations in Kothagudem, Paloncha and Sathupalli divisions for total carbon stock and carbon footprint" was carried out during 2021-2022 with objectives prescribed as (a.) Assessment of carbon sequestration (tons/ha), (b.) Assessment of carbon foot print from the plantation operations by life cycle assessment (LCA). Above ground biomass and below ground biomass of plantations pertaining to plantations of eucalyptus, bamboo, cashew-nut and teak was determined using allometric equations and the soil organic carbon was determined using Walkley and Black rapid titration method. Total carbon stocks stored in the biomass of respective plantations along with soil organic carbon and the total CO_2 emissions arising due to the operations undertaken and chemical inputs provided is assessed. Cumulative data indicates that about 42123 Tons of Carbon is stored in the form of biomass, while carbon stocks in the form of soil organic carbon is 25059 Tons. On the other hand, total CO_2 emissions arising due to the machinery operations carried out in these plantations and nursery along with chemical inputs was 51980 Tons CO_2 emissions. Thus, the net carbon stocks stand at 15202 Tons.

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1. INTRODUCTION AND OBJECTIVES OF THE STUDY

Forest ecosystems are the largest terrestrial carbon (C) sink on Earth (Pan, 2011), and their management has been recognized as a cost-effective strategy for mitigating greenhouse gas emissions in recent years. (Di Sacco, 2021 & Domke et al, 2020).

From 1960 to 2015, total anthropogenic carbon emissions amounted to 408 Pg C (Mitchard, 2018), with tropical forest destruction contributing about 8%. Conservation, restoration, and improved management of tropical forests, mangroves, and peatlands could provide 23% of the mitigation action needed to limit global warming to 2 $^{\circ}$C by 2030 (Seymour, 2016).

The role that forest management can play in a climate change mitigation strategy provides a strong incentive to quantify current patterns of forest carbon sources and sinks, especially as they relate to forest management. This is one of the key issues in the Kyoto protocol agreement. There is widespread interest in managing forests to increase the rate of carbon dioxide (CO_2) sequestration because sequestering and storing carbon in forests is relatively inexpensive when compared to efforts aimed at actually reducing emissions in fossil fuel intensive economies. (Gorte, 2009)

Forest carbon sequestration is increasingly recognized as an ecosystem service that are included as indices of sustainability as well as in modelling exercises that seek to examine interactions among multiple ecosystem services. Plantation forests present a special case for carbon sequestration because they can sequester a proportionately large amount of carbon swiftly (Byrne & Milne, 2006).

Telangana is the twelfth largest state in India, geographical area wise; with an area of 112101 Km. It is bounded by Maharashtra, Chhattisgarh and Orissa in the north, Andhra Pradesh in the east and south and Karnataka & Maharashtra in the west. The state was formed on 2nd June, 2014 by the Government of India as 29th State. It has 26903.70 Km of notified forest land, which is 24.00% of the Geographical area (TSSFR, 2015).

The Telangana State Forest Development Corporation Limited is incorporated on 14.05.2015, under the Companies Act.2013 and also a Trust under the India Income Tax 1961. (FDC, T.S.) The organisation is established for raising man-made forests so as to meet the domestic and industrial needs of forest produce and reclothe the degraded forest areas and bring them under productive use (TSFDC, 2022).

TSFDC Plantations are raised on principles of sustainability and are a huge sink of carbon, here in this investigation efforts were made to qualify the carbon sequestered in ecosystem. Keeping the above said points in view the following study was conducted with the following objectives.

Objectives of the work:

a. Assessment of carbon sequestration (tons/ha)

b. Assessment of carbon foot print from the plantation operations by life cycle assessment (LCA)

2. REVIEW OF LITERATURE:

The pertinent literature from the sources available has been reviewed as under:

2.1 Biomass Production and Carbon Sequestration Potential:

The technique of capturing carbon from the atmosphere and storing it in a reservoir is known as carbon sequestration. It entails the transport of atmospheric C, particularly CO_2, and its safe storage in long-lived pools. Aboveground C storage is the integration of C into plant matter, either in the harvested product or in the parts that stay alive on the site. Apart from the nature of the plant, the amount of biomass, and hence C, that is stored, is heavily influenced by the qualities of the soil in which it grows, with larger concentrations of organic matter (OM), nutrients, and good soil structure resulting in more biomass production (Nair et al., 2010).

Aboveground carbon sequestration is a direct result of biomass production above ground (Nair et al., 2010). The rate at which this fundamental process occurs is influenced by a wide range of ecological and managerial factors. Tree plantations, particularly in the tropics, play a vital role in carbon sequestration by accumulating carbon in the wood and increasing soil carbon storage. However, the carbon sequestration potential of different plantation species varies greatly, and estimates of the carbon sequestration rates of typical plantation species vary widely (FAO, 2003 and Negi and Chauhan, 2002).

Yashmita Ulman and S. Avudainayagam (2014) reported that Carbon concentrations were discovered in decreasing order in different portions of the tree for all ages of Eucalyptus plantation in their study: stem > root > branch > leaf. The carbon content of the litter revealed that the youngest stand yielded the lowest return and the oldest stand yielded the highest return. The carbon content was found to be 38.10 t /ha (one year plantation) and 115.88 t/ ha (four-year plantation) when estimated by biomass

and carbon content per cent (formula method), and 42.66 t /ha (one year plantation) and 129.04 t/ ha (four-year plantation) when estimated by the assumption that carbon fractions is 50% of biomass (assumption method).

Viera and Roque Rodríguez-Soalleiro (2019) investigated the Carbon Stocks in Above and Belowground Biomass Components of a Hybrid Eucalyptus Plantation in Southern Brazil and reported that the aboveground carbon was 118.45 Mg C ha $^{-1}$, belowground carbon was 30.06 Mg C ha $^{-1}$ and the soil carbon accounted for 99.7 Mg ha^{-1}.

Parveen Kumar et al., (2020) investigated inter-annual growth, biomass output, carbon storage, and sequestration in *Eucalyptus tereticornis* plantations of various ages (1–8 years) in North-west India. The non-destructive sampling was used to measure aboveground and belowground biomass of *E. tereticornis* plantations using and the allometric equation and reported that after 8 years of planting, total carbon store in *E. tereticornis* grew from 18.7–20.6 Mg C ha $^{-1}$ to 91.8–96.2 Mg C ha^{-1}. The soil organic carbon in 0–15 cm depth increased by 34.8 percent across an 8-year plantation cycle, highlighting the importance of litter input.

Kumar et al. (2019) conducted research to design and develop biomass models, as well as estimate the carbon sequestration of a *Eucalyptus tereticornis* plantation in reclaimed sodic soils. To estimate the biomass and carbon of different Eucalyptus spp. tree parts, allometric models were developed. It was discovered that dry biomass of various components in the following order: bole>roots>twigs and leaves>fuelwood (branches). Carbon concentrations in biomass ranged from 43 to 46 percent in different tree components. Total carbon stocks in a 6-year-old *E. tereticornis* plantation were 122.6 mg/ha, with a CO_2 mitigation potential of 369.2 mg/ha.

Guruveen Arora et al., (2013) investigated the Growth, biomass, carbon storage, and carbon sequestration potential along an age series in *Populus deltoides* plantations and reported that the diameter at breast height and height growth rates were faster in trees aged 4 to 7 years and 2 to 5 years, respectively, the total aboveground biomass (AGB) rose with age, peaking at 180.2 Mg ha–1 at 11 years and the average carbon concentration in aboveground components ranged from 39.7 to 51.7 percent.

Singh, A.K et al., (2020) investigated the carbon sequestration of Teak plantation in Eastern Ghats using random non-destructive quadrate method and reported that the above ground carbon was 230.16 t/ha, belowground carbon was 59.84 t/ha and soil organic carbon was 21.27 t/ha. The biomass carbon contributed 93% and soil carbon 7% of the total carbon sequestered.

Meenakshi. K et al., (2010) investigated the carbon storage and storage potential of Sal, Teak, Eucalyptus and Poplar tree species using CO_2FIX model and reported that the fast-growing short rotation poplar (8 Mg Cha^{-1} yr^{-1}) and Eucalyptus (6 Mg Cha^{-1} yr^{-1}) plantations had the highest net annual carbon sequestration rates, followed by moderate growing teak forests (2 Mg Cha^{-1} yr^{-1}) and slow growing long rotation sal forests (1 Mg Cha^{-1} yr^{-1}).

Chiranjeeva Reddy M et al., (2014) investigated the carbon sequestration potential of teak plantations of different agro-climatic zones considering age gradations of 10,15,20 years of plantation and reported that the aboveground biomass and total aboveground carbon sequestered (247.47 t/ha) of teak plantations raised on farmlands was higher in Northern Transition zone compared to Northern dry zone and hilly zone and also reported that the carbon sequestration was more in 20 years old plantation (330 t/ha) when compared to 15 years (108.53 t/ha) and 10 years (70.27 t/ha) old teak plantations.

Uthappa AR and Devakumar AS (2020) investigated the carbon sequestration potential of different land use systems viz., Tree plantations, natural forest, horticulture and agroforestry and reported that the CO2 sequestration in tree biomass was high in tree plantations (*Atrocarpus hirsutus, Terminalia bellirica*) and lowest under horticulture system and the highest soil carbon was recorded in natural forests and lowest in horticulture.

Swamy et al. (2018) investigated the carbon sequestration capacity of four distinct plantation species in Karnataka's northern region. *Eucalyptus terticornis, Casuarina equisetifolia, Acacia auriculiformis,* and *Tectona grandis* were the species used for the estimation of carbon. *Eucalyptus tereticornis* reported maximum volume (0.19 m^3), biomass (984.65 t/ha), and carbon sequestration (492.33 t/ha), followed by *Casuarina equisetifolia* and *Acacia auriculiformis*. *Tectona grandis* had the lowest volume, biomass, and carbon sequestration values of 0.06 m^3, 310.93 t/ha, and 155.46 t/ha, respectively.

3. MATERIALS AND METHODS

The present investigation was carried out in Forest Development Corporation managed eucalyptus, teak, cashew and bamboo plantations of Kothagudem, Paloncha and Sathupalli Divisions during year 2021-2022. The details about experimental site, materials used and methodology adopted in undertaking these studies are given below.

Study Area

Location

The present study was carried out at TSFDC Eucalyptus plantations, Kothagudem, Paloncha and Sathupalli Divisions in central agro-climatic zone of Telangana State.

Topography and Soil

In the study area, on an average the wet season is hot, oppressive, and overcast and the dry season is sweltering, humid, and mostly clear. Over the course of the year, the temperature typically varies from 16°C to 42°C and is rarely below 12°C or above 45°C. The study area experiences extreme seasonal variation in monthly rainfall, the mean annual rainfall ranges from 950mm to 1430 mm. Soils in the study area vary from sandy loam to heavy clay soils. The details regarding climatic data and soil types are presented here under.

a. Climatic data

Table 1. Table showing the Rainfall and Temperature Data of three divisions

Division	Year	Rainfall (mm.)	Temperature (^{0}C)
Kothagudem	2016	500-1000	18-47
	2017	589-1000	20-50
	2018	500-1000	18-47
	2019	800-1000	18-47
	2020	110-1000	20-50
	2021	875-1000	18-47

Sathupalli	2016	875-1000	22-45
	2017	800-1000	20-45
	2018	875-1000	22-45
	2019	300-450	24-45
	2020	875-1000	21-45
	2021	1200-2000	21-40
Paloncha	2016	810-900	21-47
	2017	800-1130	25-49
	2018	754-1000	25-49
	2019	920-1296	22-50
	2020	1220-1900	19-47
	2021	800-1200	22-50

(TSFDC Report, 2021)

b. Soil types

Table 2. Table showing the soil types of three divisions

Division	**Soil Types**
Kothagudem	Sandy loam
	Red Sandy loam
	Heavy clay
Sathupalli	Well drained loam & Rocky
	Sandy & Sandy loam
	Red Sandy loam
	Sandy loam
Paloncha	Sandy loam
	Red Sandy loam
	Sandy clay loam
	Red & Brown sandy loam

(TSFDC Report, 2021)

Eucalyptus plantations are spread over a gross area of 9784 Ha. across the three divisions of Kothagudem, Paloncha and Sathupalli. Different espacements have been adopted for Eucalyptus plantations of seed origin viz., 2 m x 2 m, 2.5 m x 2.5 m, 3m x 1.33 m, 1.5 m x 1.5 m, 3m x 2m. In case of Eucalyptus clonal plantations, the spacing adopted was 3m x 3m, so as to derive maximum yields in the form of dimensions and as well as pulpwood and faggot-wood in order to cater to the Industrial needs of pulpwood Industries, local people etc.

The Eucalyptus plantations raised by adopting clonal technology have shown superior performance when compared to seed origin plantations with regard to percentage of survivals, uniformity and vigour of growth, resulting in much higher yields.

For reliable estimation of total biomass of site, quantifying standing trees and their components such as stem wood, stem bark, living and dead branches, foliage, stump and roots is very essential. Destructive harvesting of forest trees is not always possible because it is time-consuming and there is high-risk of uncertainty when the obtained results are extrapolated to larger areas. Undoubtedly, the most common approach is to obtain biomass estimates at standing level.

Inventory plots (35 x 25 m) were systematically established in each site of eucalyptus stand in each age gradation. The diameter at breast height (DBH) and total height (H) were measured in all of the trees in each plot using diameter tape and Ravi- Multimeter respectively, and the density of live trees was assessed by complete enumeration. The structure and characteristics of the stand was very homogeneous in terms of density and tree dimensions. Allometric equations were used to estimate stand variables such as standing volume and biomass. Based on the stand DBH distribution, trees were virtually segregated into five diameter classes: 9.1-13; 13.1-17; 17.1-21; 21.125; 25.1-29 cm, which corresponded to 5%, 18%, 32%, 37% and 9% in relation to the total number of trees across all three divisions.

Allometric equations specific for the species were used as given below for calculation of volume (m^3): =0.02894-0.89284*DBH+8.72486*DBH. AGB was derived as 66% of the volume, whereas BGB was calculated based on the root to shoot ratio of 0.24 (IPCC, 2006). Standing carbon stock was derived as 47% of the total biomass, which is a combination of both AGB and BGB as per IPCC, 2006 protocols.

Biomass and carbon stocks derived using allometric equations was validated by adopting semi-destructive sampling in each stand. Ten trees in each diameter class were harvested for the evaluation of the carbon stocks in aboveground Eucalyptus biomass. For each of the tree harvested, the aboveground biomass was separated into four components: leaves, branches, bark, and commercial wood (smaller diameter use= 6.0 cm). Stems of diameter less than 6 cm were considered as branches.

The fresh weight of each tree component was measured and samples were taken to determine the dry weight and carbon contents. Wood and bark were sampled at three different points along the stem at relative heights of 0.25, 0.5, and 0.75. Branches and leaves were sampled randomly throughout the canopy, considering a sampling intensity of 5% of the total amount in each tree. The samples were transported to the laboratory and dried in a convection oven at 70 °C for 72 h to determine the dry weight and the total carbon per tree and component was determined. The biomass and total carbon stocks were found to be within a standard deviation of 10%, as compared to allometric data.

The accumulated carbon was estimated by multiplying the carbon content in the dry biomass of each component per plot and extrapolated to a per hectare basis. For each soil sample, carbon stocks were calculated by multiplying soil carbon concentration by the bulk density (kg/m^3) of each plot and by the depth of the soil layer. The bulk density was calculated by dividing the dry mass of soil (105°C) by the volume of the sampling cylinder.

Soil Organic Carbon: Soil samples were collected from two depths i.e. 0 to 30 cm and 30-60 cm. Thus, collected samples were mixed thoroughly to obtain an aggregate sample. Aggregate samples were air-dried at room temperature and passed through 2 mm sieve for further analysis. The organic carbon was determined using Walkley and Black rapid titration method as detailed by Piper (1950).

4. RESULTS:

For a total area of 3550 Ha of Eucalyptus plantation across 80 different sites in Kothagudem division, total biomass carbon is 12608 Tons, whereas the soil organic carbon is 4647 Tons. Total carbon stocks from Eucalyptus plantation in Kothagudem division is 17256 Tons.

For a total area of 4088 Ha of Eucalyptus plantation across 93 different sites in Paloncha division, total biomass carbon is 13113 Tons, whereas the soil organic carbon is 3385 Tons. Total carbon stocks from Eucalyptus plantation in Paloncha division is 16498 Tons.

In Sathupalli division, eucalyptus plantations at 70 locations and spread over an entire area of 2145 Ha, total biomass carbon is 12349 Tons. Soil organic carbon contributed to 2955 Tons of Carbon. Total carbon stocks accumulated to be 15304 Tons.

Carbon stocks in Bamboo Plantations in Kothagudem, Paloncha and Sathupalli Divisions. Bamboo is a plant that belongs to the true grass family *Poaceae*, a subfamily of *Bambusoideae*; it is commonly known as ‘poor man’s timber’ and is used by many rural populations in daily life. There are over 1600 bamboo species globally, consisting of 75-107 genera worldwide. Bamboo forests are distributed in approximately 31.5 million hectares (ha) of forested area, mostly in Brazil, China and India. Bamboo matures in 3-5 years and thereafter can be harvested annually for about 20 years or longer, depending on the gregarious flowering

period, after which bamboo dies. The bamboo gregarious flowering interval can be between 20 and 120 years, depending on the species.

Bamboo is a diverse plant that easily adapts to different site. It can grow in a wide variety of soil types, ranging from organic poor to mineral rich and from drought to flooding conditions. Bamboo can grow rapidly in hot and humid rainforests and even in cold climates with temperatures around -20°C.

Bamboo is one of the most important non-timber forest products in natural forests or in non-forestry areas. It is widely distributed and highly capable of natural regeneration at a low cost in natural resource management systems.

Bamboo is known as one of the fastest growing species of plants. There is also a substantial difference between bamboo forest and other forests. Bamboo has rapid growth and high re-growth rates when properly handled. The living cycle of bamboo culms (around 5-8 years) is comparatively shorter than that of most species of trees. Bamboo is commonly used in lower durability products than those in timber products. However, owing to the recent technological advancements in bamboo processing, bamboo can now be processed into very durable products.

Bamboo has a unique dense rhizome structure that helps in accelerating the growth rate of bamboo shoots and culms. Thanks to special biological characteristics of the rhizome, when a bamboo culm is harvested the bamboo rhizome system is still alive and continues to produce shoots. There are two main types of rhizome: (a) monopodial (running) and (b) sympodial (clumping). Running bamboo has the rhizome that spreads horizontally and forms the dispersed bamboo, whereas clumping bamboo has the shorter rhizome, is formed together and forms the bamboo clumps. There are two groups of bamboo, consisting of a group of herbaceous bamboo species and the other of woody bamboo species. Carbon sequestration is different among these groups of bamboo.

In the context of climate change, bamboo provides some ecosystem services, which benefit carbon sequestration. Bamboo can sequester a substantial amount of carbon in its above-ground biomass (AGB), below-ground biomass (BGB) and Soil Organic Carbon (SOC). Therefore, bamboo forests are an important resource for mitigating climate change. The sustainable management of bamboo forests that grow rapidly can support the objectives of the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD).

Despite the botanical classification, bamboo is a woody grass; however, it is capable of sequestering carbon when compared to other timber forests. As fast-growing species, organic carbon sequestration, due to photosynthesis, is substantial in culms, branches and leaves as well as in rhizome and root networks of bamboo. The sequestration of carbon in bamboo forests is similar to or larger than that of fast-growing timber plantations.

Aboveground carbon (AGC) of bamboo forest ranges from 16-128 tonne C ha^{-1}, below-ground carbon (BGC) biomass from 8-64 tonne C ha^{-1}, SOC from 70-200 tonne C ha^{-1} and total ecosystem carbon ranges from 94-392 tonne C ha^{-1}. Therefore, in terms of carbon cycle, bamboo forests have comparable characteristics to other forest types, such as the tropical rainforests in Asia which contain 56-320 tonne of C ha^{-1} in the AGB pool. Bamboo forests demonstrate significant carbon sequestration as an efficient and effective carbon sink.

The IPCC (2003, 2006) guidance, which is specific to the bamboo forest, consists of four main carbon pools, as shown below:

1. AGB consists of the following:

- Bamboo AGB
- Non-bamboo vegetation AGB

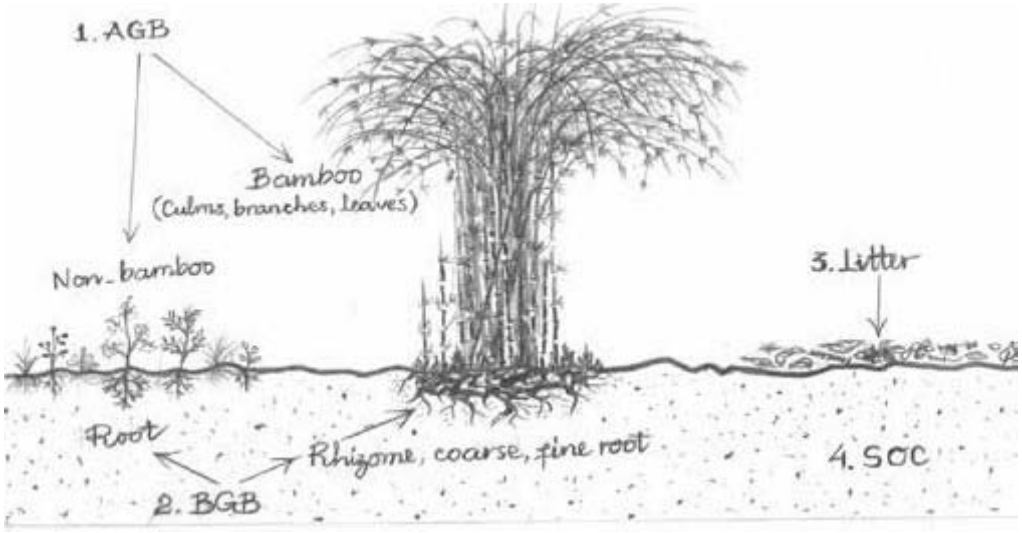
2. BGB consists of the following:

- Bamboo BGB, comprising rhizome and root networks

- Non-bamboo vegetation BGB

3.Litter

4.SOC



AGB and AGC in bamboo plantations

AGB in bamboo forest is living biomass above the soil, which includes biomass in bamboo culms, branches and leaves; and biomass in non-bamboo vegetation, including herbaceous plants, grasses and shrubs. In cases where the forest understorey is a relatively small component of the AGB carbon pool, it is acceptable to exclude it.

AGC in the bamboo forest includes carbon in all living biomass above the soil. BGB in bamboo forests is all biomass of live roots, which includes biomass in the root system of bamboo, including rhizome, coarse and fine roots larger than 2 mm in diameter and the depth of 60 cm where the bamboo root system can reach; and biomass in root of non-bamboo vegetation more than 2 mm in diameter.

Soil Organic Carbon

Organic carbon in mineral and organic soils is, to a specified depth of 50 cm. Live fine roots of less than 2 mm (or other values chosen by a country as the diameter limit for BGB)

are included in soil organic matter, where they cannot be distinguished from it empirically. SOC per unit area is calculated using following equation:

$SOC\ (tonne\ ha^{-1}) = \rho \times d \times \%C \times 100,$

where ρ is soil bulk density (g cm^{-3}) = dry soil weight of soil core (g)/volume of soil core (cm^3); d is soil depth (50 cm); and $\%C$ is the percentage of organic carbon in the dry soil core sample. The espacements adopted for Bamboo seed origin plantations are 5m x 5m, 6m x 4 m etc.

The existing bamboo plantations are at various stages of maintenance and management. Bamboo plantations are harvested by the F.D.C. from 10^{th} year of raising onwards on a (3) year felling cycle. The stocking in these mature plantations varies from 30 to 60 percent, while the younger plantations raised from 1998 onwards have on an average 80% stocking. The rate of growth and productivity of these plantations also varies depending on the source of genetic material, physio-geographic and socio-economic conditions prevailing in the area.

The older plantations prior to 1998 are harvested at a 3 years cycle (excepting two (2) such plantations whereas in plantations raised from 1998, the felling cycle is a two year one. The bamboo plantations raised under traditional method have yielded between 3 to 6 MTs per ha per cut. The plantations raised from 1998 with macro proliferation technology have shown much better performance. These plantations have yielded up to 12 MTs of Bamboo Industrial Cuts per ha besides 2500 Long Bamboo per ha.

The Bamboo plantations raised by adopting intensive site preparation, 18 months old seedlings and seedling raised with Macro-proliferation technology have shown much superior performance when compared to the seed origin, plantations with regard to percentage of survivals, uniformity and vigour of growth. Hence much higher yields are expected. Hence it is proposed to raise Bamboo plantations in future following the above technology only.

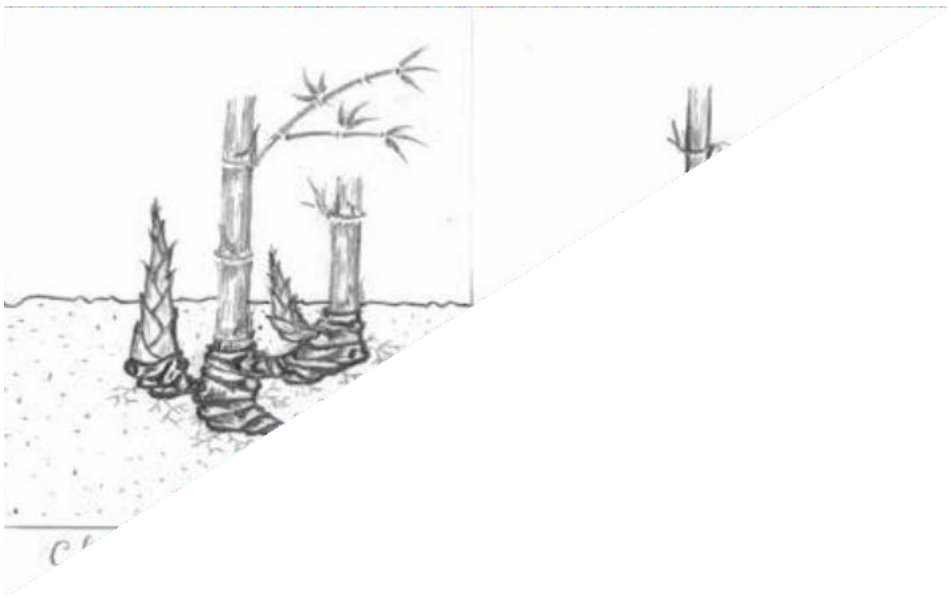
So far Bamboo is being extracted on a three-year felling cycle as per the management plan prescription. But the data collected from the private Bamboo plantations raised in

Khammam district shows that harvesting of the long Bamboo and Industrial cuts can be done in the alternate years duly following the Silvicultural prescriptions.

Table 3. Table showing the methods for measuring Bamboo biomass

Carbon pools in bamboo forests	**Method of measurement in the field**	**Method of developing allometric equations**
1. AGB/carbon		
Living Bamboo	Non-destructive measurement: Clump-based measurement: measuring clump-diameter of bamboo culm (D clump), height of bamboo clump (H clump) and number of culms per clump (N culm)	*Destructive measurement:* - Culms or clumps are felled to measure biomass of bamboo components and AGB bamboo and the allometric equation used in the studies is validated with these measurements
2. BGB/Carbon		
Bamboo root: rhizome, coarse and fine roots	*Non-destructive measurement:* Use Root-Shoot Ratio (RSR) of 0.26. No measurement	
3. Dead mass and carbon in litter		*Destructive measurement*: - Sample the litter in the frames along with the full range of the expected LD

The bamboo plant is either clump forming (clumping bamboos) or non-clump forming (running bamboos). A clump is a cluster of bamboo culms. All bamboos spread via their rhizomes. Whereas running bamboos (monopodial) have long rhizomes, which spread horizontally, clumping bamboos (sympodial) have shorter rhizomes, which bring bamboos together.



Given the different growing forms of bamboo, the bamboo measurement can be divided into two main categories:

- Culm-based measurement, which is for running bamboo or clumping bamboo with long necked rhizomes (sparse culms). In the field, it is possible to measure all individual culms in the sample plot or each culm in clump with sparse culms.
- Clump-based measurement, which is for clumping bamboo with very dense culms (short necked rhizomes). The measurement of each culm in clump is impractical. Therefore, variables of bamboo clump and/or representative culms can be measured.

For AGB bamboo: non-destructive measurement

To apply the non-destructive method to collect data in the field, AGB models are used to estimate carbon biomass; these models are set based on destructive data.

- Culm-based measurement in sample plots, which is for running bamboo or clumping bamboo with no dense culms. In a sample plot system, the collected data are the predictors of the model, used to estimate bamboo plant AGB. Normally, the variables that need to be measured are D (cm), H (m) and A (year) of bamboo culms, in which the H predictor only needs to be measured in a similar fashion to all culms because most bamboo culms reach the elongation and then maximal height in the first year.
- Clump-based measurement, which is for clumping bamboo with very dense culms:

Measuring predictors of the selected AGB clump models, such as clump girth (G-clump), D-clump, H-clump, N-culm and the number of clumps per unit area (N-clump). In this case, the allometric equations for AGB clump are used.

For BGB bamboo: non-destructive measurement

Basically, the direct measurement of BGB bamboo is difficult, mainly because of the complex rhizome and root system of bamboo. Therefore, surveys and inventories mainly apply the non-destructive measurement to collect data on predictors of the models which are available for estimating BGB bamboo. Meanwhile, to set up the BGB bamboo models, the destructive measurement needs to be applied to collect the data set of the predictors and responses. Modelling is set once for a local and/or regional/ecological area and is then applied in the long run.

Non-destructive measurement, using the available Root-Shoot Ratio (RSR) Some research results have thus far reported on RSR, which include the ratios of BGB to AGB. RSR is determined according to each species in each locality, territory or country. The RSR value of 0.86 for *Dendrocalamus strictus* as reported by Idem *et al*. in India has been used in the present studies for estimating the value of BGB bamboo from the value of AGB bamboo.

Log (AGB) = -0.3003 +0.6804 * log (D) + 1.0440 * log (H); r^2 = 0.990

BGB = 0.780 x $D^{0.708}$

Soil organic carbon: Ten soil samples within 0-60 cm depth were randomly acquired from each quadrant using a 7.5 cm diameter auger. All samples were cleared off any organic components including roots, leaves and then carried to the laboratory in a zip-lock bags. A composite consisting of equal proportions of ten samples was prepared and oven dried at 65°C. SOC was measured by oxidizing with a mixture of acid and dichromate solution and then titrating the unutilized dichromate with ferrous ammonium sulphate in the presence of diphenyl amine indicator.

Based on the inventory data available with the TSFDC and also based on the data collected from sample plots for the culms, clumps, height and girth, the aboveground and belowground biomass were estimated and a conversion factor of 47% was adopted for determining the extent of carbon sequestered. All trees falling in the sample plots (0.1 Ha) were listed to estimate biomass.

Results:

A total of 49 different bamboo plantation sites are present in the Kothagudem division, with years of establishment ranging from 1977 to 2021. These plantations are spread over an area of 2906.305 Ha. Total carbon stocks including aboveground and below ground in the bamboo plantations of Kothagudem division were 825 ton, whereas the total soil organic carbon was found to be 5495 ton (Table 6).

Similarly, 29 different sites with bamboo plantations exist in Paloncha division, as old as 3 -23 years in 1241 Ha. total carbon stocks including aboveground and below ground in the bamboo plantations of Paloncha division were 445 ton, whereas the total soil organic carbon was found to be 2346 ton.

Total carbon stocks of above and belowground for bamboo spread over 3018 Ha. in 46 locations of Sathupalli division is 613 Ton, whereas soil organic carbon contributed to 5705 Ton.

Carbon stocks in Cashew Plantations in Kothagudem & Paloncha Divisions: Cashew-nut trees (*Anacardium occidentale*) are tropical nut crop trees that belong to the family Anacardiaceae, which is known for having a resinous bark and often, caustic oils in leaves, barks and fruits. The tree is evergreen, fast growing and reaches a height of 10 - 15 m and often has an irregularly shaped trunk. Farm management practices consist of weeding, pruning and spraying pesticides and fungicides.

Cashew-nut trees are planted at a spacing of 12 × 12 m making a total of 70 trees per hectare (ha). This species has ability to grow on poor soils and can be intercropped with other food crops. Cashew-nuts are consumed as food as well as marketed for export. The crop prefers deep, well drained, light textured soils which facilitate extensive lateral root extension. It grows well from sea level to 1,200 m where the temperature does not fall below 20°C.

The optimum monthly temperature for a cashew-nut tree growth is 27° C. The cashew-nut tree is grown in areas with rainfall ranging from 800 – 1600 mm per annum. The Cashew plantations are spread in Khammam District one each in the Divisions of Kothagudem (59 Ha) and Paloncha (41.46 Ha). The total area under Cashew comprises of 100.46 ha. These plantations were raised in red soils with espacements of 7 x 7 m.

The percentage of survivals in the above plantations varies from 24.40% to 28.50% as the above plantations are raised in red soils of Khammam district. No destructive sampling was attempted in these plantations.

One sample plot each of 1 Ha was randomly selected in each division in the cashew plantations, their DBH and height were determined. The following allometric equations available in the literature were used for estimation of aboveground and belowground biomass and thereby the calculation of carbon stocks.

AGB $B = 0.3152 \times dbh^{1.7722} \times ht^{0.5003}$

BGB $B = 0.09287 \times (dbh^2)^{0.9394}$

Note: AGB or BGB = biomass (kg), dbh = diameter at breast height (cm), ht = total tree height (m)

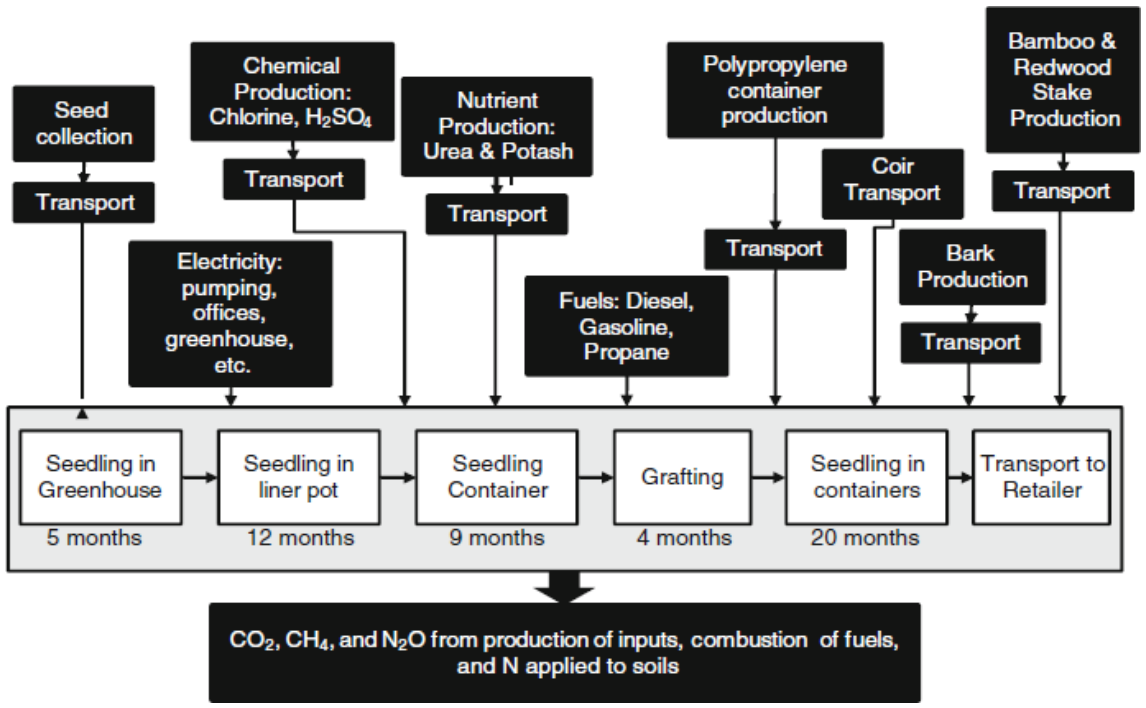
Results: The C stock data obtained from the sample plots was extrapolated to the entire area. Total carbon stocks including above and below ground biomass stand at 2170 Ton, and SOC was 588Ton (Table 6).There were no inputs or operations carried out during this year for the cashew plantations. Therefore, carbon footprint was not documented.

Life Cycle Assessment of nursery operations

The purpose of this Green House Gas life cycle inventory (LCI) is to generate the first detailed inventory for nursery operations producing containerized saplings for TSFDC plantations.

The scope of our analysis constitutes a cradle-to-retailer GHG inventory that includes material and chemical inputs, electricity and fuel use, and transportation of inputs and products for a nursery and its suppliers. The production of capital equipment and facilities used in tree production operations are not considered in this inventory. Figure 1 defines the system analysed in the study and shows the months required for each step of production for a tree.

Figure 1. Nursery system diagram



System definition: The results are reported on per-year basis, which can be translated into a per-EQU basis as well. Information on materials and energy consumed during tree production was provided by TSFDC Nursery for the year 2021. As demonstrated in Fig. 1, the production process for a #5 tree requires just over 4 years. During this period, the seedling will move from

greenhouse to outdoor growing spaces. At each growth stage through the grafting step, a portion of the seedlings are lost. These losses are accounted for in this analysis.

Life cycle inventory: Nursery operations were divided into categories for the purposes of data collection and developing the LCI model. The following section describes how each category was modelled in the life cycle inventory. All datasets adapted from LCI databases were accessed through the GaBi software tool (PE International 2009), and other datasets were adapted directly from reports and publications.

Data collection required interviewing and surveying representatives of TSFDC Nursery and their suppliers. TSFDC Nursery provided data on fuels and electricity used on site broken down by fuel type, and application to production activities, greenhouse activities, irrigation, and buildings (office, docks, shop, and canning). In addition, the nursery provided annual data for container use, agro-chemical use, potting soil use and constituent materials, and total annual production in EQUs. Supplier contacts provided key data on production and transport of nursery materials.

On-site and direct energy use in nursery: Electricity consumption in all nursery buildings, including offices, was reported by TSFDC Nursery. To model life cycle GHG emissions for electricity, data for delivered electricity from the power grid were taken from the electricity bills. Transportation and equipment fuels including diesel and gasoline consumption in nursery trucks, tractors, and equipment were also tracked. Data for combustion were used to estimate total fuel cycle emissions.

Potting mix

Potting mix includes bark, manure, and coir. The bark used at the nursery is known to be transported within a distance of 10-20 km by truck; Organic manure and coir were treated as low-value by-products of other production processes. Neither requires significant processing before use in the potting mix. Thus, only transport of these materials was considered in our analysis.

Synthetic fertilizers and chemicals used in production: Urea, urea ammonium nitrate (UAN 36-0-0), and potassium sulphate (0-0-52) are used in production. Production of these fertilizers as well as their transport to the nursery is accounted for in the study. Emissions for production of these fertilizers are taken from the Eco-invent database. Transport distances and truck types (engine size and brand) were provided by suppliers and are modelled using the

diesel production emissions for combustion. Chlorine is used in the production system in a very small way for disinfection purposes.

Consumables used in production

Plastic bags and stakes are both used in large quantities for tree production. Their production is not included. Containers are all assumed to be made of injection-moulded polypropylene and are sourced from suppliers and shipped by truck to the nursery. The suppliers provided data on total distance travelled and the fuel economy of their trucks.

Seed collection or seedling procurement

Seed purchased by the nursery or seedlings procured are provided by suppliers who harvest seeds from trees already growing in the environment. Thus, acquisition burdens are limited to the trucks used to travel to different seed collection sites and deliver seeds to the nursery.

Emissions from soils

Emissions from potting and natural soils were also considered in this inventory but were limited to N_2O emissions from fertilized soils. Carbon dioxide emissions from the decay of organic matter used in potting mixes were not considered within the system boundary of this study. This is consistent with GHG inventory practices because bark, coir, and chicken manure all constitute biogenic sources of CO_2.N_2O emissions were calculated using the Inter-governmental Panel on Climate Change's Tier 1 methods (Intergovernmental Panel on Climate Change 1996). Potting mixes and greenhouse systems are different than typical field-based agriculture and forestry, the intended application of Tier I estimates. Nevertheless, these methods were chosen because no other estimates of N_2O emissions from nursery operations were found.

To apply Tier I methods, estimates of N-content in materials is required. The N-content in synthetic fertilizers is easily calculated based on reported N-content by manufacturers. For the organic sources of N, manure, and coir, research was conducted to estimate N-content by mass. Coir contains approximately 0.5%N by dry weight, and an estimate of 1.55% was used for the N content of chicken manure.

Co-product allocation

This assessment considers the entire nursery operation and requires an allocation step to attribute inputs and outputs to a particular production unit per year. While the ISO and many

experts recommend avoiding allocation by subdivision or system expansion, neither of these methods can be applied to this production system.

Subdivision is not possible because the nursery operates as an integrated system, and data collected by nursery operators cannot be subdivided and assigned to particular (sub)processes attributable to a specific product. System expansion is not possible because no suite of substitutable products could be identified for the other products produced in the nursery, namely many different-sized trees. Thus, an allocation step is a requirement to determine the life cycle inventory for nursery products.

Impact assessment

The impact assessment is limited to applying global warming potentials (GWP) to the three primary GHG emissions: CO_2, CH_4, and N_2O, as this study evaluates only GHG emissions. GWPs are based on the 100-year time horizon from IPCC's Fourth Assessment Report and equate to 25 for CH_4 and 298 for N_2O (Intergovernmental Panel on Climate Change 2007).

Results:

Results for the inputs to the nursery production operations are shown in Table 4. These inputs are reported in total annual requirements for the nursery and total requirements per tree. Transportation-related requirements are reported either in volume of diesel consumed, or freight transport units of t-km (ton-kilometres) or kt-km(kiloton-kilometres). The use of volume of fuel units versus t-km units reflect the kind of information provided by suppliers, which either facilitated direct calculations of fuel or only provided the distance travelled of goods. Key users of energy inputs include irrigation and radiant heating of the nursery's large greenhouse. Total annual GHG emissions for the nursery operations are 5757 tons CO_2e (Table 5).

The largest contributor of emissions, electricity consumed on-site by the nursery, constitutes nearly 29% of CO_2e (Table 5). Electricity use for pumping water, irrigation technologies and green house maintenance and utilization accounted for the larger part of GHG emissions from nursery operations, followed by the use of diesel for transport of materials. Lifecycle assessment of various operations and chemicals inputs in the plantations are shown in Table 4 and Table 5.

Table 4. Details of the inputs in nursery raising

Input	Per nursery-year	Unit
Electricity	3,550	MWh
Diesel (transport of product to site)	98	kL
Manure	1200	T
Urea (46-0-0)	11	T
Overhead transport by truck	0.13	kL
Potassium sulfate (0-0-52)	190	T
Diesel for truck transport	1.6	kL
UAN (36-0-0)	180	T
Chlorine	2.4	T
Seeds	50	kg

Table 5. CO_2e Emissions for total nursery output per year

Category	CO_2 per year for nursery in Tons
Electricity	2,020
Fertilizers	1,145
Chlorine	4
Material transport	1,729
N_2O from potting mix and fertilizer	430
Synthetic fertilizer	333
Manure	96
Coir	4.78E-02
Total	5757

To understand the carbon footprint of eucalyptus, bamboo and cashew plantations in three divisions of Kothagudem, Paloncha and Sathupalli, the series of operations undertaken in each plantation were analysed for their potential contribution to greenhouse gas emissions.

The forest scenario considers a standard hectare of commercial Eucalyptus, Bamboo and Cashew nut cultivated in three divisions. The forest management scenario has been assessed from cradle (raw material production) to forest gate perspective.

Thus, further distribution and final conversion of wood into other products has been excluded for the assessment. The production of capital goods such as forest machines (tractors, chainsaw, forwarders, chipper, backhoe and spreaders) and implements (front blade and ripper) have been excluded from system boundaries. Similarly, the production of agrochemicals (herbicides and fertilizers) and seedlings has been excluded from the system boundaries.

The system boundary includes crop establishment, wherein the site is prepared for establishment of stand. Site preparation is based on deeply breaking-up compacted soils using a tractor connected with a ripper. Weed control measures to eradicate grass and perennial weeds like Mahaveera and Lantana are undertaken.

Stand establishment consists of three activities: planting, application of herbicides and fertilizing. The plantations are manually established at appropriate densities. In the next phase, harvests or cutting cycles are included. In each cutting cycle, all processes are repeated every 7 years. First agrochemicals are applied to remove undesirable vegetation and to improve the soil nutritional quality. Harvesting is done manually using chainsaw.

Activities related to the hauling take place at the end of the last cutting cycle. After all remaining trees have been harvested for last time, the stumps are removed with a backhoe. First the stumps collected are left in the forest; afterwards, the stumps are uprooted and the biomass is scattered on the soil in order to improve the soil quality.

In this cradle to gate analysis, the total biomass production was considered as a whole. The remaining biomass generated in the plantation such as leaves; branches and stumps have not been computed in the analysis of by-products. Because the LCA was done in a “cradle to gate” perspective, special attention has been paid to all the processes, including those activities and procedures in Eucalyptus nursery. Seedling production process includes all the activities performed at the nursery from the plantation of the seed until the seedling is ready to be sent to the forest plantations.

The nursery is considered to be located at 20 km from the plantation area. The inventory data for the seedling production has been directly collected by means of surveys with workers at the nursery. The seedling production includes two mainstages: sprout production and stems production. Both stages are carried out in the same expanded polystyrene-based pot using bark as substrate. The seeds are collected from the forest and stored in the nursery. However, seeds production has not been included in this study due to the lack of available information.

The seeds are manually planted at a rate of 200 seeds per m^2. Itis important to remark that all the activities performed in the nursery are done manually. Seedling production takes place during a first stage of 4 weeks, requiring one initial application of fertiliser(urea) and fungicide (4 g /m^2 and 1.5 mg/m^2 respectively). The irrigation is every 8 h (0.5 L/m^2). After that, half of the seedlings are manually selected. Seedling final production stage is performed during 3 months where a ternary fertiliser is manually applied once a week (1.5 g/m^2) and insecticide once a month (10 mL/m^2). The irrigation is every 12 h (0.35 L/m^2).

The estimation of fuel requirements in site preparation, stand establishment, harvesting, hauling and logistic infrastructure related activities were collected directly by surveys from the contract agencies with the TSFDC. Primary and site-specific inventory concerning the forest machinery and implements used (operating hours and input rates) was collected.

Nitrogen based emissions to air from fertilizers were calculated following the emission factors for the Indian context. Following the methodological approach taken in previous LCA studies of forest systems, the forest production system under study has been assumed to be in a steady state with respect to both carbon stock and management operations. It involves that there is no change in the forest biomass productivity, soil organic matter stocks, availability of nutrients and water over the steady state.

LCA data indicates that various operations for all the three rotations of eucalyptus over the entire area of eucalyptus plantations in all three divisions account for a mere 0.088 Tons of CO_2 emissions. However, the chemical inputs during the first year of maintenance, namely SSP and urea application account for 5.52 and 46217.5 Tons of CO_2 emissions, respectively. As a whole, urea application is the major contributor to the greenhouse gas emissions in the eucalyptus plantations.

Total CO_2 emissions arising due to the operations carried out in Bamboo plantations was 0.00057753 Tons. No chemical inputs are provided for the bamboo. Further, the total CO_2 emissions arising due to the operations carried out in Cashew nut plantations was 0.00000719 Tons. No chemical inputs are provided for the Cashewnut.

5. SUMMARY

A summary of the total carbon stocks stored in the biomass of respective plantations along with soil organic carbon and the total CO_2 emissions arising due to the operations undertaken and chemical inputs provided is shown below. Cumulative data indicates that about 42123 Tons of Carbon is stored in the form of biomass (Table 6), while carbon stocks in the form of soil organic carbon are 25059 Tons (Table 6). On the other hand, total CO_2 emissions arising due to the machinery operations carried out in these plantations and nursery along with chemical inputs was 51980 Tons CO_2 emissions (Table 6). Thus, the net carbon stocks stand at 15202 Tons (Table 6).

Table 6. Summary of Carbon stored and CO_2 emissions from the plantations

S.No.	Division/Unit	Plantation	Total Biomass Carbon (Ton)	SOC (Ton)	CO_2 emissions (Ton) due to machinery operations	CO_2 emission (Ton) due to chemical inputs (Ton)
1	Kothagudem	Eucalyptus	12608	4647	0.089	4004944.59
2	Paloncha	Eucalyptus	13113	3385		
3	Sathupalli	Eucalyptus	12349	2955		
4	Kothagudem	Bamboo	825	5495	0.0006	-
5	Paloncha	Bamboo	445	2346		
6	Sathupalli	Bamboo	613	5705		
7	Kothagudem + Paloncha	Cashew nut	2170	526.81	0.000007	-
8	Nursery	Seedling production	-	-	5757	-
		TOTAL	42123	25059.81	5757.08	46223
			67182		51980	
Net Carbon			15202 Tons			

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Name of the plantation in Sathupalli Dvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
1998 CMA Sathupalli	5.78	5.18	25899	19424	3.50	9.00	2.86624	0.02866	0.00082	0.010516817	204.281277	114.3975151	75.50236	27.4554	102.9577636	48.3901489	0.138	1380	2954621.4
1999 CMA Sathupalli	5.06	2.50	12540	9405	4.50	8.50	2.70701	0.02707	0.00073	0.01116424	104.999678	58.79981966	38.80788	14.112	52.91983769	24.8723237			
2002 EP CTD Sathupalli	5.99	5.04	6666	5000	4.20	8.60	2.73885	0.02739	0.00075	0.011031216	55.1505632	30.8843154	20.38365	7.41224	27.79588386	13.0640654			
2003 EP Chandraipale	35.73	35.07	38962	29222	4.10	8.10	2.57962	0.0258	0.00067	0.011714036	342.30169	191.6889462	126.5147	46.0053	172.5200516	81.0844243			
2004 EP Chandraipale	27.75	24.11	26786	20090	4.70	8.60	2.73885	0.02739	0.00075	0.011031216	221.611609	124.1025011	81.90765	29.7846	111.692251	52.495358			
2005 EP Buggapadu	44.00	43.18	47976	35982	4.30	8.20	2.61146	0.02611	0.00068	0.011573932	416.453219	233.2138028	153.9211	55.9713	209.8924226	98.6494386			
2005 EP Chandraipale	51.30	51.30	75144	56358	4.20	8.30	2.64331	0.02643	0.0007	0.011435598	644.487442	360.9129674	238.2026	86.6191	324.8216707	152.666185			
2005 EP CMA Aswaraopet	5.00	5.00	12636	9477	4.10	8.70	2.7707	0.02771	0.00077	0.010899961	103.298933	57.84740246	38.17929	13.8834	52.06266221	24.4694512			
2006 EP Balarajugude	48.13	47.19	78625	58969	4.70	8.90	2.83439	0.02834	0.0008	0.010642762	627.590356	351.4505996	231.9574	84.3481	316.3055396	148.663604			
2006 EP Buggapadu 'A'	38.68	37.03	61708	46281	4.30	8.22	2.61783	0.02618	0.00069	0.011546124	534.366147	299.2450421	197.5017	71.8188	269.3205379	126.580653			
2006 EP Buggapadu 'A' CMA	20.35	20.35	67827	50870	4.40	8.56	2.72611	0.02726	0.00074	0.011084213	563.856692	315.7597476	208.4014	75.7823	284.1837728	133.566373			
2007 EP Balarajugude	77.82	75.85	126395	94796	13.00	30.80	9.80892	0.09809	0.00962	0.025308179	2399.12047	1343.507463	886.7149	322.442	1209.156716	568.303657			
2007 EP Buggapadu	23.75	23.75	39581	29686	13.50	29.60	9.42675	0.09427	0.00889	0.022306478	662.184522	370.8233325	244.7434	88.9976	333.7409992	156.85827			
2007 EP Chowdaram	39.24	8.5	64141	48106	13.00	28.60	9.10828	0.09108	0.0083	0.01999974	962.102504	538.7774025	355.5931	129.307	484.8996623	227.902841			

Name of the plantation in Sathupalli Dvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2007 EP Jagannadhapur Bit - II	19.10	19.1	59365	44524	13.00	30.30	9.64968	0.0965	0.00931	0.024026498	1069.74981	599.0598908	395.3795	143.774	539.1539017	253.402334			
2007 EP Jagannadhapur Bit-I	45.92	45.83	76360	57270	4.00	9.50	3.02548	0.03025	0.00092	0.009913639	567.754096	317.9422939	209.8419	76.3062	286.1480645	134.48959			
2007 EP Katkur	52.38	52.06	86746	65060	10.00	21.60	6.87898	0.06879	0.00473	0.008808074	573.048918	320.907394	211.7989	77.0178	288.8166546	135.743828			
2008 EP Balarajugudem Bit - I	32.46	32.46	54082	40562	10.50	20.30	6.46497	0.06465	0.00418	0.00768444	311.692423	174.5477566	115.2015	41.8915	157.092981	73.8337011			
2008 EP Chowdaram	45.61	43.34	75992	56994	10.50	20.60	6.56051	0.06561	0.0043	0.007917193	451.232505	252.6902029	166.7755	60.6456	227.4211826	106.887956			
2008 EP CMA Aswaraopet	1.62	1.62	5393	4045	10.50	22.10	7.03822	0.07038	0.00495	0.009319883	37.6965981	21.11009493	13.93266	5.06642	18.99908544	8.92957016			
2008 EP Jagannadhap	56.54	56.55	94208	70656	10.50	23.40	7.45223	0.07452	0.00555	0.010857655	767.158504	429.6087623	283.5418	103.106	386.6478861	181.724506			
2008 EP Katkur Bit - I	16.34	15.99	26634	19976	10.50	24.60	7.83439	0.07834	0.00614	0.01254261	250.544915	140.3051526	92.6014	33.6732	126.2746374	59.3490796			
2008 EP Katkur Bit - II	6.06	6.06	10096	7572	10.50	22.62	7.20382	0.07204	0.00519	0.0098991	74.9559869	41.97535267	27.70373	10.0741	37.7778174	17.7555742			
2008 EP Naramvargudem	33.30	33.05	55060	41295	10.50	22.85	7.27707	0.07277	0.0053	0.010170557	419.993152	235.1961651	155.2295	56.4471	211.6765486	99.4879778			
2008 EP Vedanthapur Bit - I	30.00	27.04	64173	48130	10.50	24.00	7.64331	0.07643	0.00584	0.011668276	561.591216	314.4910811	207.5641	75.4779	283.041973	133.029727			
2008 EP Vedanthapur Bit - II	16.50	16.27	27106	20330	10.50	22.65	7.21338	0.07213	0.0052	0.009933977	201.952779	113.0935563	74.64175	27.1425	101.7842006	47.8385743			

Name of the plantation in Sathupalli Dvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2009 EP Chowdaram	28.60	28.67	49959	37469	10.00	23.10	7.35669	0.07357	0.00541	0.010476238	392.536768	219.8205901	145.0816	52.7569	197.8385311	92.9841096			
2009 EP Guntimadug	33.44	32.5	54146	40610	10.00	21.80	6.94268	0.06943	0.00482	0.009007489	365.789605	204.8421789	135.1958	49.1621	184.357961	86.6482417			
2009 EP Jagannadhapur Bit - I	55.91	54.29	92992	69744	10.00	22.15	7.05414	0.07054	0.00498	0.009373498	653.745225	366.097326	241.6242	87.8634	329.4875934	154.859169			
2009 EP Jagannadhapur Bit - II	18.28	18.39	30615	22961	10.00	22.50	7.16561	0.07166	0.00513	0.009761187	224.12906	125.5122736	82.8381	30.1229	112.9610463	53.0916917			
2009 EP Katkur	44.10	43.04	71706	53780	10.00	21.90	6.97452	0.06975	0.00486	0.00910985	489.923194	274.3569889	181.0756	65.8457	246.92129	116.053006			
2009 EP Lankalapalli (RA)	3.34	3.34	5558	4169	10.00	22.46	7.15287	0.07153	0.00512	0.009715783	40.5002396	22.68013417	14.96889	5.44323	20.41212076	9.59369676			
2009 EP Lankalapalli Bit - II	20.60	20.6	34324	25743	10.00	21.95	6.99045	0.0699	0.00489	0.009161695	235.849511	132.0757263	87.16998	31.6982	118.8681537	55.8680322			
2009 EP Lankapalli 'A'	35.18	35.18	60733	45550	10.00	22.00	7.00637	0.07006	0.00491	0.009213982	419.694572	235.0289605	155.1191	56.407	211.5260644	99.4172503			
2009 EP Naramvarigudem	6.71	6.71	11176	8382	10.00	21.20	6.75159	0.06752	0.00456	0.008430484	70.6643174	39.57201774	26.11753	9.49728	35.61481597	16.7389635			
2009 EP Lankalapalli (DA)	7.69	7.69	12818	9614	10.00	22.00	7.00637	0.07006	0.00491	0.009213982	88.5786151	49.60402443	32.73866	11.905	44.64362199	20.9825023			
2010 EP Anantharam	13.46	12.74	28220	21165	4.00	8.50	2.70701	0.02707	0.00073	0.01116424	236.291141	132.3230391	87.33321	31.7575	119.0907352	55.9726456			
2010 EP Jagannadhapur	54.96	52.7	122138	91604	4.00	7.50	2.38854	0.02389	0.00057	0.012591823	1153.45509	645.9348505	426.317	155.024	581.3413655	273.230442			
2010 EP Lankalapalli Bit - I	5.64	5.64	11185	8389	4.00	7.40	2.35669	0.02357	0.00056	0.012744316	106.908878	59.86897181	39.51352	14.3686	53.88207463	25.3245751			

Name of the plantation in Sathupalli Dvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2010 EP Lankalapalli Bit - II	13.80	13.80	27369	20527	4.00	7.50	2.38854	0.02389	0.00057	0.012591823	258.46921	144.7427576	95.53022	34.7383	130.2684818	61.2261865			
2010 EP Lankapalli 'A'	41.30	40.55	90290	67718	4.00	8.30	2.64331	0.02643	0.0007	0.011435598	774.390119	433.6584668	286.2146	104.078	390.2926201	183.437531			
2010 EP Sunnambatti	34.87	31.64	70315	52736	4.00	8.50	2.70701	0.02707	0.00073	0.01116424	588.760156	329.7056873	217.6058	79.1294	296.7351186	139.465506			
2010 EP Vedanthapur	20.14	19.64	43644	32733	4.00	8.70	2.7707	0.02771	0.00077	0.010899961	356.788432	199.8015221	131.869	47.9524	179.8213699	84.5160438			
2011 EP Balarajugudem	75.50	73.54	184546	138410	4.00	8.10	2.57962	0.0258	0.00067	0.011714036	1621.3338	907.9469296	599.245	217.907	817.1522366	384.061551			
2011 EP Guntimadug	32.64	31.71	69993	52495	4.00	8.54	2.71975	0.0272	0.00074	0.011110818	583.259612	326.6253827	215.5728	78.3901	293.9628444	138.162537			
2011 EP Jagannadhap	17.80	17.08	37985	28489	4.00	8.62	2.74522	0.02745	0.00075	0.011004823	313.513659	175.5676492	115.8746	42.1362	158.0108843	74.2651156			
2011 EP Lankapalli 'A'	43.97	42.97	95482	71612	16.00	29.54	9.40764	0.09408	0.00885	0.022163083	1587.13159	888.793691	586.6038	213.31	799.9143219	375.959731			
2011 EP Reddigudem	45.65	44.4	98762	74072	16.00	28.64	9.12102	0.09121	0.00832	0.020088612	1487.9936	833.2764166	549.9624	199.986	749.948775	352.475924			
2011 EP Sunnambatti	36.20	34.72	77218	57914	4.00	8.60	2.73885	0.02739	0.00075	0.011031216	638.856314	357.759536	236.1213	85.8623	321.9835824	151.332284			
2012 EP Anantharam	35.80	35.02	86023	64517	16.00	32.30	10.2866	0.10287	0.01058	0.029418694	1898.01325	1062.887422	701.5057	255.093	956.5986798	449.60138			
2012 EP Balarajugude	22.53	22.05	49000	36750	4.00	8.50	2.70701	0.02707	0.00073	0.01116424	410.285823	229.7600609	151.6416	55.1424	206.7840548	97.1885057			
2012 EP Buggapadu	30.86	30.29	67324	50493	16.00	31.25	9.95223	0.09952	0.0099	0.026499522	1338.04035	749.3025933	494.5397	179.833	674.372334	316.954997			
2012 EP Gandugulapa	30.54	29.84	66393	49795	15.00	31.62	10.0701	0.1007	0.01014	0.027505918	1369.65032	767.0041773	506.2228	184.081	690.3037595	324.442767			

Name of the plantation in Sathupalli Dvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2012 EP Guntimadugu	32.26	32.68	72619	54464	4.00	4.50	1.43312	0.01433	0.00021	0.017936465	976.896131	547.0618336	361.0608	131.295	492.3556503	231.407156			
2012 EP Jagannadhapur	47.38	47.38	105308	78981	17.00	30.25	9.63376	0.09634	0.00928	0.023900764	1887.70622	1057.115485	697.6962	253.708	951.4039362	447.15985			
2012 EP Lankapalli 'A'	46.66	46.21	102692	77019	16.00	31.65	10.0796	0.1008	0.01016	0.02758858	2124.84482	1189.913101	785.3426	285.579	1070.921791	503.333242			
2013 EP Balarajugudem Bit - I	44.07	43.32	96259	72194	16.00	30.26	9.63535	0.09635	0.00928	0.023913317	1726.40401	966.7862445	638.0789	232.029	870.10762	408.950581			
2013 EP Balarajugudem Bit - II	17.72	17.72	58905	44179	4.00	8.50	2.70701	0.02707	0.00073	0.01116424	493.222171	276.204416	182.2949	66.2891	248.5839744	116.834468			
2013 EP Buggapadu	47.37	45.9	102573	76930	17	32.6	10.3822	0.10382	0.01078	0.030288582	2330.09308	1304.852123	861.2024	313.165	1174.366911	551.952448			
2013 EP CMA Aswaraopet	1.29	1.29	4301	3226	15	31.3	9.96815	0.09968	0.00994	0.026634105	85.9149651	48.11238048	31.75417	11.547	43.30114243	20.3515369			
2013 EP Guntimadug	40.60	8.06	84578	63434	16	31.8	10.1274	0.10127	0.01026	0.028004277	1776.40931	994.789212	656.5609	238.749	895.3102908	420.795837			
2013 EP Jagannadhapur	57.72	56.25	128320	96240	17	30.5	9.71338	0.09713	0.00943	0.024533861	2361.1388	1322.237727	872.6769	317.337	1190.013954	559.306558			
2013 EP Lankapalli 'A'	39.49	38.81	86655	64991	15	30.8	9.80892	0.09809	0.00962	0.025308179	1644.81019	921.0937076	607.9218	221.062	828.9843369	389.622638			
2014 EP Buggapadu 'A' Bit - I	26.99	26.01	57990	43493	16	30.6	9.74522	0.09745	0.0095	0.024790197	1078.18766	603.7850875	398.4982	144.908	543.4065788	255.401092			
2014 EP Buggapadu 'A' Bit - II	34.55	33.1	73567	55175	17	30.4	9.68153	0.09682	0.00937	0.024279295	1339.61616	750.1850509	495.1221	180.044	675.1665458	317.328277			

Name of the plantation in Sathupalli Dvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2014 EP Kessappagud a	49.30	48	106674	80006	15	31.2	9.93631	0.09936	0.00987	0.02636538	2109.37544	1181.250248	779.6252	283.5	1063.125223	499.668855			
2014 EP Jagannadhap	14.80	14.8	45418	34064	16	30.1	9.58599	0.09586	0.00919	0.023526215	801.385217	448.7757216	296.192	107.706	403.8981495	189.83213			
2020 EP CDP Jagannadhap ur	7.40	7.16	15929	11947	5	10.5	3.34395	0.03344	0.00112	0.00884002	105.609504	59.1413225	39.03327	14.1939	53.22719025	25.0167794			
2020 EP CTA Jagannadhap ur	5.34	5.34	8916	6687	5	11.5	3.66242	0.03662	0.00134	0.007943382	53.1173984	29.74574309	19.63219	7.13898	26.77116878	12.5824493			
2020 EP CTA Kessappagud	7.13	7.08	11803	8852	5	11.8	3.75796	0.03758	0.00141	0.007708903	68.2411346	38.21503539	25.22192	9.17161	34.39353185	16.16496			
2020 EP Jagannadhap	27.04	24.81	55132	41349	5	11.3	3.59873	0.03599	0.0013	0.008108551	335.280488	187.7570734	123.9197	45.0617	168.9813661	79.4212421			
	2141.03	2026.08																	

Biomass Carbon			**12349**
	SOC		**2954.6**
Total Carbon			**15303.6**

Name of the plantation in KOTHAGUDEMDvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2006 EP Penagadapa	56.32	53.73	89519	79403	88.70	13.75	29.50	9.39	0.0939	0.00883	0.765	60724	34005	22443	8161	30605	14384	0.138	4647826	4647.826
2006 EP Abbugudem	50.00	46.45	77384	59614	77.04	13.90	23.20	7.39	0.0739	0.00546	0.011	632	353.92	233.6	84.9	318.5	149.7			
2006 EP Marrigudem	41.88	39.08	48252	36713	76.09	13.80	23.20	7.39	0.0739	0.00546	0.011	389.22	217.96	143.9	52.3	196.2	92.2			
			8445					0.00	0.0000	0.00000	0.029	0	0	0	0	0	0			
2006 EP Chaparalapalli	39.19	37.65	62732	32638	52.03	9.90	21.10	6.72	0.0672	0.00452	0.008	272.22	152.44	100.6	36.6	137.2	64.48			
2006 EP Pentlam-I	37.08	36.6	62521	35659	57.04	7.92	18.90	6.02	0.0602	0.00362	0.007	242.8	135.97	89.74	32.6	122.4	57.51			
2006 EP Pentlam-II	52.04	49.94	85314	65717	77.03	8.30	20.35	6.48	0.0648	0.00420	0.008	507.47	284.19	187.6	68.2	255.8	120.2			
2006 EP Nagupalli	42.17	40.56	67577	52580	77.81	11.85	27.10	8.63	0.0863	0.00745	0.017	887.1	496.78	327.9	119	447.1	210.1			
2006 EP Srirampur	21.65	20.93	34875	23150	66.38	14.00	30.10	9.59	0.0959	0.00919	0.024	544.63	304.99	201.3	73.2	274.5	129			
2007 EP Penagadapa	79.19	74.62	124322	100452	80.80	13.00	28.50	9.08	0.0908	0.00824	0.02	1986.8	1112.6	734.3	267	1001	470.6			
2007 EP Abbugudem	90.39	86.06	143382	113195	78.95	12.30	22.40	7.13	0.0713	0.00509	0.01	1092.1	611.59	403.7	147	550.4	258.7			
2007 EP Marrigudem	77.28	73.65	122703	96305	78.49	12.90	22.50	7.17	0.0717	0.00513	0.01	940.05	526.43	347.4	126	473.8	222.7			
2007 EP Garimellapadu	57.32	51.8	86301	54974	63.70	12.40	26.75	8.52	0.0852	0.00726	0.016	890.52	498.69	329.1	120	448.8	210.9			
2007 EP Thippanapalli	47.95	45.48	75770	56865	75.05	13.10	27.50	8.76	0.0876	0.00767	0.018	1004.6	562.59	371.3	135	506.3	238			

Name of the plantation in KOTHAGUDEMDvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2007 EP Pentlam A	38.26	37	61667	46182	74.89	6.23	15.10	4.81	0.0481	0.00231	0.006	285.45	159.85	105.5	38.4	143.9	67.62			
2007 EP Pentlam B	49.78	45.67	76097	63822	83.87	6.10	15.75	5.02	0.0502	0.00252	0.006	389.77	218.27	144.1	52.4	196.4	92.33			
2007 EP Pentlam C	37.83	36.63	61028	48651	79.72	5.60	14.35	4.57	0.0457	0.00209	0.006	309.37	173.25	114.3	41.6	155.9	73.28			
2007 EP Buggapadu B	54.73	53.4	88892	58988	66.36	7.20	18.35	5.84	0.0584	0.00342	0.007	386.95	216.69	143	52	195	91.66			
2007 EP Chaparalapalli	37.89	36.82	61355	40287	65.66	11.50	18.25	5.81	0.0581	0.00338	0.007	262.68	147.1	97.09	35.3	132.4	62.22			
2007 EP Nagupalli	87.5	85.7	142775	83095	58.20	11.20	25.05	7.98	0.0798	0.00636	0.013	1100.2	616.11	406.6	148	554.5	260.6			
2007 EP Srirampur	24.37	24.08	40114	23165	57.75	8.60	22.85	7.28	0.0728	0.00530	0.01	235.6	131.94	87.08	31.7	118.7	55.81			
2008 EP Abbugudem	54.28	53.88	88926	77051	86.65	8.50	15.30	4.87	0.0487	0.00237	0.006	473.88	265.37	175.1	63.7	238.8	112.3			
2008 EP Penagadapa	54.34	53.08	88453	73858	83.50	7.75	15.35	4.89	0.0489	0.00239	0.006	453.76	254.11	167.7	61	228.7	107.5			
2008 EP Thippanapalli-I	41.3	40.62	67673	60804	89.85	7.50	14.90	4.75	0.0475	0.00225	0.006	378.12	211.75	139.8	50.8	190.6	89.57			
2008 EP Thippanapalli-II	56.5	52.28	87102	67634	77.65	7.30	13.50	4.30	0.0430	0.00185	0.007	451.87	253.05	167	60.7	227.7	107			
2008 EP Garimellapadu	86.75	80.65	134366	76656	57.05	8.00	21.25	6.77	0.0677	0.00458	0.008	649.75	363.86	240.1	87.3	327.5	153.9			
2008 EP Suraram	82.24	70.26	117055	87089	74.40	8.25	18.00	5.73	0.0573	0.00329	0.006	559.91	313.55	206.9	75.3	282.2	132.6			

Name of the plantation in KOTHAGUDEMDvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2008 EP Gareebpeta	75.82	71.96	119948	78684	65.60	9.15	20.30	6.46	0.0646	0.00418	0.008	604.64	338.6	223.5	81.3	304.7	143.2			
2008 EP Pentlam-A	20.8	20.8	34769	10392	29.89	5.02	11.50	3.66	0.0366	0.00134	0.008	82.548	46.227	30.51	11.1	41.6	19.55			
2008 EP Pentlam-B	27.74	27.5	48805	36442	74.67	4.90	11.20	3.57	0.0357	0.00127	0.008	298.6	167.21	110.4	40.1	150.5	70.73			
2008 EP Thallapenta A	78.40	41.4	76148	58253	76.50	5.20	11.45	3.65	0.0365	0.00133	0.008	465.09	260.45	171.9	62.5	234.4	110.2			
2008 EP Thallapenta B		35.37	58939	41551	70.50	6.40	12.95	4.12	0.0412	0.00170	0.007	289.1	161.89	106.8	38.9	145.7	68.48			
2008 EP Srirampur	22.39	21.4	35669	25146	70.50	6.60	14.40	4.59	0.0459	0.00210	0.006	159.53	89.334	58.96	21.4	80.4	37.79			
2009 EP Penagadapa I	35.18	34.41	57342	48746	85.01	8.00	14.20	4.52	0.0452	0.00205	0.006	312.29	174.88	115.4	42	157.4	73.98			
2009 EP Penagadapa II	37.8	33.83	19276	14804	76.80	8.10	14.30	4.55	0.0455	0.00207	0.006	94.366	52.845	34.88	12.7	47.56	22.35			
			8904					0.00	0.0000	0.00000	0.029	0	0	0	0	0	0			
2009 EP Thippanapalli	38.05	36.51	65743	48321	73.50	8.10	13.90	4.43	0.0443	0.00196	0.007	314.74	176.25	116.3	42.3	158.6	74.56			
2009 EP Chatakonda	64.62	62.66	104400	50112	48.00	9.65	14.90	4.75	0.0475	0.00225	0.006	311.63	174.51	115.2	41.9	157.1	73.82			
2009 EP Suraram	62.75	61.04	101681	78396	77.10	8.70	20.50	6.53	0.0653	0.00426	0.008	614.46	344.09	227.1	82.6	309.7	145.6			
2009 EP Garimellapadu	64.7	63.63	106024	72202	68.10	7.80	19.90	6.34	0.0634	0.00402	0.007	534.21	299.16	197.4	71.8	269.2	126.5			
2009 EP Gareebpeta I	75.79	71.38	127157	82716	65.05	8.75	18.40	5.86	0.0586	0.00343	0.007	544.29	304.8	201.2	73.2	274.3	128.9			

Name of the plantation in KOTHAGUDEMDvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
2009 EP Gareebpeta II	49.62	47.62	79533	64342	80.90	8.60	18.50	5.89	0.0589	0.00347	0.007	426.1	238.62	157.5	57.3	214.8	100.9			
2009 EP Chaparalapalli	24.39	23.98	39951	33885	84.82	6.10	12.20	3.89	0.0389	0.00151	0.007	251.46	140.82	92.94	33.8	126.7	59.57			
2009 EP Thallapenata A	71.6	69.2	118429	88821	75.00	6.80	14.00	4.46	0.0446	0.00199	0.006	575.21	322.12	212.6	77.3	289.9	136.3			
2009 EP Thallapenata B	84.61	82.78	144846	112835	77.90	6.90	15.00	4.78	0.0478	0.00228	0.006	699.45	391.69	258.5	94	352.5	165.7			
2010 EP Penagadapa	13.77	12.73	28301	22273	78.70	4.15	7.25	2.31	0.0231	0.00053	0.013	289.02	161.85	106.8	38.8	145.7	68.46			
2010 EP Chatakonda	36.12	33.27	77233	49777	64.45	5.10	9.20	2.93	0.0293	0.00086	0.01	511.22	286.28	188.9	68.7	257.7	121.1			
2010 EP Thippanapalli	29.50	28.68	63727	40912	64.20	3.95	6.90	2.20	0.0220	0.00048	0.014	553.68	310.06	204.6	74.4	279.1	131.2			
2010 EP Garimellapadu	45.36	44.12	101252	65307	64.50	4.00	6.00	1.91	0.0191	0.00037	0.015	983.85	550.96	363.6	132	495.9	233.1			
2010 EP Suraram	65.59	61.07	136595	89470	65.50	6.00	12.80	4.08	0.0408	0.00166	0.007	630.08	352.84	232.9	84.7	317.6	149.3			
2010 EP Gareebpeta	44.29	42.81	95123	57740	60.70	4.30	8.90	2.83	0.0283	0.00080	0.011	614.51	344.13	227.1	82.6	309.7	145.6			
2010 EP Lingagudem	36.75	36.19	80430	57024	70.90	4.30	10.92	3.48	0.0348	0.00121	0.008	481.39	269.58	177.9	64.7	242.6	114			
2010 EP Buggapadu B	57.62	56.26	125082	58832	47.03			0.00	0.0000	0.00000	0.029	1702.6	953.45	629.3	229	858.1	403.3			
2011 EP Penagadapa	42.36	40.60	90794	79081	87.10	1.39	30.00	9.55	0.0955	0.00913	0.023	1840.9	1030.9	680.4	247	927.8	436.1			

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2011EP Chatakonda	51.17	49.69	111769	79915	71.50	12.90	30.10	9.59	0.0959	0.00919	0.024	1880.1	1052.9	694.9	253	947.6	445.4			
2011EP Garimellapadu	41.80	39.24	87198	63829	73.20	12.50	29.00	9.24	0.0924	0.00853	0.021	1334.1	747.1	493.1	179	672.4	316			
2011EP Gareebpeta	47.46	39.19	87084	63484	72.90	13.00	28.50	9.08	0.0908	0.00824	0.02	1255.6	703.16	464.1	169	632.8	297.4			
2011EP Thallapenta	39.27	38.39	85329	69411	81.35	11.00	27.00	8.60	0.0860	0.00739	0.017	1157.6	648.24	427.8	156	583.4	274.2			
2011 EP Lingagudem	46.52	45.72	103716	82972	80.00	9.60	25.12	8.00	0.0800	0.00640	0.013	1107.8	620.39	409.5	149	558.3	262.4			
2011 EP Srirampur I	40.86	40.19	92329	49756	53.89	12.50	32.30	10.29	0.1029	0.01058	0.029	1463.8	819.7	541	197	737.7	346.7			
2011 EP Srirampur II	35.62	35.2	78240	47657	60.91	13.20	32.50	10.35	0.1035	0.01071	0.03	1429.6	800.55	528.4	192	720.5	338.6			
2011 EP Pentlam	60.46	59.27	131698	97877	74.32	11.20	25.40	8.09	0.0809	0.00654	0.014	1351.4	756.8	499.5	182	681.1	320.1			
2012 EP Chatakonda	41.00	37.00	82218	72352	88.00	13.90	26.80	8.54	0.0854	0.00728	0.016	1178.9	660.17	435.7	158	594.2	279.3			
2012 EP Ramavaram	54.62	48.00	106659	77968	73.10	14.10	26.10	8.31	0.0831	0.00691	0.015	1170.1	655.25	432.5	157	589.7	277.2			
2012 EP Garimellapadu	14.31	11.00	24443	19676	80.50	14.00	26.10	8.31	0.0831	0.00691	0.015	295.28	165.36	109.1	39.7	148.8	69.95			
2012 EP VIIth shaft	48.75	44.25	98360	69934	71.10	12.60	25.50	8.12	0.0812	0.00660	0.014	977.23	547.25	361.2	131	492.5	231.5			
2012 EP Lingagudem	75.90	74.50	166615	145788	87.50	9.55	24.85	7.91	0.0791	0.00626	0.013	1884.4	1055.3	696.5	253	949.7	446.4			
2012 EP Brahmalakunta	13.55	11.17	24839	19262	77.55	10.15	25.80	8.22	0.0822	0.00675	0.014	278.96	156.22	103.1	37.5	140.6	66.08			

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2012 EP Pentlam	55.42	50.05	111233	85482	76.85	9.80	21.10	6.72	0.0672	0.00452	0.008	712.96	399.26	263.5	95.8	359.3	168.9			
2012 EP Buggapadu-B Bit-I	46.77	41.32	91817	64997	70.79	9.20	19.45	6.19	0.0619	0.00384	0.007	462.22	258.85	170.8	62.1	233	109.5			
2012 EP Buggapadu-B Bit-II	55.55	50.63	112510	77316	68.72	8.90	18.70	5.96	0.0596	0.00355	0.007	518.95	290.61	191.8	69.7	261.6	122.9			
2013 EP Lingagudem	31.80	25.00	55550	48328	87.00	9.50	24.06	7.66	0.0766	0.00587	0.012	567.99	318.08	209.9	76.3	286.3	134.5			
2013 EP Penagadapa	22.07	21.80	48443	43390	89.57	12.50	20.75	6.61	0.0661	0.00437	0.008	348.84	195.35	128.9	46.9	175.8	82.63			
2019 EP Chatakonda	17.76	17.49	38863	38474	99.00	8.15	19.00	6.05	0.0605	0.00366	0.007	263.93	147.8	97.55	35.5	133	62.52			
2019 EP Pentlam	31.05	30.00	66660	61920	92.89	6.50	16.00	5.10	0.0510	0.00260	0.006	377.63	211.47	139.6	50.8	190.3	89.45			
2019 EP Balarajugudem	24.62	24.12	53600	49480	92.31	4.10	9.50	3.03	0.0303	0.00092	0.01	490.53	274.7	181.3	65.9	247.2	116.2			
2020 EP Gareebpeta - I	32.88	29.77	66178	62869	95.00	5.00	3.00	0.96	0.0096	0.00009	0.021	1333.2	746.6	492.8	179	671.9	315.8			
2020 EP Gareebpeta - I	2.55	2.47	5489	5050	92.00	4.00	2.00	0.64	0.0064	0.00004	0.024	119.22	66.761	44.06	16	60.08	28.24			
2020 CTA Pentlam	9.710	4.71	7848	7769	98.99	5	10.5	3.34	0.0334	0.00112	0.009	68.678	38.46	25.38	9.23	34.61	16.27			
2020 CDP Pentlam		5.00	11110	10998	98.99	5	11.5	3.66	0.0366	0.00134	0.008	87.361	48.922	32.29	11.7	44.03	20.69			
2020 CTA Srirampur	5.00	5.00	8400	7728	92.00	5	11.8	3.76	0.0376	0.00141	0.008	59.574	33.362	22.02	8.01	30.03	14.11			

Name of the plantation in KOTHAGUDEMDvn.	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m^3 ***	Volume for survivals m^3	Above ground stem biomass (Ton) *	TOTAL AGB *	BGB **	Total biomass	Total Carbon * (Ton)	SOC (Kg/m^2)`	SOC (Kg/Ha)	Total SOC (Ton/Ha)
	3550.3	3367.99														56547	26577			

Biomass Carl	12607.8
SOC	4647.83
Total Carbo	17255.6

Name of the plantation in Paloncha Dvn.	Gross area (Ha)	Net area (Ha)	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m3 ***	Volume for survivals m3	Above ground stem biomass (Ton) *	Total aboveground biomass *	Belowground biomass **	Total biomass	Total Carbon *	SOC (kg/m^2)	SOC (kg/ha)	SOC (Kg/Ha) for the entire area of 4088.68 Ha
Mulakalapally	51.25	50.94		27102		13	28	8.91719745	0.08917197	0.00795	0.018700649	506.8249923	283.8219957	187.3225171	68.11727896	255.439796	120.0567042	0.0828	828	3385427
Wodduramaram - I & II	40.3	40.3		37984		13	29	9.23566879	0.09235669	0.00853	0.020901197	793.9110825	444.5902062	293.4295361	106.7016495	400.131186	188.0616572			
Satyampeta	41.24	41.19		26548		12	29	9.23566879	0.09235669	0.00853	0.020901197	554.8849889	310.7355938	205.0854919	74.57654251	279.662034	131.4411562			
Mulakalapally	32.26	32.2		28910		8.2	15.1	4.8089172	0.04808917	0.00231	0.0061809	178.689812	100.0662947	66.04375452	24.01591074	90.0596653	42.32804267			
Wodduramaram	36	35.98		29529		8.78	15.36	4.89171975	0.0489172	0.00239	0.006142419	181.3794884	101.5725135	67.03785892	24.37740324	91.4152622	42.96517322			
Satyampeta	33.65	32.53		20719		5	11	3.50318471	0.03503185	0.00123	0.008369578	173.4092924	97.10920372	64.09207446	23.30620889	87.3982834	41.07719318			
Subbanapally	30.98	30.81		16562		4.5	11	3.50318471	0.03503185	0.00123	0.008369578	138.6169555	77.62549506	51.23282674	18.63011881	69.8629456	32.83558441			
Wodduramaram	32.08	30.88		23829		8.04	16.58	5.28025478	0.05280255	0.00279	0.006121634	145.8724257	81.68855841	53.91444855	19.60525402	73.5197026	34.55426021			
Mulakalapally	26.8	26.42		22315		6.64	15.96	5.08280255	0.05082803	0.00258	0.006099278	136.1053966	76.21902212	50.3045546	18.29256531	68.5971199	32.24064636			
Subbanapally	47.4	47.2		33452		6	12	3.82165605	0.03821656	0.00146	0.007561432	252.9450268	141.649215	93.48848192	33.99581161	127.484294	59.91761796			
Mulakalapally	51.66	51		47621		6.23	15.33	4.88216561	0.04882166	0.00238	0.006146248	292.6904966	163.9066781	108.1784075	39.33760274	147.51601	69.33252484			
Mulakalapally	49	49		46156		6.08	16.67	5.3089172	0.05308917	0.00282	0.006130534	282.960936	158.4581242	104.5823619	38.0299498	142.612312	67.02778652			
Subbanapally	23	23		19794		8	15	4.77707006	0.0477707	0.00228	0.006198886	122.7007447	68.71241701	45.35019522	16.49098008	61.8411753	29.06535239			
Madharam	28.28	28.28		26395		6.58	14.73	4.6910828	0.04691083	0.0022	0.006256288	165.1347271	92.47544716	61.03379513	22.19410732	83.2279024	39.11711415			
Mulakalapally	68.1	68		57910		6.08	14.45	4.60191083	0.04601911	0.00212	0.006329444	366.5381182	205.2613462	135.4724885	49.26272309	184.735212	86.82554944			
Lingareddipally	58.6	58.6		37364		9.02	17.08	5.43949045	0.0543949	0.00296	0.006189218	231.2539563	129.5022156	85.47146227	31.08053173	116.551994	54.77943718			
Satyampeta	36.25	36.25		33025		5.07	11.76	3.74522293	0.03745223	0.0014	0.007739246	255.5886133	143.1296234	94.46555146	34.35110962	128.816661	60.54383071			
Mulakalapally	62	60.5		53238		13	30	9.55414013	0.0955414	0.00913	0.023278728	1239.312907	694.0152281	458.0500505	166.5636547	624.613705	293.5684415			
Lingareddipally	49.46	48.5		50168		13	30	9.55414013	0.0955414	0.00913	0.023278728	1167.847213	653.9944394	431.63633	156.9586654	588.594995	276.6396478			
Pogallapally	48	46.08		62520		13	30	9.55414013	0.0955414	0.00913	0.023278728	1455.386058	815.0161926	537.9106871	195.6038862	733.514573	344.7518495			
Wodduramaram	46.59	45.9		59601		13	26.51	8.44267516	0.08442675	0.00713	0.015750143	938.7242527	525.6855815	346.9524838	126.1645396	473.117023	222.365001			
Madharam	38.3	36.95		36198		13	31	9.87261146	0.09872611	0.00975	0.02583324	935.1116248	523.6625099	345.6172565	125.6790024	471.296259	221.5092417			
CMA Madahram I & II	12.49	12.29		49300		5.5	13	4.14012739	0.04140127	0.00171	0.006930268	341.6622105	191.3308379	126.278353	45.9194011	172.197754	80.93294443			
Nallamudi	37.73	37.02		31830		13	28	8.91719745	0.08917197	0.00795	0.018700649	595.2416613	333.3353303	220.001318	80.00047928	300.001797	141.0008447			
Mulakalapally	66.76	66.76		98480		8.5	17	5.41401274	0.05414013	0.00293	0.006175432	608.1565099	340.5676456	224.7746461	81.73623493	306.510881	144.0601141			
Dantalabora	51.21	47		70240		13	28	8.91719745	0.08917197	0.00795	0.018700649	1313.533594	735.5788125	485.4820162	176.538915	662.020931	311.1498377			
Pogallapally	43	42.4		60150		12.5	27	8.59872611	0.08598726	0.00739	0.016677083	1003.126533	561.7508585	370.7555666	134.820206	505.575773	237.6206131			
Wodduramaram	66.18	65.86		95210		12.1	27	8.59872611	0.08598726	0.00739	0.016677083	1587.825057	889.1820322	586.8601412	213.4036877	800.263829	376.1239996			
Lothuvagu	57.42	55.76		52604		15	24	7.6433121	0.07643312	0.00584	0.011668276	613.7980011	343.7268806	226.8597412	82.49445135	309.354193	145.3964705			
Subbanapally	52	46.59		50492		10	20	6.36942675	0.06369427	0.00406	0.007467616	377.0548532	211.1507178	139.3594737	50.67617227	190.035646	89.31675362			

Name of the plantation in Paloncha Dvn.	Gross area (Ha)	Net area (Ha)	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m3 ***	Volume for survivals m3	Above ground stem biomass (Ton) *	Total aboveground biomass *	Belowground biomass **	Total biomass	Total Carbon *	SOC (kg/m^2)	SOC (kg/ha)	SOC (Kg/Ha) for the entire area of 4088.68 Ha
Madharam	97.13	94.8		123488		5.9	14	4.45859873	0.04458599	0.00199	0.006476086	799.7188889	447.8425778	295.5761013	107.4822187	403.05832	189.4374104			
Madharam (Foreign clones)	6.07	6.07		6860		8.5	18	5.73248408	0.05732484	0.00329	0.006429178	44.10415871	24.69832888	16.30089706	5.92759893	22.228496	10.44739311			
sambaigudem	30.5	30.23		43988		6	13.25	4.21974522	0.04219745	0.00178	0.00680013	299.1241346	167.5095154	110.5562802	40.20228369	150.758564	70.85652501			
Govindapur	9.73	9.22		20089		6	14	4.45859873	0.04458599	0.00199	0.006476086	130.0980885	72.85492959	48.08425353	17.4851831	65.5694366	30.81763521			
Pogallapally	32.25	32.15		43433		10.27	19.7	6.27388535	0.06273885	0.00394	0.00726672	315.6154323	176.7446421	116.6514638	42.4187141	159.070178	74.76298359			
Dantalabora I	47	46.24		59750		10	19	6.05095541	0.06050955	0.00366	0.006859906	409.8793641	229.5324439	151.491413	55.08778654	206.5792	97.09222377			
Dantalabora II	75.23	74.48		106210		9.9	18.7	5.95541401	0.05955414	0.00355	0.006712104	712.8925824	399.2198462	263.4850985	95.81276308	359.297862	168.8699949			
Dantalabora III	54.09	53.15		69290		10.1	19.1	6.08280255	0.06082803	0.0037	0.006912712	478.9818484	268.2298351	177.0316912	64.37516042	241.406852	113.4612202			
jinnelagudem	52.08	51.33		63320		10	19.12	6.08917197	0.06089172	0.00371	0.006923486	438.3951481	245.5012829	162.0308467	58.92030791	220.951155	103.8470427			
Madharam	43.04	41.81		41269		9	18	5.73248408	0.05732484	0.00329	0.006429178	265.3257326	148.5824103	98.06439077	35.65977846	133.724169	62.85035954			
CMA Madahram	10	9.8		18492		8.7	17	5.41401274	0.05414013	0.00293	0.006175432	114.1960823	63.94980607	42.20687201	15.34795346	57.5548255	27.05076797			
Lothuvagu	76.84	74.92		70302		9	20	6.36942675	0.06369427	0.00406	0.007467616	524.9883207	293.9934596	194.0356833	70.5584303	264.594114	124.3592334			
Subbanapally	94.38	93.35		96049		8	14	4.45859873	0.04458599	0.00199	0.006476086	622.0215694	348.3320788	229.899172	83.59969892	313.498871	147.3444693			
Govindapur-i	55.34	54.02		82100		6.5	16	5.0955414	0.05095541	0.0026	0.006098668	500.7006177	280.3923459	185.0589483	67.29416302	252.353111	118.6059623			
Govindapur-ii	23.15	22.58		33450		6	15	4.77707006	0.0477707	0.00228	0.006198886	207.3527285	116.117528	76.63756847	27.86820672	104.505775	49.11771434			
sambaigudem	27.79	27.1		38712		5.5	14.7	4.68152866	0.04681529	0.00219	0.006263463	242.4711669	135.7838535	89.61734328	32.58812483	122.205468	57.43657001			
Sarapaka	40	37.81		39132		4	12.5	3.98089172	0.03980892	0.00158	0.007223727	282.678896	158.3001817	104.4781199	37.99204362	142.470164	66.96097688			
Madharam	91.3	79.15		105013		9.5	18	5.73248408	0.05732484	0.00329	0.006429178	675.147233	378.0824505	249.5344173	90.73978812	340.274205	159.9288766			
Wodduramaram	16.91	16.62		24225		10.12	19	6.05095541	0.06050955	0.00366	0.006859906	166.181215	93.0614804	61.42057706	22.3347553	83.7553324	39.36500621			
Satyampeta	63.95	63.27		85152		7	13	4.14012739	0.04140127	0.00171	0.006930268	590.1261775	330.4706594	218.1106352	79.31295826	297.423593	139.7890889			
Subbanapally	27.22	26.82		39023		7	12	3.82165605	0.03821656	0.00146	0.007561432	295.0697651	165.2390685	109.0577852	39.65737643	148.715162	69.89612596			
Lothuvagu	107.2	104.69		136218		10	21	6.68789809	0.06687898	0.00447	0.008252308	1124.112864	629.5032039	415.4721146	151.0807689	566.552884	266.2798553			
Uppaka	49.5	48.5		62698		7	18	5.73248408	0.05732484	0.00329	0.006429178	403.0965806	225.7340851	148.9844962	54.17618043	203.160677	95.485518			
Gopalraopeta	63.71	60.75		81395		5.6	15	4.77707006	0.0477707	0.00228	0.006198886	504.5583061	282.5526514	186.4847499	67.81263634	254.297386	119.5197716			
Peddipally	43.5	42.6		52896		7.5	18	5.73248408	0.05732484	0.00329	0.006429178	340.0777812	190.4435575	125.6927479	45.70645379	171.399202	80.55762481			
Kristasagar	41.3	39.8		49700		3.85	10.6	3.37579618	0.03375796	0.00114	0.008742392	434.4968683	243.3182462	160.5900425	58.3963791	218.986422	102.9236182			
Suraram	86.9	78.5		52138		7.5	18	5.73248408	0.05732484	0.00329	0.006429178	335.2044645	187.7145001	123.8915701	45.05148003	168.94305	79.40323356			
Tekulacheruvu	60.3	59.16		72034		9	18	5.73248408	0.05732484	0.00329	0.006429178	463.1193831	259.3468546	171.168924	62.2432451	233.412169	109.7037195			
Lothuvagu	21.15	15.08		22539		5.5	14	4.45859873	0.04458599	0.00199	0.006476086	145.9644989	81.74011937	53.94847878	19.61762865	73.5661074	34.57607049			
Subbanapally	38.16	35.49		48893		5	11	3.50318471	0.03503185	0.00123	0.008369578	409.2137908	229.1597228	151.2454171	54.99833348	206.243751	96.93456276			
Peddipally	47.75	45.72		78310		6.5	17	5.41401274	0.05414013	0.00293	0.006175432	483.5980533	270.8149099	178.7378405	64.99557837	243.733419	114.5547069			
Kondapur	3.4	3.4		4855		6	16	5.0955414	0.05095541	0.0026	0.006098668	29.60903166	16.58105773	10.9434981	3.979453855	14.922952	7.013787419			
Pagideru	27.73	27.05		38960		6	16	5.0955414	0.05095541	0.0026	0.006098668	237.6040934	133.0582923	87.81847291	31.93399015	119.752463	56.28365764			

Name of the plantation in Paloncha Dvn.	Gross area (Ha)	Net area (Ha)	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m3 ***	Volume for survivals m3	Above ground stem biomass (Ton) *	Total aboveground biomass *	Belowground biomass **	Total biomass	Total Carbon *	SOC (kg/m^2)	SOC (kg/ha)	SOC (Kg/Ha) for the entire area of 4088.68 Ha
Suraram	125	123.79		159402		6	13.7	4.36305732	0.04363057	0.0019	0.006593757	1051.058112	588.5925427	388.4710782	141.2622102	529.733288	248.9746455			
Tekulacheruvu	55.04	52.63		79136		8.49	13.04	4.15286624	0.04152866	0.00172	0.006908703	546.7270907	306.1671708	202.0703327	73.480121	275.550454	129.5087133			
Kondapur-ii	36.62	36.01		51489		12	25	7.96178344	0.07961783	0.00634	0.013160896	677.641394	379.4791806	250.4562592	91.07500335	341.531263	160.5196934			
Tekulacheruvu	70	66.35		103566		13	29	9.23566879	0.09235669	0.00853	0.020901197	2164.653411	1212.20591	800.0559008	290.9294185	1090.98532	512.7631			
Lothuvagu -i	60.35	56.54		92950		12	32.05	10.2070064	0.10207006	0.01042	0.028705955	2668.218514	1494.202368	986.1735629	358.6085683	1344.78213	632.0476017			
Lothuvagu -ii	27.85	27.11		45620		12	32.5	10.3503185	0.10350318	0.01071	0.02999685	1368.456293	766.3355244	505.7814461	183.9205258	689.701972	324.1599268			
Lothuvagu -iii	17.77	17.72		11968		11.5	32	10.1910828	0.10191083	0.01039	0.028564734	341.8627422	191.4431356	126.3524695	45.94635255	172.298822	80.98044636			
Satyampeta-i	37.73	36.65		59672		2.5	5	1.59235669	0.01592357	0.00025	0.016935078	1010.549968	565.9079821	373.4992682	135.8179157	509.317184	239.3790764			
Satyampeta-ii	51.51	50.6		77872		2	4	1.27388535	0.01273885	0.00016	0.018982098	1478.173956	827.7774152	546.333094	198.6665796	744.999674	350.1498466			
Gollagudem	64.59	60.03		94151							0.02894									
Wodduramaram -i	50.63	50.03		90045		13	28	8.91719745	0.08917197	0.00795	0.018700649	1683.899949	942.9839717	622.3694213	226.3161532	848.685575	398.88222			
Wodduramaram -ii	60.09	58.2		104755		13.1	28.5	9.07643312	0.09076433	0.00824	0.019778801	2071.928247	1160.279819	765.7846802	278.4671564	1044.25184	490.7983632			
Mulakalapally	53.5	49.95		101230		13	28.3	9.01273885	0.09012739	0.00812	0.01934223	1958.013993	1096.487836	723.6819716	263.1570806	986.839052	463.8143545			
Satyampeta	26.9	26.32		47006		9	25	7.96178344	0.07961783	0.00634	0.013160896	618.6410955	346.4390135	228.6497489	83.14536323	311.795112	146.5437027			
Gollagudem	42.5	38.53		68949		10	26	8.28025478	0.08280255	0.00686	0.014830499	1022.548048	572.6269069	377.9337585	137.4304577	515.364216	242.2211816			
Govindapur	21.29	20.89		37800		7	21	6.68789809	0.06687898	0.00447	0.008252308	311.9372349	174.6848515	115.292002	41.92436437	157.216366	73.8916922			
Regalla	37.63	30.43		62667		5.56	19.84	6.31847134	0.06318471	0.00399	0.007358489	461.1344254	258.2352782	170.4352836	61.97646678	232.41175	109.2335227			
Regalla	37.19	29.4		56459		4.31	13.24	4.21656051	0.04216561	0.00178	0.006805123	384.2104673	215.1578617	142.0041887	51.63788681	193.642076	91.01177549			
Peddipally	17.16	14.81		32910		6	15	4.77707006	0.0477707	0.00228	0.006198886	204.0053302	114.2429849	75.40037005	27.41831638	102.818686	48.32478262			
Mulakalapally	54.62	53.75		112516		5.42	10.34	3.29299363	0.03292994	0.00108	0.008999906	1012.633368	567.0746861	374.2692928	136.0979247	510.367218	239.8725922			
Satyampeta	15.87	15.74		72309		6.14	12.69	4.04140127	0.04041401	0.00163	0.007107001	513.9001078	287.7840604	189.9374798	69.06817448	259.005654	121.7326575			
Dantalabora	34.98	34.21		76740		6.96	12.71	4.0477707	0.04047771	0.00164	0.007095085	544.4768432	304.9070322	201.2386412	73.17768772	274.416329	128.9756746			
Subbanapally	16.11	15.69		34870		5.4	10.7	3.40764331	0.03407643	0.00116	0.008646534	301.5046275	168.8425914	111.4361103	40.52222194	151.958332	71.42041617			
Mulakalapally-CTA	4.54	4.47		7564		4.9	10.65	3.39171975	0.0339172	0.00115	0.008694241	65.76324228	36.82741568	24.30609435	8.838579762	33.1446741	15.57799683			
Dantalabora- I CDP Area	5.2	5.06		11257		5.12	11.6	3.69426752	0.03694268	0.00136	0.007863453	88.51888741	49.57057695	32.71658079	11.89693847	44.6135193	20.96835405			
Pogallapally CTA Area	4.98	4.98		8310		4.98	11.2	3.56687898	0.03566879	0.00127	0.00819379	68.09039891	38.13062339	25.16621144	9.151349613	34.317561	16.12925369			
Regalla-i	52.88	50.32		111829		5.22	10.85	3.45541401	0.03455414	0.00119	0.008506065	951.2247322	532.6858501	351.572661	127.844604	479.417265	225.3261146			
Regalla-ii	39.37	38.08		84625		5.1	11.23	3.57643312	0.03576433	0.00128	0.008168033	691.2197842	387.0830792	255.4748323	92.899939	348.374771	163.7361425			
Sarapaka Bit-i	51.36	50		111100		5.66	10.95	3.48726115	0.03487261	0.00122	0.008414631	934.8655447	523.5247051	345.5263053	125.6459292	471.172235	221.4509502			
Sarapaka Bit-ii	10.56	9.53		21197		5.12	10.95	3.48726115	0.03487261	0.00122	0.008414631	178.3649411	99.88436699	65.92368222	23.97224808	89.8959303	42.25108724			
Mussallamudugu	22.27	18.59		41308		5.3	11.25	3.58280255	0.03582803	0.00128	0.00815095	336.699429	188.5516802	124.444109	45.25240326	169.696512	79.75736074			
	4088.7	3946.26										55356.23515				27899.5425	13112.78498			

Name of the plantation in Paloncha Dvn.	Gross area (Ha)	Net area (Ha)	No.of planting points	No.of survivals	Survivals %	Average height (m)	Average girth (cm)	DBH (cm)	DBH (m)	DBH^2	Equation based volume m3 ***	Volume for survivals m3	Above ground stem biomass (Ton) *	Total aboveground biomass *	Belowground biomass **	Total biomass	Total Carbon *	SOC (kg/m^2)	SOC (kg/ha)	SOC (Kg/Ha) for the entire area of 4088.68 Ha

Biomass Carbon	**13113**
SOC	**3385.4**
Total Carbon	**16498**

*	IPCC (2006). IPCC Guidelines for national greenhouse gas inventories, Prepared by the National Greenhouse Gas Inventories Programme, IGES, Japan.
**	Mokany, K., Raison, R. J., & Prokushkin, A. S. (2006). Critical analysis of root: shoot ratios in terrestrial biomes. *Global change biology* , *12* (1), 84-96.
***	FSI (2021) FSI Carbon Reports

TELANGANA STATE FOREST DEVELOPMENT CORPORATION LIMITED: PALONCHA DIVISION

Statement showing the details of Bamboo plantations in the Paloncha Division

Sl.no	Name of the Plantation	Year of the establishment	Gross area in ha.	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height in Mtrs	Average girth in Cms	Avg dia in cms	Avg dia in mts	log AGB	AGB per culm	Avg no of culms	Avg no of culms/ clump	AGB	BGB	Total Biomass kg	Total Biomass tonn	Total Carbon	SOC kg/m2	SOC kg/ha	SOC 2906.30 kg/ha
1	1999 BP Wodduramaram	1999	56	56	21600	13100	60.65	10	16	5.096	0.051	-0.1359	0.8729	20842	42	18193.102	15646.07	33839.17	33.839	15.904	0.138	1890.6	2346291.318
2	2003 BP Wodduramaram	2003	25.84	25.4	10160	9201	90.56	9	14	4.459	0.045	-0.2232	0.8000	20842	42	16673.388	14339.11	31012.50	31.013	14.576			
3	2004 BP Wodduramaram-Mixed	2004	24.55	24.55	9817	7310	74.46	9	14	4.459	0.045	-0.2232	0.8000	20842	42	16673.388	14339.11	31012.50	31.013	14.576			
4	2016 BP Wodduramaram	2016	25.45	25	10049	10000	99.51	8	14	4.459	0.045	-0.2766	0.7584	20842	42	15806.333	13593.45	29399.78	29.400	13.818			
5	1999 BP Dantalabora	1999	57	57	22140	18213	82.26	10	16	5.096	0.051	-0.1359	0.8729	20842	42	18193.102	15646.07	33839.17	33.839	15.904			
6	2000 BP Dantalabora	2000	35.24	34.98	13405	11582	86.40	10	15	4.777	0.048	-0.1550	0.8564	20842	42	17849.433	15350.51	33199.95	33.200	15.604			
7	2005 BP Dantalabora - Mixed	2005	52.5	52.5	21035	18012	85.63	9	15	4.777	0.048	-0.2028	0.8165	20842	42	17016.797	14634.45	31651.24	31.651	14.876			
8	2018 BP Dantalabora	2018	26.03	25.79	10317	9800	94.99	7	9	2.866	0.029	-0.4677	0.6265	20842	42	13056.789	11228.84	24285.63	24.286	11.414			
9	2009 BP Lingareddypally-Mixed	2009	40.25	39.48	15792	12310	77.95	10	13	4.140	0.041	-0.1973	0.8210	20842	42	17110.397	14714.94	31825.34	31.825	14.958			
10	2009 BP Pogallapally-Mixed	2009	60.74	59.55	23835	19002	79.72	10	13	4.140	0.041	-0.1973	0.8210	20842	42	17110.397	14714.94	31825.34	31.825	14.958			
11	BP 1998 Gollagudem	1998	65.5	62.5	26252	19100	72.76	9	15	4.777	0.048	-0.2028	0.8165	24631	49	20110.389	17294.93	37405.32	37.405	17.581			
12	BP 1999 Gollagudem	1999	52	52	19804	15187	76.69	10	16	5.096	0.051	-0.1359	0.8729	24631	49	21500.541	18490.47	39991.01	39.991	18.796			
13	BP 1999 Subbanapally	1999	55	55	21431	14640	68.31	10	16	5.096	0.051	-0.1359	0.8729	24631	49	21500.541	18490.47	39991.01	39.991	18.796			
14	BP 2000 Gollagudem	2000	32.14	29.14	11468	7801	68.02	10	15	4.777	0.048	-0.1550	0.8564	24631	49	21094.395	18141.18	39235.57	39.236	18.441			
15	BP 2000 Subbanapally	2000	48.18	48.18	18572	7744	41.70	9	15	4.777	0.048	-0.2028	0.8165	24631	49	20110.389	17294.93	37405.32	37.405	17.581			
16	BP 2001 Gollagudem	2001	25.7	24.81	9868	7868	79.73	11	16	5.096	0.051	-0.0927	0.9115	24631	49	22450.033	19307.03	41757.06	41.757	19.626			
17	BP 2002 Gollagudem	2002	4.38	4.3	3508	1500	42.76	10	15	4.777	0.048	-0.1550	0.8564	24631	49	21094.395	18141.18	39235.57	39.236	18.441			
18	BP 2002 Satyampeta	2002	21.01	21	8181	7615	93.08	10	16	5.096	0.051	-0.1359	0.8729	24631	49	21500.541	18490.47	39991.01	39.991	18.796			
19	BP 2003 Nallamudi	2003	50.18	50	20005	18354	91.75	9	14	4.459	0.045	-0.2232	0.8000	24631	49	19704.55	16945.91	36650.46	36.650	17.226			
20	BP 2004 Nallamudi	2004	55.95	55.95	22379	18825	84.12	9	14	4.459	0.045	-0.2232	0.8000	24631	49	19704.55	16945.91	36650.46	36.650	17.226			
21	BP 2005 Nallamudi	2005	45.67	45.67	18266	15910	87.10	9	15	4.777	0.048	-0.2028	0.8165	22000	44	17962.265	15447.55	33409.81	33.410	15.703			
22	1999 BP Madharam	1999	55	55	21223	8488	39.99	10	13	4.140	0.041	-0.1973	0.8210	22000	44	18061.066	15532.52	33593.58	33.594	15.789			
23	2004 BP Madharam	2004	1.4	1.4	585	255	43.58	7	10	3.185	0.032	-0.4365	0.6463	22000	44	14218.073	12227.54	26445.62	26.446	12.429			
24	2008 BP Madharam Mixed	2008	102.3	99.18	38831	8302	21.37	7	8	2.548	0.025	-0.5025	0.6050	22000	44	13310.808	11447.29	24758.10	24.758	11.636			
25	2010 BP Lothuvagu-mixed	2010	55.04	51.91	20412	15991	78.34%	10	23	7.325	0.073	-0.0287	0.9717	22000	44	21377.76	18384.87	39762.63	39.763	18.688			
26	2011 BP Lothuvagu-1 mixed	2011	65.5	62.82	25127	4522	18.00%	4	6	1.911	0.019	-0.8412	0.4312	22000	44	9486.1825	8158.12	17644.30	17.644	8.293			
27	2011 BP Lothuvagu-2 mixed	2011	36.65	28.15	11262	9840	87.37%	5	8	2.548	0.025	-0.6550	0.5194	22000	44	11427.453	9827.61	21255.06	21.255	9.990			
28	2010 BP Iravendi-mixed	2010	51.28	47	19017	13401	70.46%	6	9	2.866	0.029	-0.5376	0.5842	22000	44	12851.853	11052.59	23904.45	23.904	11.235			
29	2017 BP Iravendi-mixed	2017	14.55	14.3	5671	4480	79.00%	6	13	4.140	0.041	-0.4289	0.6512	22000	44	14327.037	12321.25	26648.29	26.648	12.525			
	Total		**1241.03**	**1208.56**																445.384			

Biomass Carbon	**445.384**
SOC	**2346.29**
Total Carbon	**2791.68**

TELANGANA STATE FOREST DEVELOPMENT CORPORATION LIMITED: SATHUPALLI DIVISION

Statement showing the details of Bamboo plantations in Sathupalli Division

Sl.no	Name of the Plantation	Year of the establishment	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height in Mtrs	Average girth in Cms	Avg dia in cms	Avg dia in mts	log AGB	AGB per culm	Avg no of culms	Avg no of culms/ clump	AGB	BGB	Total Biomass kg	Total Biomass tonn	Total Carbon (Ton)	SOC kg/m2	SOC kg/ha	SOC 2906.30 kg/ha
1	Jagannadhapur	1976	22.00	22.00	29300	2294	7.83	8	12	3.822	0.038	-0.32211	0.7246	20842	42	15102.497	12988.148	28090.645	28.091	13.203	0.138	1890.6	5705849.71
2	Vedanthapur	1977	32.17	32.17	38051	9117	23.96	10	16	5.096	0.051	-0.13593	0.8729	20842	42	18193.102	15646.067	33839.169	33.839	15.904			
3	Jagannadhapur	1978	51.86	51.86	49995	135	0.27	7	10	3.185	0.032	-0.43653	0.6463	20842	42	13469.685	11583.929	25053.614	25.054	11.775			
4	Gandugulapalli	1979	125.00	118.00	62135	32932	53.00	10	16	5.096	0.051	-0.13593	0.8729	20842	42	18193.102	15646.067	33839.169	33.839	15.904			
5	Buggapadu-A	1979	125.00	124.56	49825	17638	35.40	9	14	4.459	0.045	-0.22316	0.8000	20842	42	16673.388	14339.114	31012.503	31.013	14.576			
6	Vedanthapur	1979	136.88	128.80	64400	19835	30.80	10	16	5.096	0.051	-0.13593	0.8729	20842	42	18193.102	15646.067	33839.169	33.839	15.904			
7	Lankalapalli	1979	137.96	133.60	66804	24584	36.80	10	15	4.777	0.048	-0.15500	0.8564	20842	42	17849.433	15350.512	33199.945	33.200	15.604			
8	Gandugulapalli	1980	150.00	148.26	74990	53243	71.00	9	14	4.459	0.045	-0.22316	0.8000	20842	42	16673.388	14339.114	31012.503	31.013	14.576			
9	Balrajgudem	1980	144.08	144.00	70000	26131	37.33	8	12	3.822	0.038	-0.32211	0.7246	20842	42	15102.497	12988.148	28090.645	28.091	13.203			
10	Buggapadu-A	1980	151.50	136.36	68182	27431	40.20	9	15	4.777	0.048	-0.20277	0.8165	20842	42	17016.797	14634.446	31651.243	31.651	14.876			
11	Jagannadhapur	1980	6.55	6.55	68627	3418	4.98	6	10	3.185	0.032	-0.50642	0.6026	24631	49	14843.837	12765.7	27609.537	27.610	12.976			
12	Vedanthapur	1980	93.08	93.08	46542	14112	30.32	10	17	5.414	0.054	-0.11801	0.8887	24631	49	21889.177	18824.692	40713.870	40.714	19.136			
13	Lankalapalli	1980	125.80	107.90	53957	15524	28.77	10	16	5.096	0.051	-0.13593	0.8729	24631	49	21500.541	18490.466	39991.007	39.991	18.796			
14	Gandugulapalli	1981	140.00	140.00	70000	27300	39.00	9	15	4.777	0.048	-0.20277	0.8165	24631	49	20110.389	17294.935	37405.324	37.405	17.581			
15	Balrajgudem	1981	135.00	134.53	67260	25555	38.00	8	14	4.459	0.045	-0.27656	0.7584	24631	49	18679.868	16064.686	34744.554	34.745	16.330			
16	Buggapadu-A	1981	143.00	132.40	66241	17090	25.80	9	16	5.096	0.051	-0.18370	0.8322	24631	49	20497.59	17627.927	38125.517	38.126	17.919			
17	Jagannadhapur	1981	44.30	44.30	51307	739	1.44	8	15	4.777	0.048	-0.25617	0.7740	24631	49	19064.602	16395.558	35460.160	35.460	16.666			
18	Vedanthapur	1981	19.00	16.12	8061	2902	36.00	10	16	5.096	0.051	-0.13593	0.8729	24631	49	21500.541	18490.466	39991.007	39.991	18.796			
19	Lankalapalli	1981	20.26	20.26	53600	16187	30.20	10	16	5.096	0.051	-0.13593	0.8729	24631	49	21500.541	18490.466	39991.007	39.991	18.796			
20	Gandugulapalli	1982	95.00	90.94	45470	26373	58.00	10	14	4.459	0.045	-0.17539	0.8391	24631	49	20668.698	17775.081	38443.779	38.444	18.069			
21	Balrajgudem	1982	51.00	46.71	23355	8875	38.00	7	10	3.185	0.032	-0.43653	0.6463	22000	44	14218.073	12227.542	26445.615	26.446	12.429			
22	Buggapadu-A	1982	108.06	102.04	51021	19005	37.25	9	15	4.777	0.048	-0.20277	0.8165	22000	44	17962.265	15447.548	33409.814	33.410	15.703			
23	Vedanthapur	1982	12.00	12.00	6000	1920	32.00	10	16	5.096	0.051	-0.13593	0.8729	22000	44	19203.926	16515.377	35719.303	35.719	16.788			
24	Lankalapalli	1982	61.00	60.30	30160	12667	42.00	10	16	5.096	0.051	-0.13593	0.8729	22000	44	19203.926	16515.377	35719.303	35.719	16.788			
25	Guntimadugu	1982	54.91	54.91	40158	9236	23.00	8	12	3.822	0.038	-0.32211	0.7246	22000	44	15941.605	13709.781	29651.386	29.651	13.936			
26	Buggapadu-A	1983	48.00	47.60	23779	14951	62.82	9	14	4.459	0.045	-0.22316	0.8000	22000	44	17599.777	15135.808	32735.585	32.736	15.386			
27	Katkur	1983	48.00	48.00	24000	12480	52.00	8	12	3.822	0.038	-0.32211	0.7246	22000	44	15941.605	13709.781	29651.386	29.651	13.936			
28	Anantharam	1983	13.50	13.50	13530	6960	51.00	7	10	3.185	0.032	-0.43653	0.6463	22000	44	14218.073	12227.542	26445.615	26.446	12.429			
29	Guntimadugu	1983	3.82	3.82	35945	12581	35.00	7	10	3.185	0.032	-0.43653	0.6463	22000	44	14218.073	12227.542	26445.615	26.446	12.429			
30	Sunnambatti	1983	3.80	3.80	20016	686	3.43	7	10	3.185	0.032	-0.43653	0.6463	22000	44	14218.073	12227.542	26445.615	26.446	12.429			
31	Reddigudem	1983	40.00	40.00	20000	8200	31.00	7	10	3.185	0.032	-0.43653	0.6463	22000	44	14218.073	12227.542	26445.615	26.446	12.429			
32	Vedanthapur	2003	35.20	30.20	12080	11597	96.00	10	16	5.096	0.051	-0.13593	0.8729	22000	44	19203.926	16515.377	35719.303	35.719	16.788			
33	Vedanthapur	2004	34.04	34.04	13810	13600	98.4	10	16	5.096	0.051	-0.13593	0.8729	22000	44	19203.926	16515.377	35719.303	35.719	16.788			
34	Vedanthapur	2005	20.00	19.80	8653	8653	95.00	10	16	5.096	0.051	-0.13593	0.8729	22000	44	19203.926	16515.377	35719.303	35.719	16.788			

35	Balrajgudem Bit-I	2008	60.24	57.88	23708	9483	40.00	2	8	2.548	0.025	-1.07047	0.3428	22000	44	7542.6174	6486.651	14029.268	14.029	6.594			
36	Lankalapalli	2008	36.75	29.18	13008	4943	38.00	2	8	2.548	0.025	-1.07047	0.3428	22000	44	7542.6174	6486.651	14029.268	14.029	6.594			
37	Lankalapalli Bit - I	2009	59.98	59.98	23992	5998	25.00	2	8	2.548	0.025	-1.07047	0.3428	19914	40	6827.4402	5871.5986	12699.039	12.699	5.969			
38	Lankalapalli Bit - II	2009	33.28	33.28	13312	5058	38.00	2	8	2.548	0.025	-1.07047	0.3428	19914	40	6827.4402	5871.5986	12699.039	12.699	5.969			
39	Lankalapalli	2010	56.38	56.38	22552	6540	29.00	2	8	2.548	0.025	-1.07047	0.3428	19914	40	6827.4402	5871.5986	12699.039	12.699	5.969			
40	Buggapadu 'A' Bit	2016	29.59	27.78	11115	10081	90.70	5	14	4.459	0.045	-0.48966	0.6128	19914	40	12203.982	10495.424	22699.406	22.699	10.669			
41	Buggapadu 'A' Bit	2016	36.76	36.16	14463	13234	91.45	5	14	4.459	0.045	-0.48966	0.6128	19914	40	12203.982	10495.424	22699.406	22.699	10.669			
42	Buggapadu 'A'	2018	21.94	20.97	8390	8147	97.10	4	10	3.185	0.032	-0.69026	0.5014	19914	40	9985.7862	8587.7761	18573.562	18.574	8.730			
43	Buggapadu 'A'	2019	37.06	36.72	14688	13954	95.00	4	10	3.185	0.032	-0.69026	0.5014	19914	40	9985.7862	8587.7761	18573.562	18.574	8.730			
44	Kessappaguda	2019	65.00	62.10	24840	23598	95.00	4	10	3.185	0.032	-0.69026	0.5014	19914	40	9985.7862	8587.7761	18573.562	18.574	8.730			
45	Gandugulapalli	2020	70.39	66.70	26680	25346	95.00	3	8	2.548	0.025	-0.88663	0.4120	12200	24	5026.8927	4323.1277	9350.020	9.350	4.395			
46	Kessappaguda	2020	78.87	77.10	30840	29298	95.00	3	8	2.548	0.025	-0.88663	0.4120	12200	24	5026.8927	4323.1277	9350.020	9.350	4.395			
	Total		**3018.01**	**2906.64**																613.046			

Biomass Carbon	**613.05**
SOC	**5705.8**
Total Carbon	**6318.9**

TELANGANA STATE FOREST DEVELOPMENT CORPORATION LIMITED: KOTHAGUDEM DIVISION

Statement showing the details of Bamboo plantations in the Kothagudem Division

Sl.no	Name of the Plantation	Year of the establishment	Gross area in ha	Net area in ha.	No.of planting points	No.of survivals	Survivals %	Average height in Mtrs	Average girth in Cms	Avg dia in cms	Avg dia in mts	log AGB	AGB per culm	Avg no of culms	Avg no of culms/ clump	AGB	BGB	Total Biomass kg	Total Biomass tonn	Total Carbon	SOC kg/m2`	SOC kg/ha	SOC 2906.30 kg/ha
1	BP Pentlam (Balance after con. 2019)	1977	17.99	17.99				12.500	15.750	5.016	0.050	-0.03941	0.9614	20842	42	20036.648	17231.52	37268.165	37.268	17.5160	0.138	1890.6	5494660.233
2	BP Buggapadu B	1977	110.00	110.00				12.500	15.750	5.016	0.050	-0.03941	0.9614	20842	42	20036.648	17231.52	37268.165	37.268	17.5160			
3	BP Srirampur	1978	8.08	8.08				12.500	15.750	5.016	0.050	-0.03941	0.9614	20842	42	20036.648	17231.52	37268.165	37.268	17.5160			
4	BP Buggapadu B	1978	127.00	127.00				12.500	15.750	5.016	0.050	-0.03941	0.9614	20842	42	20036.648	17231.52	37268.165	37.268	17.5160			
5	BP Pentlam	1979	39.13	39.13				12.500	15.750	5.016	0.050	-0.03941	0.9614	20842	42	20036.648	17231.52	37268.165	37.268	17.5160			
6	BP Nagupalli	1979	104.00	104.00	52105	18087	34.71	12.500	13.510	4.303	0.043	-0.08474	0.9188	20842	42	19148.631	16467.82	35616.453	35.616	16.7397			
7	BP Srirampur	1979	131.60	131.60	65938	23311	35.35	12.500	13.412	4.271	0.043	-0.08689	0.9168	20842	42	19107.481	16432.43	35539.914	35.540	16.7038			
8	BP Buggapadu B	1979	92.00	92.00				12.500	15.750	5.016	0.050	-0.03941	0.9614	20842	42	20036.648	17231.52	37268.165	37.268	17.5160			
9	BP Nagupalli	1980	100.00	98.51	49262	20864	42.35	12.500	13.422	4.275	0.043	-0.08667	0.9170	20842	42	19111.689	16436.05	35547.742	35.548	16.7074			
10	BP Srirampur	1980	100.00	100.00	50697	27191	53.63	12.500	13.510	4.303	0.043	-0.08474	0.9188	20842	42	19148.631	16467.82	35616.453	35.616	16.7397			
11	BP Pentlam	1981	32.46	32.46				12.500	15.750	5.016	0.050	-0.03941	0.9614	24631	49	23679.238	20364.14	44043.382	44.043	20.7004			
12	BP Nagupalli	1981	111.50	110.00	55808	16645	29.83	12.500	13.616	4.336	0.043	-0.08243	0.9209	24631	49	22682.104	19506.61	42188.713	42.189	19.8287			
13	BP Srirampur	1981	117.00	115.46	57540	23180	40.29	12.500	12.570	4.003	0.040	-0.10605	0.8994	24631	49	22152.64	19051.27	41203.910	41.204	19.3658			
14	BP Buggapadu B	1981	135.00	135.00	71000			12.500	15.750	5.016	0.050	-0.03941	0.9614	24631	49	23679.238	20364.14	44043.382	44.043	20.7004			
15	BP Nagupalli	1982	142.08	142.08	71720	22451	31.30	12.500	13.299	4.235	0.042	-0.08939	0.9145	24631	49	22524.765	19371.30	41896.063	41.896	19.6911			
16	BP Srirampur	1982	111.60	111.04	55538	25956	46.74	12.500	13.307	4.238	0.042	-0.08921	0.9147	24631	49	22528.768	19374.74	41903.509	41.904	19.6946			
17	BP Buggapadu B	1982	51.00	51.00	25545			12.500	15.750	5.016	0.050	-0.03941	0.9614	24631	49	23679.238	20364.14	44043.382	44.043	20.7004			
18	BP Buggapadu B	1983	39.00	39.00	19372			12.500	15.750	5.016	0.050	-0.03941	0.9614	24631	49	23679.238	20364.14	44043.382	44.043	20.7004			
19	BP Chaparalapalli	1999	84.28	75.00	30089	20890	69.43	12.500	13.799	4.395	0.044	-0.07848	0.9245	24631	49	22771.762	19583.72	42355.477	42.355	19.9071			
20	BP Gandugulapalli	1999	26.24	25.60	10240	9674	94.47	12.500	18.000	5.732	0.057	0.00005	1.0001	24631	49	24632.245	21183.73	45815.975	45.816	21.5335			
21	BP Chaparalapalli	2000	70.55	69.00	27475	7260	26.42	12.500	14.542	4.631	0.046	-0.06299	0.9390	22000	44	20657.016	17765.03	38422.051	38.422	18.0584			
22	BP Penagadapa	2001	50.48	49.46	19036	14688	77.16	12.500	13.077	4.165	0.042	-0.09436	0.9100	22000	44	20018.918	17216.27	37235.187	37.235	17.5005			
23	BP Chaparalapalli -I	2001	25.97	24.46	13165	3028	23.00	12.500	18.000	5.732	0.057	0.00005	1.0001	22000	44	22001.112	18920.96	40922.068	40.922	19.2334			
24	BP Chaparalapalli -II	2001	7.32	7.32				12.500	15.750	5.016	0.050	-0.03941	0.9614	22000	44	21149.902	18188.92	39338.817	39.339	18.4892			
25	BP Balarajgudem	2001	36.51	36.02	14413	11207	77.76	12.500	13.205	4.205	0.042	-0.09149	0.9126	22000	44	20076.621	17265.89	37342.514	37.343	17.5510			
26	BP Gandugulapalli	2002	32.18	32.18	12980	10903	84.00	12.500	12.369	3.939	0.039	-0.11081	0.8951	22000	44	19692.346	16935.42	36627.763	36.628	17.2150			
27	BP Chaparalapalli	2003	30.00	29.92	11970	10973	91.67	12.500	18.000	5.732	0.057	0.00005	1.0001	22000	44	22001.112	18920.96	40922.068	40.922	19.2334			
28	BP Gandugulapalli	2003	40.81	40.81	16324	14691	90.00	12.500	13.063	4.160	0.042	-0.09468	0.9097	22000	44	20012.582	17210.82	37223.403	37.223	17.4950			
29	BP Chaparalapalli (Mixed with Euc.)	2004	42.80	42.00	16804	16468	98.00	12.500	12.348	3.932	0.039	-0.11131	0.8947	22000	44	19682.461	16926.92	36609.377	36.609	17.2064			
30	BP Gandugulapalli (Mixed with Euc.)	2004	29.84	28.00	11200	8685	77.54	12.500	12.640	4.025	0.040	-0.10441	0.9009	22000	44	19818.865	17044.22	36863.090	36.863	17.3257			
31	BP&EP Pentlam	2005	32.24	32.04	12800	11008	86.00	12.500	12.382	3.943	0.039	-0.11050	0.8954	22000	44	19698.459	16940.68	36639.135	36.639	17.2204			

32	BP&EP Srirampur	2005	55.12	55.08	21780	21250	97.57	12.500	13.395	4.266	0.043	-0.08727	0.9164	22000	44	20161.552	17338.93	37500.486	37.500	17.6252			
33	BP Buggapadu-B (MLT)	2007	10.00	9.08	3166	1155	36.48	12.500	15.750	5.016	0.050	-0.03941	0.9614	22000	44	21149.902	18188.92	39338.817	39.339	18.4892			
34	BP & EP Buggapadu-B	2008	97.80	94.80	37965	26917	70.90	12.500	12.058	3.840	0.038	-0.11834	0.8884	22000	44	19544.722	16808.46	36353.183	36.353	17.0860			
35	BP Pentlam (Mixed with Euc.)	2009	100.87	94.88	38466	31503	81.90	12.500	12.536	3.992	0.040	-0.10685	0.8987	22000	44	19770.54	17002.66	36773.204	36.773	17.2834			
36	BP Pentlam	2010	40.00	40.00				12.500	15.750	5.016	0.050	-0.03941	0.9614	22000	44	21149.902	18188.92	39338.817	39.339	18.4892			
37	BP Srirampur	2016	53.00	50.59	20530	19914	97.00	12.500	18.000	5.732	0.057	0.00005	1.0001	19914	40	19915.006	17126.91	37041.912	37.042	17.4097			
38	BP Ramavaram	2017	20.60	19.28				12.500	15.750	5.016	0.050	-0.03941	0.9614	19914	40	19144.507	16464.28	35608.782	35.609	16.7361			
39	EP,BP&MD Pentlam (Mixed With EP)	2017	39.50	33.03	29630	27431	92.58	12.500	15.000	4.777	0.048	-0.05382	0.9476	19914	40	18870.477	16228.61	35099.086	35.099	16.4966			
40	BP Nagupalli	2018	24.37	22.81	9415	9225	97.98	12.500	15.750	5.016	0.050	-0.03941	0.9614	19914	40	19144.507	16464.28	35608.782	35.609	16.7361			
41	BP Pentlam	2019	51.90	48.03	19213	17868	93.00	12.500	15.750	5.016	0.050	-0.03941	0.9614	19914	40	19144.507	16464.28	35608.782	35.609	16.7361			
42	BP Nagupally - A	2019	44.94	43.63	17452	16418	94.08	12.500	15.750	5.016	0.050	-0.03941	0.9614	19914	40	19144.507	16464.28	35608.782	35.609	16.7361			
43	BP Nagupally - B	2019	55.49	53.75	21500	20081	93.40	12.500	15.750	5.016	0.050	-0.03941	0.9614	19914	40	19144.507	16464.28	35608.782	35.609	16.7361			
44	BP Nagupally - C	2019	48.52	45.78	18313	16893	92.25	12.500	15.150	4.825	0.048	-0.05088	0.9504	19914	40	18926.042	16276.40	35202.439	35.202	16.5451			
45	BP Buggapadu B	2020	44.70	43.74	17497	17497	100.00	8.000	15.000	4.777	0.048	-0.25617	0.7740	12200	24	9442.903	8120.90	17563.800	17.564	8.2550			
46	BP Pentlam	2020	70.00	60.21	24085	24085	100.00	8.000	15.750	5.016	0.050	-0.24176	0.7852	12200	24	9580.0294	8238.83	17818.855	17.819	8.3749			
47	BP Srirampur	2020	30.00	27.60	11040		0.00	8.000	15.750	5.016	0.050	-0.24176	0.7852	12200	24	9580.0294	8238.83	17818.855	17.819	8.3749			
48	BP Buggapadu B	2021	28.04	27.00	10808	10808	100.00	6.000	15.750	5.016	0.050	-0.37219	0.6892	4654	9	3207.6409	2758.57	5966.212	5.966	2.8041			
49	BP Balarajgudem (BambusaTulda)	2021	12.81	11.50	4712	4105	87.12	6.000	15.000	4.777	0.048	-0.38661	0.6794	4654	9	3161.7274	2719.09	5880.813	5.881	2.7640			
	Total		**2906.305**	**2836.95**																825.0157			

Biomass Carbon	**825.0157**
SOC	**5494.66**
Total Carbon	**6319.676**

Carbon stocks of Cashew Plantation
Kothagudem and Paloncha Division

S.No.	Girth (cm)	Height (m)	DBH (cm)	DBH^2	AGB (Kg)	BGB (Kg)	Total Biomass (Kg)	Carbon (Kg)	Carbon (Ton)	Carbon (Ton/Ha)	SOC (Kg/m^2)	SOC (Kg/Ha)	Total SOC (Kg/ha) for net area of 100.46 Ha	Total SOC (Ton/Ha) for 100.46 Ha
1	146	12	46.4968	2162	985.1628	126.0753	1111.238124	522.2819184	0.52228	2170.0125	0.5852	5852	587891.92	587.89192
2	125	11	39.8089	1584.7	716.2756	94.1713	810.4469221	380.9100534	0.38091					
3	143	9	45.5414	2074	822.2834	121.2521	943.5355597	443.461713	0.44346					
4	112	9	35.6688	1272.3	533.2848	76.61518	609.8999689	286.6529854	0.28665					
5	127	14	40.4459	1635.9	831.1823	97.02205	928.204372	436.2560548	0.43626					
6	109	14	34.7134	1205	633.9611	72.80495	706.7660125	332.1800259	0.33218					
7	111	10	35.3503	1249.6	553.285	75.33501	628.6199733	295.4513874	0.29545					
8	90	10	28.6624	821.53	381.5365	50.8013	432.3377767	203.198755	0.20320					
9	90	10	28.6624	821.53	381.5365	50.8013	432.3377767	203.198755	0.20320					
10	105	9	33.4395	1118.2	475.6491	67.86635	543.5154592	255.4522658	0.25545					
11	96	9	30.5732	934.72	405.8038	57.35024	463.1540215	217.6823901	0.21768					
12	150	15	47.7707	2282	1155.566	132.643	1288.209296	605.458369	0.60546					
13	120	15	38.2166	1460.5	778.1278	87.21873	865.3465567	406.7128817	0.40671					
14	116	13	36.9427	1364.8	682.1279	81.83662	763.9644919	359.0633112	0.35906					
15	110	13	35.0318	1227.2	620.854	74.06493	694.9188968	326.6118815	0.32661					
16	95	13	30.2548	915.35	478.8011	56.23298	535.0340617	251.466009	0.25147					
17	131	12	41.7197	1740.5	812.9616	102.8427	915.8043083	430.4280249	0.43043					
18	120	12	38.2166	1460.5	695.9321	87.21873	783.1508267	368.0808885	0.36808					
19	96	12	30.5732	934.72	468.6223	57.35024	525.972528	247.2070882	0.24721					
20	108	16	34.3949	1183	666.7796	71.5551	738.3346802	347.0172997	0.34702					
21	103	16	32.8025	1076	613.0542	65.45798	678.5121398	318.9007057	0.31890					
22	107	16	34.0764	1161.2	655.8774	70.31537	726.1927368	341.3105863	0.34131					

S.No.	Girth (cm)	Height (m)	DBH (cm)	DBH^2	AGB (Kg)	BGB (Kg)	Total Biomass (Kg)	Carbon (Kg)	Carbon (Ton)	Carbon (Ton/Ha)	SOC (Kg/m^2)	SOC (Kg/Ha)	Total SOC (Kg/ha) for net area of 100.46 Ha	Total SOC (Ton/Ha) for 100.46 Ha
23	130	13	41.4013	1714.1	834.7641	101.3726	936.1367315	439.9842638	0.43998					
24	114	13	36.3057	1318.1	661.4243	79.20578	740.6300415	348.0961195	0.34810					
25	151	11	48.0892	2312.6	1001.196	134.3092	1135.505447	533.68756	0.53369					
26	119	11	37.8981	1436.3	656.4786	85.85818	742.3367728	348.8982832	0.34890					
27	127	14	40.4459	1635.9	831.1823	97.02205	928.204372	436.2560548	0.43626					
28	120	14	38.2166	1460.5	751.7273	87.21873	838.9460702	394.304653	0.39430					
29	141	14	44.9045	2016.4	1000.418	118.0856	1118.503488	525.6966392	0.52570					
30	130	14	41.4013	1714.1	866.2949	101.3726	967.6675366	454.8037422	0.45480					
31	108	14	34.3949	1183	623.6902	71.5551	695.2453001	326.765291	0.32677					
32	138	15	43.949	1931.5	996.8267	113.4093	1110.236043	521.8109403	0.52181					
33	98	15	31.2102	974.08	543.4715	59.61555	603.0870781	283.4509267	0.28345					
34	134	18	42.6752	1821.2	1036.562	107.3121	1143.87444	537.6209869	0.53762					
35	112	18	35.6688	1272.3	754.3354	76.61518	830.9506031	390.5467834	0.39055					
36	96	18	30.5732	934.72	574.0126	57.35024	631.362803	296.7405174	0.29674					
37	150	9	47.7707	2282	894.9607	132.643	1027.603639	482.9737102	0.48297					
38	134	17	42.6752	1821.2	1007.34	107.3121	1114.652349	523.886604	0.52389					
39	110	17	35.0318	1227.2	710.0308	74.06493	784.0957441	368.5249997	0.36852					
40	110	9	35.0318	1227.2	516.5247	74.06493	590.5896705	277.5771451	0.27758					
41	120	10	38.2166	1460.5	635.2614	87.21873	722.480162	339.5656762	0.33957					
42	105	10	33.4395	1118.2	501.394	67.86635	569.260382	267.5523795	0.26755					
43	120	10	38.2166	1460.5	635.2614	87.21873	722.480162	339.5656762	0.33957					
44	109	11	34.7134	1205	561.9058	72.80495	634.7107165	298.3140368	0.29831					
45	69	11	21.9745	482.88	249.8875	30.83711	280.7246539	131.9405873	0.13194					
46	123	10	39.172	1534.4	663.6779	91.36035	755.0382005	354.8679543	0.35487					
47	123	10	39.172	1534.4	663.6779	91.36035	755.0382005	354.8679543	0.35487					
48	130	10	41.4013	1714.1	732.0789	101.3726	833.451558	391.7222323	0.39172					
49	119	10	37.8981	1436.3	625.9099	85.85818	711.7680617	334.530989	0.33453					

S.No.	Girth (cm)	Height (m)	DBH (cm)	DBH^2	AGB (Kg)	BGB (Kg)	Total Biomass (Kg)	Carbon (Kg)	Carbon (Ton)	Carbon (Ton/Ha)	SOC (Kg/m^2)	SOC (Kg/Ha)	Total SOC (Kg/ha) for net area of 100.46 Ha	Total SOC (Ton/Ha) for 100.46 Ha
50	96	10	30.5732	934.72	427.7683	57.35024	485.1185052	228.0056974	0.22801					
51	144	12	45.8599	2103.1	961.3729	122.8501	1084.222981	509.584801	0.50958					
52	100	12	31.8471	1014.2	503.7811	61.92186	565.7029567	265.8803897	0.26588					
53	101	12	32.1656	1034.6	512.7435	63.09036	575.8339081	270.6419368	0.27064					
54	133	10	42.3567	1794.1	762.285	105.8124	868.0973643	408.0057612	0.40801					
55	93	10	29.6178	877.22	404.3645	54.02936	458.393806	215.4450888	0.21545					
56	78	10	24.8408	617.06	296.0721	38.82499	334.8971299	157.4016511	0.15740					
57	140	10	44.586	1987.9	834.8253	116.517	951.3423011	447.1308815	0.44713					
58	86	10	27.3885	750.13	352.0024	46.64227	398.6446876	187.3630032	0.18736					
59	104	12	33.121	1097	540.043	66.65708	606.7000845	285.1490397	0.28515					
60	97	12	30.8917	954.3	477.308	58.47776	535.7857835	251.8193182	0.25182					
61	141	12	44.9045	2016.4	926.1642	118.0856	1044.249756	490.7973853	0.49080					
							45959.06598	21600.76101	21.60076					

Biomass Carbon	**2170.012**
SOC	**587.8919**
Carbon	**2757.904**

List of operations and their emissions for Life Cycle Assessment of Eucalyptus Plantations															
Machinery															
S.No.	**Column1**	**Operation**	**Machinery**	**Power**	**Weight**	**Implement**	**Weight2**	**Hrs/Ha**	**Fuel**	**Fuel consumption (Litres/Hr)**	**Total area under Eucalyptus plantation**	**Total fuel consumption (L)**	**CO_2 emissions/L**	**Total CO_2 emissions (g)**	Column2
1		Land clearance	Manual	-	-	-	-	-	-	-					
2		Uprootal with HD Proclainer	JCB EXCAVATOR	75Kw (100 HP)	14320 Kg with 0.63 - 0.72 cum bucket capacity	-	-	18	Diesel	12	9749	2105784	0.002239	4714.850376	
3		Tilling with proclainer in total area with HD Proclainer													
4		SMC works: Gully plugs, CCT, Brushwood dams	TATA HITACHI SHINRAI	74.3 HP	8050 Kg with 0.26-1.1 Cum bucket capacity			12	Diesel	8	9749	935904	0.002239	2095.489056	
5		Levelling with dozer	Dozer Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
6		Baseline formation	Dozer Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
7		Cultivator/Disc harrow one side ploughing	Dozer Tractor	50 HP				4	Diesel	4	9479	151664	0.002239	339.575696	
8		Alignment and Staking									9749				
9		Transportation of plants	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
10		FMB/Two-disc ploughting	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
11	1st Year Maintenance	Cultivator/FMB Ploughing	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
12		Plough back with FMB or disc after 45 days	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
13		Fire tracing	Blower	2.7 HP				8	Diesel	0.5	9749	38996	0.002239	87.312044	
14	2nd Year Maintenance	Cultivator/FMB Ploughing	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	

S.No.	Column1	Operation	Machinery	Power	Weight	Implement	Weight2	Hrs/Ha	Fuel	Fuel consumption (Litres/Hr)	Total area under Eucalyptus plantation	Total fuel consumption (L)	CO_2 emissions/L	Total CO_2 emissions (g)	Column2
15		Plough back with FMB or disc after 45 days	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
16	3rd Year Maintenanc	FMB/Two-disc ploughting	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
17	Felling year maintenance	Felling	Handpower saw	250HP				72	Diesel	10	9749	7019280	0.002239	15716.16792	
18		Debarking	Debarking machine with tractor	50 HP				12	Diesel	25	9749	2924700	0.002239	6548.4033	
19		Billet cutting	Handpower saw	250 HP				72	Diesel	10	9749	7019280	0.002239	15716.16792	
20	EP coppicing first rotation post-harvesting year	Two disc/FMB ploughtng	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
21	Post-harvesting 2nd year	Cultivator/Disc harrow one side ploughing	Dozer Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
22		Plough back with FMB or disc after 45 days	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
23	Post-harvesting 3rd year	Two disc/FMB ploughtng	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
24		Fire tracing	Blower	2.7 HP				8	Diesel	0.5	9749	38996	0.002239	87.312044	
25	Felling year maintenance	Felling	Handpower saw	250HP				72	Diesel	10	9749	7019280	0.002239	15716.16792	
26		Debarking	Debarking machine with tractor	50 HP				12	Diesel	25	9749	2924700	0.002239	6548.4033	
27		Billet cutting	Handpower saw	250 HP				72	Diesel	10	9749	7019280	0.002239	15716.16792	
28	EP coppicing second rotation post-harvesting year	Two disc/FMB ploughtng	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
29		Fire tracing	Blower	2.7 HP				8	Diesel	0.5	9749	38996	0.002239	87.312044	

S.No.	Column1	Operation	Machinery	Power	Weight	Implement	Weight2	Hrs/Ha	Fuel	Fuel consumption (Litres/Hr)	Total area under Eucalyptus plantation	Total fuel consumption (L)	CO_2 emissions/L	Total CO_2 emissions (g)	Column2
30		Singling operatio within 4 months leaving best 2-3 shoots									9749				
31		Removal of Mahaveera and other weeds									9749				
32	Next year onwards till harvesting	Two disc/FMB ploughtng	Tractor	50 HP				4	Diesel	4	9749	155984	0.002239	349.248176	
33		Fire tracing	Blower	2.7 HP				8	Diesel	0.5	9749	38996	0.002239	87.312044	
														88699.36422	0.0886994

List of operations and their emissions for Life Cycle Assessment of Cashew Plantations															
Machinery															
S.No.	**Operation**	**Machinery**	**Power**	**Weight**	**Implement**	**Weight**	**Hrs/Ha**	**Fuel**	**Fuel consumption (Litres/Hr)**	**Total area under Cashewnut plantation (ha)**	**Total fuel consumption (L)**	**CO_2 emissions (Kg)/L**	**Total CO_2 emissions (Kg)**		
1	Ploughing	Tractor	50 HP				4	Diesel	4	100.46	1607.36	2.7	4339.872		
2	First spraying of monocrotophos	Tractor	50 HP				4	Diesel	4	0	0	2.7	0		
													4339.872	4.3398720	

List of operations and their emissions for Life Cycle Assessment of Bamboo Plantations															
Machinery															
S.No.		**Operation**	**Machinery**	**Power**	**Weight**	**Implement**	**Weight**	**Hrs/Ha**	**Fuel**	**Fuel consumption (Litres/Hr)**	**Total area under Bamboo plantation (ha)**	**Total fuel consumption (L)**	**CO_2 emissions (Kg)/L**	**Total CO_2 emissions (Kg)**	
1	1st Year Maintenance	Cultivator/FMB Ploughing	Tractor	50 HP				4	Diesel	4	0	0	2.7	0	
2		Plough back with FMB or disc after 45 days	Tractor	50 HP				4	Diesel	4	0	0	2.7	0	
3	2nd to 5th Year maintenance	Fire tracing	Blower	2.7 HP				8	Diesel	0.5	7165	28660	2.7	77382	
														77382	77.382

Inputs (Fertilizer/ha)									
S. No.	Operation	Material	Quantity	No. of plants/ Ha	Total No. of Ha	Total Kg of chemical used	CO_2 emission (g) per Kg of	Total CO_2 emission (g)	Total CO_2 emission (ton)
1	Drenching with 1% chloropyriphos	chlorofyriphos	1 L/2500 plants	-	-	-	-	-	-
2	Basal dressing with single sugar phosphate (SSP)	SSP	10 g/plant	1250	2000	25000	220.9	5522500	5.5225
3	Urea application	Urea	10 g/plant	1250	2000	25000	1848.7	46217500	46.2175
								51740000	51.74