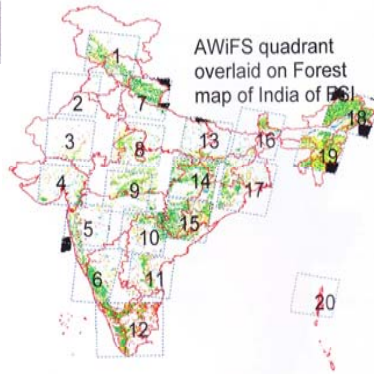
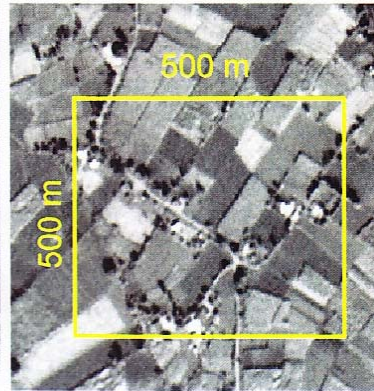


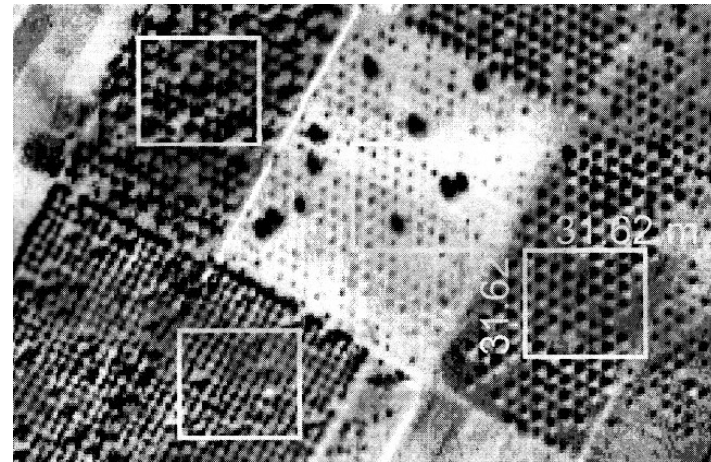
Plantations (TOF)



KFRI Research Report No 400

## National Carbon Project: Spatial Assessment of Vegetation and Soil Carbon Pool of Northern Kerala

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**National Carbon Project: Spatial Assessment of Vegetation  
and Soil Carbon Pool of Northern Kerala  
(Final Report of the project: KFRI 563/2009)**

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**Kerala**

**July 2011**

## **Abstract of project proposal**

**Code:** KFRI 563/09

**Title:** National Carbon Project: Spatial Assessment of Vegetation and Soil Carbon Pool of Northern Kerala

**Objectives:**

1. To generate baseline data for the assessment of the terrestrial vegetation carbon using satellite remote sensing, ground sampling and modeling techniques.
2. To devise appropriate estimation methodology and data integration procedure for spatial assessment of soil carbon pools.
3. To explore new and alternative RS based techniques and data sets for their utility in large scale vegetation carbon pool assessment.
4. To generate geospatial data of the terrestrial phytomass and carbon of India.

**Date of commencement:** April 2009

**Date of completion:** June 2011

**Funding agency:** ISRO

**Investigators:** Dr.A.R.R.Menon  
Dr.Thomas P.Thomas

**Research Fellow:** Sri.Deepu Divakaran (June. 2009 - Sept.2010)

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## Abstract

In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fiber or energy from the forest, will generate the largest sustained mitigation benefit. Therefore, it is very much essential to understand and quantify the terrestrial carbon balance of India and its associated uncertainties. Pilot studies have been done in India to estimate forest /vegetation carbon and these estimates are spread over a decade and are based on different approaches *viz.*: historical records, ecological data and population based forest biomass, scales and classification schemes and objectives. In the 11<sup>th</sup> Five Year Plan it is planned to provide extra thrust to understanding the terrestrial Carbon Cycle through a “National Carbon Project”. The project has three major components and aims to understand Vegetation Carbon pools, Soil Carbon pools and Soil-Vegetation Carbon fluxes.

The major objectives of the Vegetation Carbon Pool assessment project are:

1. Assessment of terrestrial vegetation biomass in the country using ground sampling and satellite remote sensing data, and
2. Generation of geospatial data of the terrestrial phytomass carbon of India along with estimates of uncertainty.

Among these, fulfillment of the first objective in the Northern Kerala region is the major thrust area of the current project.

Under this subproject, determination of soil organic carbon in surface and sub-surface soils of forests of Northern Kerala is covered in the present study. A cluster based sampling using remote sensing data for stratification was suggested at national level by ISRO and the same methodology was adopted in the current work.

Information on trees outside Forests (TOF) was generated in three phases: land use classification and mapping; identification of tree-cover classes; and measurement of tree characteristics. Satellite images and aerial photos were suitable for the first two. High-resolution satellite images are likely to allow the identification of single trees (or crowns) and can be a data source for a large-area TOF inventory.

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## **Introduction**

Carbon dioxide is among the major green house gases (GHG) contributing to global warming and associated impacts. Under the Kyoto protocol of United Nations Framework Convention on Climate Change (UNFCCC), most of the countries have agreed to reduce the GHG emissions and also report these emissions regularly. This reporting is necessary and is done as a National Communication to UNFCCC. In India, the assessment of carbon pools in vegetation, forests and other lands, soils and net balance due to various land cover/ use changes is a subject of much debate and uncertainty. This understanding balance of temporal changes in net carbon balance as well as its spatial pattern requires creation of consistent and reliable national scale digital data sets. While data bases for recent periods can be developed using Remote Sensing coupled with ancillary data, historical and future data sets are also required can be created only through data integration approach and modeling respectively.

Regional level carbon cycles are valuable for assessing, what is known as element cycle processes in a particular ecosystem of a region and for addressing region specific environmental policy questions. India constitutes an important part of terrestrial biosphere and agriculture is the major economic activity in these regions. Reducing deforestation is the dominant mitigation option for tropical regions. The carbon mitigation potentials from reducing deforestation, forest management, afforestation, and agro- forestry differ greatly in their activity, regions, system boundaries and the time horizon over which these options are compared. In short term, the carbon mitigation benefits of reducing deforestation are greater than the benefits of afforestation. In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fiber or energy from the forest, will generate the largest sustained mitigation benefit. Therefore, it is very much essential to understand and quantify the terrestrial carbon balance of India and its associated uncertainties. It is also important to estimate anthropogenic influence and the effect of future climate changes on carbon balance with its temporal and spatial aspects.

The global forest cover is 3952 million ha, which is about 30% of the world's land area (FAO, 2005). Forests sequester atmospheric carbon and use solar energy to produce organic matter by means of photosynthesis. Deforestation is a critical environmental problem in all developing countries leading to biodiversity loss. The above ground biomass of tropical moist forests is often more than 175 tons of carbon per ha; when cleared and burnt; much of this carbon ends up in the atmosphere as carbon dioxide. As per the FAO (2001) records, the annual rate of deforestation in the developing countries between 1980 and 1990 ranged from 13.7 million to 15.5 million ha. The increasing anthropogenic pressure on the forests has resulted in clearing of forests and that has led to

decreased photosynthetic activity, ultimately resulting in low biomass production. In addition to the decreasing forest area globally, forests are severely affected by disturbances such as forest fires, pests and climatic events including draught, wind, snow and floods. All these factors have also carbon balance implications. Such disturbance affects roughly 100 million ha of forests annually (FAO, 2006).

The Intergovernmental Panel on Climate Change (IPCC) estimates that the level of carbon dioxide in the atmosphere today is 31% higher than what it was about 250 years back, at the time of the start of industrial revolution. During next century carbon dioxide levels are expected to rise 90 to 250% over pre-industrial revolution level. Burning of fossil fuels is the most important source of green house gases. As the global economy has grown, there has been a dramatic increase in the consumption of fossil fuels. Depending upon use, the lithosphere, ocean, soil, atmosphere and biosphere, can act as sink or sources of carbon. Whether India is a net sink or source of carbon is poorly understood. Systematic studies are required to assess the pools and fluxes of carbon to arrive the country level carbon budget.

Remote sensing with its capacity to provide repeated information of a large area facilitates in assessment of forest vegetation cover type and density precisely. NOAA AVHRR, SPOT Vegetation and ASTER satellite data are commonly used for biomass and productivity assessments. The normalized difference vegetation index (NDVI) is a good indicator of leaf area index (LAI), which in turn is positively correlated with biomass and productivity. Converting digital numbers from satellite data to actual biomass or carbon values requires systematic studies on the rate of carbon exchange over a variety of cover types under different agro-ecological / climatic conditions.

FAO (2006) after receiving data for terrestrial carbon has concluded that:

- There are large gaps in available data on biomass in terms of inclusion of above and below ground components, spatial and temporal consistency, in both spatial and temporal dimensions (FAO, 2001).
- *In situ* inventory agencies and remote sensing agencies must work together to allow validation and upscaling of the *in situ* measurement based on remote sensing products (IGCOS,2004).
- To increase the quantity of below ground biomass observations, new soil carbon estimation techniques must be developed that combine *in situ* and modeling strategies.
- Though still under development, satellite based methods are very important for quantifying above-ground biomass and its changes at high spatial resolution.

In the light of above conclusions, FAO (2006) has recommended following:

1. *In situ* measurement of biomass should be conducted every five years, and remote sensing measures should be conducted on annual basis.



2. Improve the quality and quantity of *in situ* monitoring of above and below ground biomass estimates in order to validate remote sensing.
3. Expand forest biomass inventories to tropical forests, non-commercial forests, and woodlands.
4. Develop new soil measurement techniques and sampling strategies.
5. For below-ground biomass, increase the density of *in situ* observations, i) by improving or adding observations within existing network; ii) by significantly expanding the soil profile data base available through SOTER and similar programmes; and iii) through more efficient use of national inventories, in combination with land cover derived from satellite data. Development of biomass surveys to obtain full coverage of forest ecosystems, in tropics, is necessary.
6. Full advantage should be taken of existing and planned satellites SAR missions including historical data (JERS-1, ERS-1/2 interferometry), current sensors (multi-temporal ENVISAT-ASAR, ALOS-PALSAR) and support future missions (ALOS follow up, ESA-BIOMASS).
7. For remote sensing estimation of biomass, use a single classification system, such as Land Cover Classification System.

Pilot studies have been done in India to estimate forest /vegetation carbon and these estimates are spread over a decade and are based on different approaches *viz*: historical records, ecological data and population based forest biomass, scales and classification schemes and objectives. According to Ravindranath *et al.* (1977), the standing biomass in India (both above and below ground) was estimated to be 8,375 million tons for the year 1986, of which carbon storage was reported to be 4178 million tons. The total carbon stored in forests of India including soil was estimated to be 9578 million tons. The spatial analysis of phytomass carbon in Indian forests for the period 1988-94 was carried out at district level by Dadhwal *et al.* (2002). This data was computed by combining remote sensing based forest area inventories on 1:250,000 scale field inventories of growing stock volume by FSI and crown density based biomass expansion factor. Based on earlier studies (Hingane, 1991; Richards and Flint, 1994; Dadhwal and Shah, 1997; Ravindranath *et al.*, 1997; Chhabra *et al.* 2002; Chhabra, 2002) it is clear that different approaches have produced different estimates of biomass. Thus there is a need to harmonize the whole methodology considering sampling design in different zones (sample and plot size), methodology for calculation of volume, biomass and carbon using similar approach and models in the country within a specific time frame. In the 11<sup>th</sup> Five Year Plan it is planned to provide extra thrust in understanding the terrestrial Carbon Cycle through a “National

Carbon Project”. The project has three major components and aims to understand Vegetation Carbon pools, Soil Carbon pools and Soil-Vegetation Carbon fluxes.

### National Carbon Project:

Under the National Carbon Project, the country was divided into 9 geographical zones and different zones were allotted to collaborating institutions for detailed data collection in a common frame work.



*Fig.1. Nine geographical zones for detailed study*

The major goals of this project are:

1. Assessment of carbon pools, fluxes and net carbon balance for terrestrial biomass in India.
2. Establishment of an observational network and create remote sensing based spatial database for modeling and periodic assessment of net carbon balance in India.
3. Providing support to Second National Communication (SNC) activity of Ministry of Environment and Forests, GOI to UNFCCC with respect to carbon balance.

The NCP implementation is based on three sets of interrelated subjects viz:

- i. Vegetation Carbon Pool Assessment
- ii. Soil Carbon Pool Assessment, and

iii. Soil and Vegetation- Atmosphere Carbon Fluxes.

The major objectives of the Vegetation Carbon Pool assessment project are:

1. Assessment of terrestrial vegetation biomass in the country using ground sampling and satellite remote sensing data, and
2. Generation of geospatial data of the terrestrial phytomass carbon of India along with estimates of uncertainty.

Among this, fulfillment of the first objective in the Northern Kerala region is the major thrust area of the current project.

The soil carbon pool assessment sub project covers three major objectives viz;

- i. Determination of soil organic carbon in surface and sub-surface soils and inorganic carbon in arid regions of the country using field sampling.
- ii. Device stratification and remote sensing data integration methodology for spatial mapping of soil carbon pools.
- iii. Generating soil carbon spatial data sets along with estimation of uncertainty.

Under this subproject, determination of soil organic carbon in surface and sub-surface soils of forests of Northern Kerala is covered in the present study.

The third sub-project, Soil and Vegetation – Atmosphere carbon fluxes assessment component, is not dealt with.

## **Methodology**

Defining an appropriate phytomass density observation mapping and modeling approach for National-scale vegetation carbon pool assessment is one of the major tasks in the National Carbon Project. Very few studies have used satellite data along with ground data for biomass estimation and extrapolation and most have used only compiled forest inventory data. Several of these studies have considered only main bole, hence approaches to account biomass in other components are needed. Since these estimates vary greatly, it is important to have uniform methodology to generate baseline data on total biomass and carbon in terrestrial ecosystem in India. Satellite data enables stratification and has several advantages. Therefore, a cluster based sampling using remote sensing data for stratification was suggested at national level by ISRO and the same methodology was adopted in the current works.

The TOF resources in general are independent of forest resources, and are an integral part of the non-forest landscape having ecological and economic functions of their own. Therefore, they should be taken into consideration in large-area natural resource planning.

Trees outside forests (roads, canals, railways, urban area, agricultural crops etc.) have high amount of biomass. Tree resources outside continuous forest areas or trees outside forests (TOF) can cover considerable areas. They occur as small woodlots and block plantations, along linear features (e.g. roads, canals) or are found scattered on farmlands, homesteads, community lands and in urban areas. Traditionally, TOF were not inventoried and as a result, quantitative information about TOF is scarce. However, interest in TOF has increased worldwide. Besides providing support to subsistence economies, these trees form a substantial source of raw materials for forest industries. In its Forest Resource Assessment 2000, the Food and Agriculture Organization (FAO) of the United Nations concluded that information on TOF remains fragmented, diffuse, sometimes empirical and often sectoral.

The use of trees in farming systems date back to the beginning of domestic agriculture. More recently, interest in partnerships (e.g. outgrower scheme, joint ventures) between the private and public sectors, communities and individuals for the production of goods and services outside forests has been increasing. In temperate agricultural landscapes, trees and shrubs mainly occur in the form of scattered trees, windbreaks, blocks and linear plantations. For centuries, farmers in India have maintained a traditional land-use system known as "sacred groves", in which a separate area with trees was set aside. Trees are also a vital component of the urban landscapes.

The Forest Survey of India (FSI) has been conducting TOF assessments since the early 1990s. Due to its expertise in this field, FSI is in a position to take the lead in Asia offering training on inventory methods of TOF to professionals. It is in this context that FSI has prepared this "Training Manual on Inventory of TOF".

Fundamental starting points for a comprehensive approach to conducting inventories of TOF are clear definitions and a brief overview of the extent and state of the resource. TOF comprise tree formations ranging from single discrete trees, to systematically managed trees on private and public lands. Inventory is the process of obtaining quantitative and qualitative information about a resource (Kleinn, 2000).

A clear definition of TOF is required in order to guarantee consistency and comparability among data sets, and to facilitate communication. In this connection FAO (2001) categorization is as follows:

**Tree:** *A woody perennial with a single main stem, or in the case of coppice with several stems, having a more or less definite crown. Includes: bamboos, palms and other plants meeting the above criterion.*

**Forest:** *Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 m at maturity **in situ**. May consist of either closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground, or open forest formations with a continuous vegetation cover, in which tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5 m are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.*

*Includes: forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and width of more than 20 m; plantations primarily used for forestry purposes, including rubberwood plantations and cork oak stands. The term specifically excludes stands of trees established primarily for agricultural production, for example fruit tree plantations. It also excludes trees planted in agroforestry systems.*

**Other wooded land:** *Land with either a crown cover (or equivalent stocking level) of 5 to 10 percent of trees, able to reach a height of 5 m at maturity **in situ**; or a crown cover (or equivalent stocking level) of more than 10 percent of trees not able to reach a height of 5 m at maturity **in situ** (e.g. dwarf or stunted trees); or with shrub or bush cover of more than 10 percent.*

**Trees outside forests:** *Trees on land not defined as forest and other wooded land. Includes: trees on land that fulfils the requirements of forest and other wooded land except that the area is less than 0.5 ha; trees able to reach a height of at least 5 m at maturity **in situ** where the stocking level is below 5 percent; trees not able to reach a height of 5 m at maturity **in situ** where the stocking level is below 20 percent; scattered trees in permanent meadows and pastures; permanent tree crops such as fruit-trees and coconuts; trees in parks and gardens, around buildings and in lines along streets, roads, railways, rivers, streams and canals; trees in shelterbelts of less than 20 m width and 0.5 ha area.*

**Source: FAO (2001)**

FAO's definition of TOF depends on the definition of forest and other wooded land. Different definitions will affect inventory results.

TOF information was generated in three phases: land use classification and mapping; identification of tree-cover classes; and measurement of tree characteristics. Satellite images and aerial photos are suitable for the first two. High-resolution satellite images are likely to allow the identification of single trees (or crowns) and can be a data source for a large-area TOF inventory.

Land use and land cover are important factors for TOF inventory and therefore, the classification rules should be formulated in such a way that these factors are suitably considered. Since sources of information for land use and land cover are different, and in some cases segregation between land use and land cover is difficult, some other methods need to be adopted for classification purposes. The geometric resolution of an image allows the determination of crown cover, tree density and spatial arrangement of trees (or crowns). Other important attributes (e.g. species, stem, DBH, crown width) are more reliably observed in the field. Non-biophysical variables such as ownership and type of tree management can also be observed in the field.

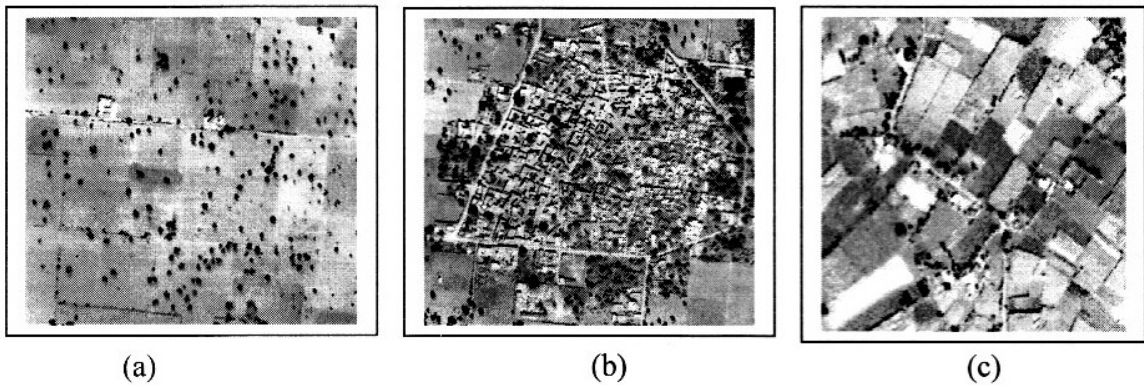
The basic prerequisite for a large-area TOF inventory is a land-use map, readily available or produced from satellite images. This base map is then used for the identification of areas where TOF are found and the type of TOF that are likely to be encountered during the inventory. On the basis of this map, the inventory can be planned.

The choice of variables for which data are to be collected depends upon the objectives of the inventory. Land use, land cover and tenure may be important issues. The choice of appropriate sampling design is also crucial. It should be practical and ensure the desired results with the specified reliability, at a minimum cost and/or with the maximum reliability at a given cost, given the most effective use of the resources available.

Efficient inventory designs integrate the use of aerial photos or high-resolution satellite images with field plots. The role of high-resolution satellite images is to identify TOF and its configurations, support mapping and spatial analysis and assist in fieldwork planning. Detailed field sampling is required to provide information on species composition, tree dimensions, management practices and ownership. The spatial distribution (e.g. scattered individual trees, trees in lines, trees in blocks) necessitates an adjusted design of sample plots, combining fixed-area plots and line samples, as carried out in ecological surveys and forest inventories.

TOF were classified into eight categories for the purpose of data collection, processing and analysis. These categories for classification were:

1. Farm forestry: trees along field bunds and in small patches of up to 0.1 ha.
2. Village woodlot: naturally growing or planted trees on community land.
3. Block plantation: compact plantations covering an area of more than 0.1 ha and not falling in categories (i) and (ii).
4. Roadside plantation: trees planted along roads.
5. Pond side plantation: trees planted around water bodies.
6. Railway side plantation: trees planted along railway lines.
7. Canal side plantation: trees planted along canals.
8. Others: trees not falling in any of the above categories.



*Fig. 2. TOF as seen in satellite imageries*

Most of the TOF came under old plantations and have giant trees as comparison to natural vegetation. Since these are not in contiguous patches, such vegetation has been ignored, for biomass studies. There are few studies on biomass and carbon estimation on Trees outside forests (TOF) mostly by Forest Survey of India.

TOF can be classified as per the location and type and different sampling approaches can be made accordingly.

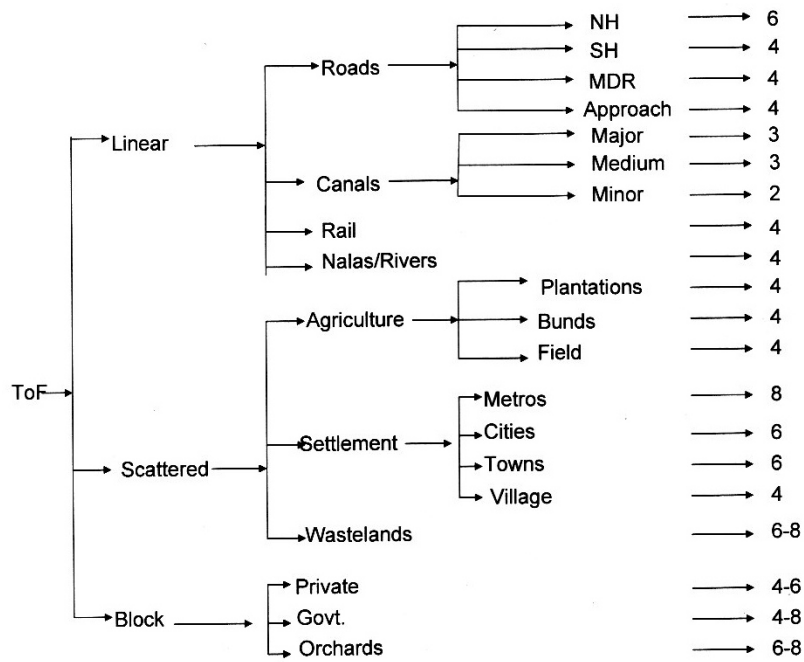


Fig.3. TOF classification

The estimation of biomass and carbon using satellite data for TOF become pertinent for vegetation. Hence, for estimation of biomass and carbon assessment of TOF in the country, a standard method was formulated by ISRO and the same was adopted in the present study.

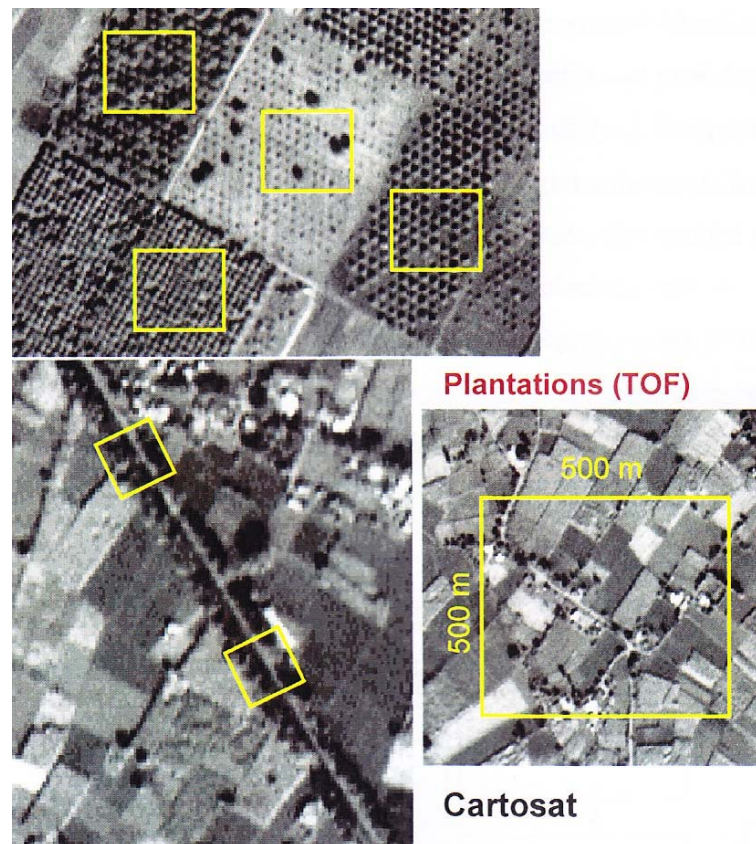


Fig. 4. Sampling design for TOF



The methodology for estimation of biomass and carbon was developed for different components such as trees in the forest ecosystem, trees outside forests, crops and waste lands.

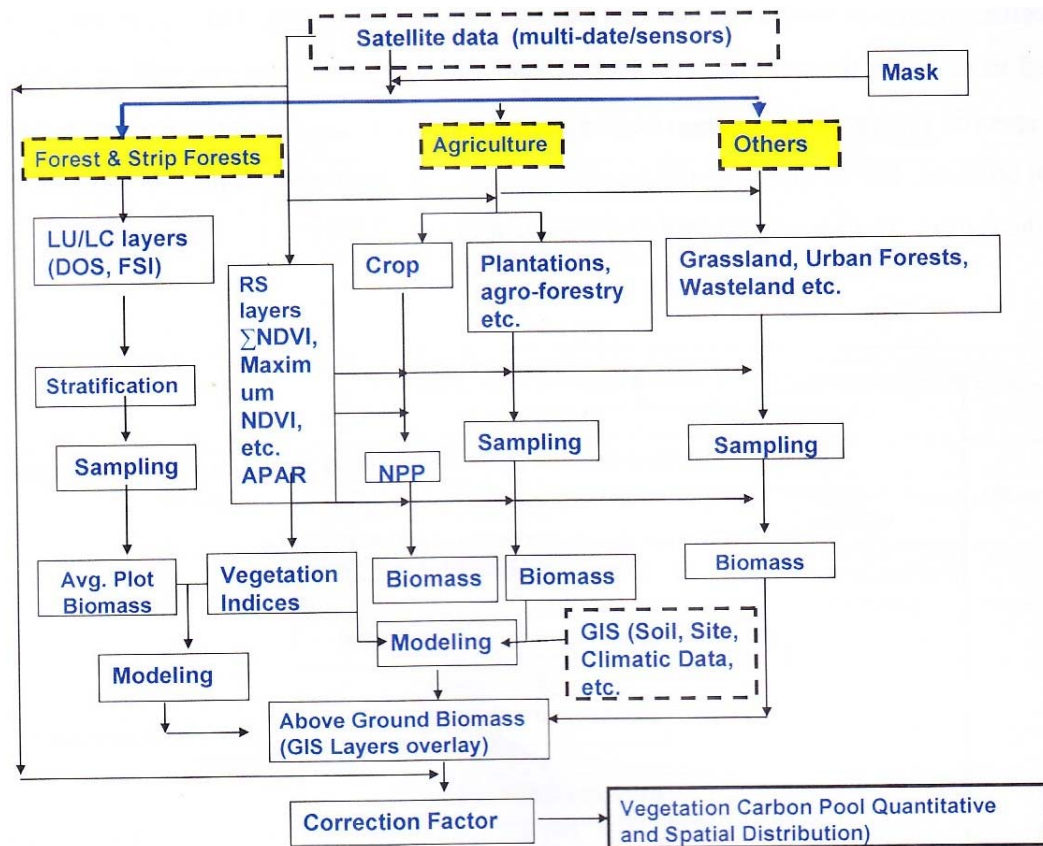


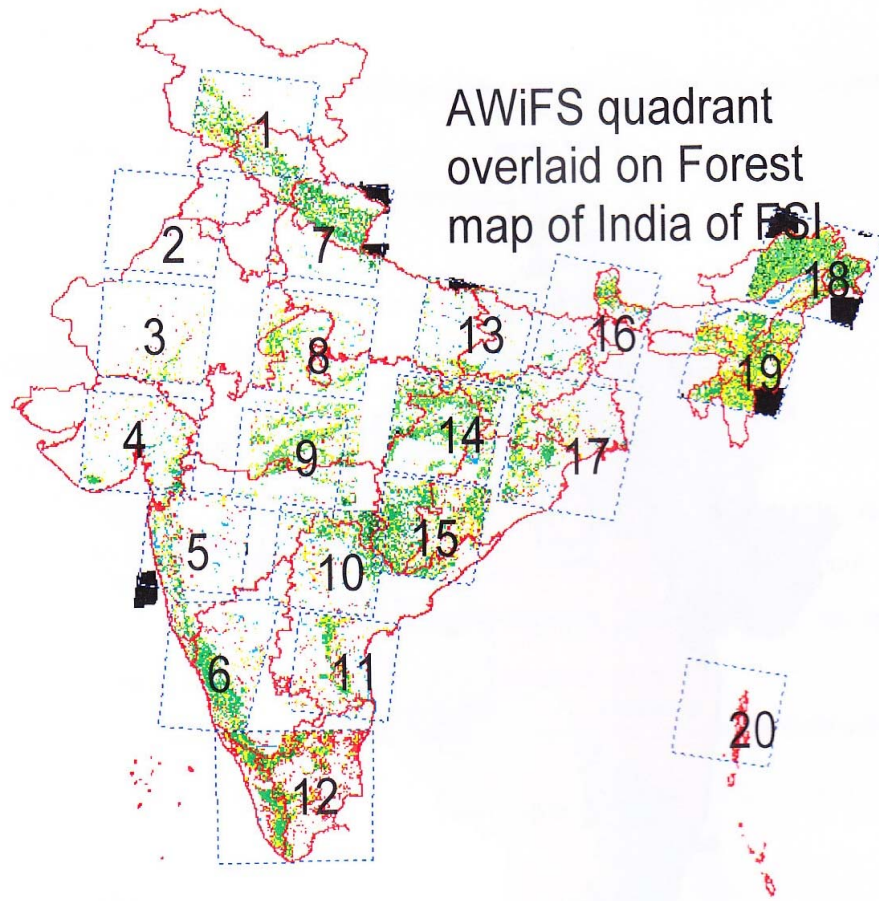
Fig.5. Stages of phytomass and carbon estimation

The project envisages taking up the fresh observation, because earlier estimates in the country were either based on historical data or had followed different methodologies in terms of data collection protocols, analysis, area, time frame etc. Hence a uniform methodology was proposed by ISRO and protocols have been developed for biomass and carbon estimation in Trees outside Forests. The protocols developed by ISRO were used for National Level estimation of Carbon. The current work was a part of National Carbon Assessment Project.

### Spatial stratification and sampling procedure

Satellite data enables stratification of various types/ components of vegetation. The stratification is usually based on forest vegetation density and type, envisaging to collect ground data uniformly throughout the study region. Since forest ecosystems are very dynamic, biomass distribution pattern is governed by factors like site quality, forest type, climate, physiography, moisture availability etc. Hence twenty major zones covering all the major biomes in the country were identified by National Remote Sensing Centre (NRSC), which equals to one quadrant of AWiFS coverage, covering about 70% of the geographic area of the country. AWiFS data of three seasons in the year 2006-07 were

used and the data correction was done for geometric and radiometric distortions. Geo-rectification on 1:250,000 scale was done for removal of geometric distortions. Among these 20 zones, one zone covers Kerala and Tamil Nadu states; of which northern part of Kerala state is selected for the present study.

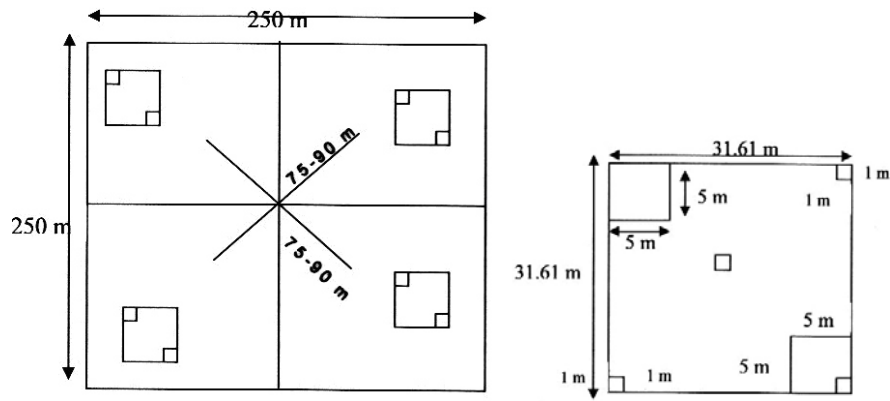


*Fig.6. AWiFS quadrant mosaic of India*

It is envisaged to do sampling at 2500 sites in forest ecosystems throughout the country. For sampling design and identification of the sites the strata considered are forest type based on DOS and ISRO studies, forest density based on FSI, and NDVI based on AWiFS and MODIS. Since accessibility to collect data in remote forest areas is important, communication aspects are also been combined in selection of sites for field data collection.

### **Sampling approach**

Four plots of 0.1ha size were identified in each site. Nested two stage sampling approach was adopted to sample for trees (0.1ha), shrubs (25sq.m), herbs (1m x 5m), bamboo (0.1ha), litter (1m x 5m) and dead trees (0.1ha). - Fig.7.



*Fig.7. Clustering 2-stage sampling and plot design for tree, shrub and herb sampling*

The spatial resolution of AWiFS is 56 m and the plot size would be 31.61 x 31.61 m, so that one pixel would cover nearly four plots. In order to obtain better relationship of ground measurements with satellite derived parameter, cluster sampling was done to lay four sample plots of 0.1 ha at each site within an area of 250 x 250 m.

The sample plots were laid at different density levels viz. very dense (more than 70%), dense (40-70%), medium (20-40%) and open (less than 20%) density classes. Random sampling was carried out, within the systematically identified locations. Among the 20 zonal sites (Fig.6), in each zone, 70-100 sample sites of 250 x 250 m grids (Fig.7) were identified, considering types of vegetation, density of vegetation and physiographic conditions of the area and other ground realities. Coordinates of the center of the site was obtained using FCC (LISS III) or maps. Global Position System (GPS) in conjunction with topo maps were used to locate site on the ground. The area was divided into four quadrates (NE, SE, SW, and NW). Four permanent sample plots, about 75-90 m away from center, were laid in each quadrate (Fig.7). At each sample sites of 250 x 250 m, four sample plots of 31.6 x 31.6 m size, in each quadrant were identified for detailed enumeration and volume estimation. Each tree was numbered for future monitoring by fixing a steel plate (scot tags) with number, at the base of the trees. Dbh of trees were noted at 1.37 m height using steel tapes. Height of trees, girth of bole and branches at different levels etc were noted for phytomass estimation. The phytomass estimation of shrubs was done from the sub plot of 5 x 5 m. The gbh was measured about 30 cm above ground. The specieswise and bushwise number of tillers, in the entire plot of 0.1 ha, was noted. Sample tillers were collected for the estimation of biomass. For herbaceous layer, harvesting of the plant material in 2-5 sites of 1 x 1 m plot within 0.1 ha plot was done. For the estimation of phytomass of bamboos, number of clumps, number of culms per clump and the average cbh of the stems were noted. Plant material collected was dried at 80° C for 24 hours and weighed.

For better understanding ground based and satellite derived biomass and carbon estimates, a two stage clustering sample design was followed (Fig.8).

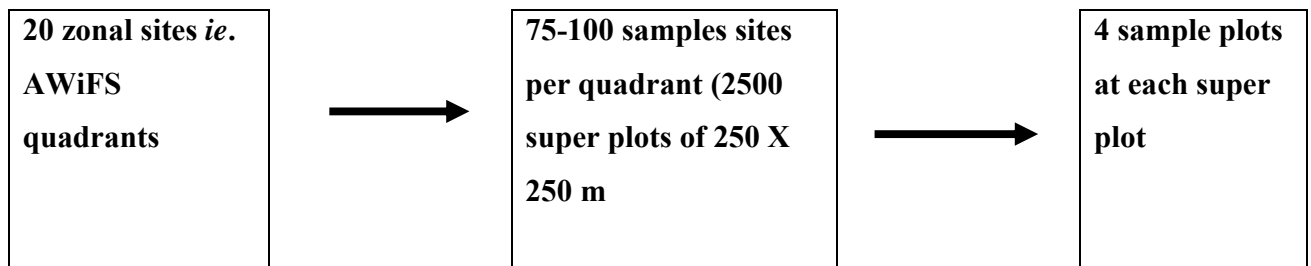


Fig.8. Two stage clustering sample design

To ensure that the data is complete for different components, standard format supplied by ISRO (see Appendix 1) was used for data recording. Periodical monitoring of structural and biomass data of different forest cover type is essential in view of the global issues like loss of biomass/ biodiversity, impact of climate on the distribution pattern, migration of species etc. Hence laying of permanent sample plots for future monitoring was also undertaken by fixing rust proof aluminium metal coins with numbers 1-135 in one of the four sample plots in each site along with GPS coordinates of the plot.

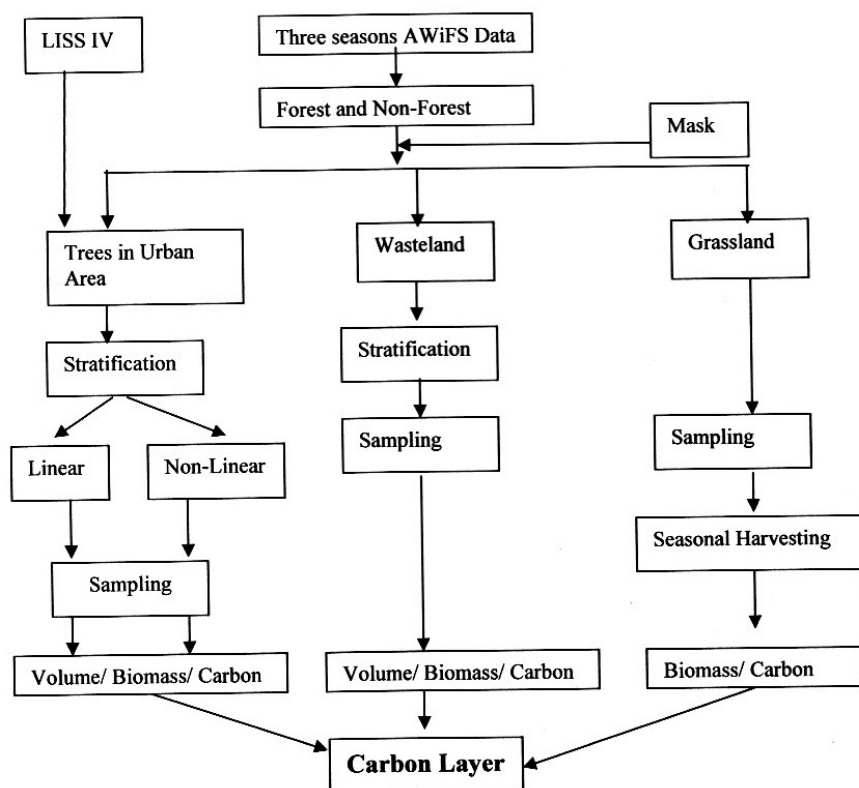


Fig. 9. Stages in carbon estimation of non-forest ecosystems

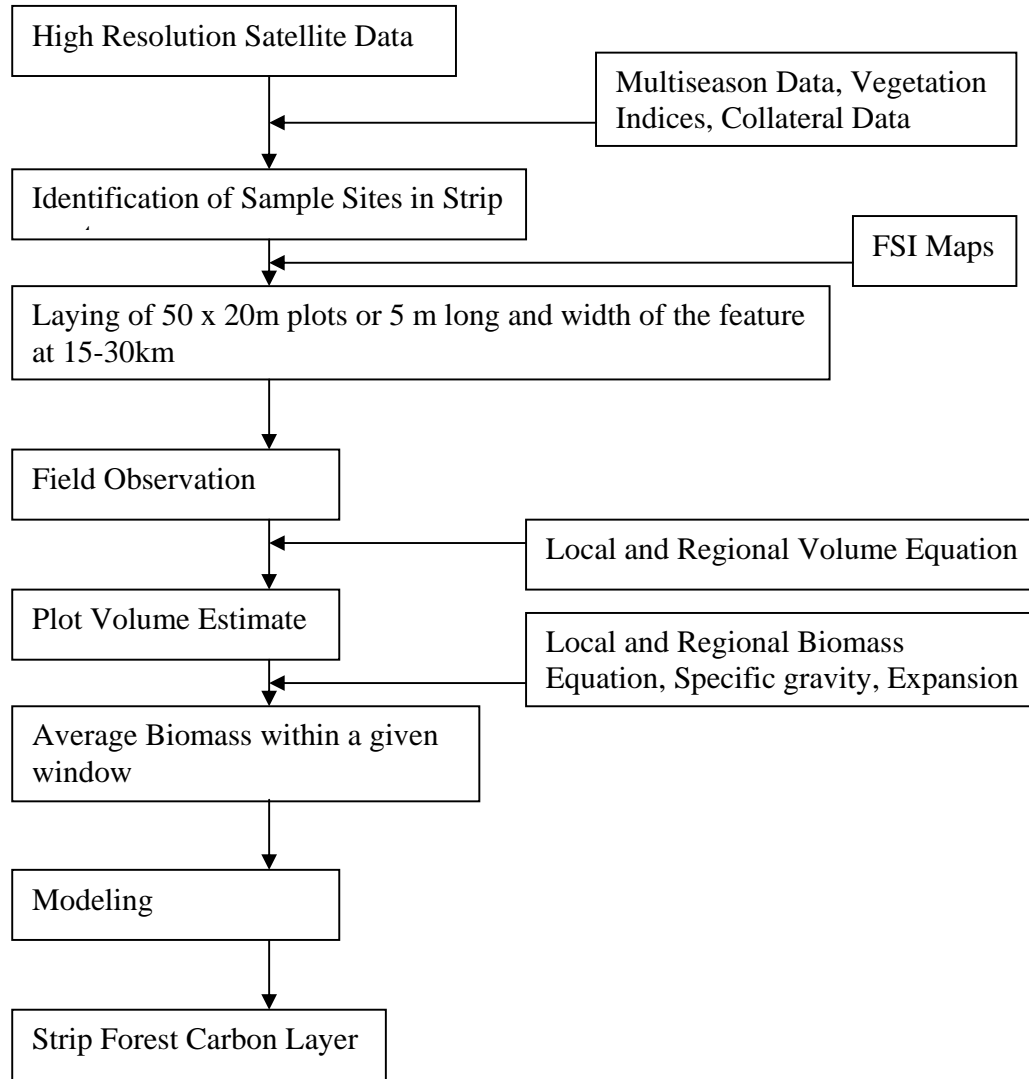
## **Estimation of Plot Biomass and Carbon**

From the ground data collected, volume of each tree can be calculated using site specific volume equations available in literature. Biomass of each tree can be worked out after multiplying with specific gravity and expansion factor. Biomass of each plot can be estimated by summing the phytomass of all trees. Based on this, per plot and per ha phytomass can be estimated. Carbon estimation can be done by using 47.5% (average value) of the total biomass. Per pixel biomass can be obtained for further analysis and establishing relationship with NDVI. GIS layers of biomass and carbon can be summed up to obtain site biomass.

The field data collected was handed over to ISRO for further processing. In the process of biomass estimation, estimation of volume of each tree was required. Since nondestructive approach was adopted, the wood volume was estimated using regional species specific regression equations which required diameter at breast height (dbh) and tree height. The product of volume and species specific gravity gives biomass, which could be estimated using the field data supplied to the project coordinator centre at ISRO.

Based on the literature survey of TOF in different Agro-ecological zones in the country, it was noted that there is an increase in phytomass/ carbon in TOF in India from 436 million tons to 548 million tons. To account for the biomass and carbon in these systems, format for enumerating trees, shrubs, herbs, bamboos, litter, humus, saplings and seedlings of TOF has been designed by ISRO. The same format was used in the current study. (see Appendix 1)

Based on the field information gathered during the project, geospatial modeling and up-scaling of plot biomass to spatial forest carbon density using multi-resolution remote sensing data will be done in the National Project Coordination Centre at ISRO. Hence regression modeling between optical spectral data and plot-wise biomass density will not be done at local level. The different steps in the carbon pool assessment are as follows:



*Fig.10. Steps in carbon estimation in Strip Forest Ecosystems*

### **Soil sampling and analysis**

Soil samples were collected from both natural forest and trees outside forest areas. The depth of sampling was 0-30, 30-60 and 60-100cm in the former and 0-15, 15-30, 30-60 and 60-100cm in the latter. Organic carbon in the soil was determined by wet digestion method of Walkley and Black (1934) as described by Jackson (1979). Bulk density was estimated using core sampler of ample diameter. Carbon mass was calculated using the formula,  $C_m = \sum_{i=1}^n Tc_i B_i d_i$ ; where  $C_m$ = carbon mass,  $Tc_i$ =total carbon of  $i^{th}$  layer,  $B_i$ =bulk density of  $i^{th}$  layer and  $d_i$ =depth of  $i^{th}$  layer.

## **Discussion**

For extrapolation of the point observations, spectral modeling can be used. Satellite derived parameters like raw bands (red and infra red) and ratio indices form good basis for extrapolating the phytomass and therefore, these can be correlated with ground observations for specific forest types in each ecological region. Various regression models like linear, power, logarithmic, exponential etc can be attempted. Best correlation can be used to extrapolate the biomass in that forest type. Forest type wise biomass can be estimated in each ecological zone. Biomass of all ecological zones can be added in GIS domain to get the total biomass of the area.

There are well established protocols for bole volume and biomass estimation. A product of volume and specific gravity yields biomass. Species specific local volume equations are not available in all ecological regions, hence regional equations can be used for biomass estimation. If such equations are not available, equations of genus or families can also be tried. If genus specific or family specific equations are also not available, then, general equations at State/ Region level can be used for biomass estimation.

Individual tree biomass is added to get the plot biomass. Biomass of shrubs, herbs, bamboos etc should also be added to get the plot biomass. Since each site in the current study is having four plots, mean site/ plot biomass can be obtained for further spectral modeling/ extrapolation using satellite data.

Carbon in plant biomass was reported to vary from 33 to 52%. In the National Carbon Project, it is envisaged to use 48% of the phytomass for considering carbon estimation. For regional and country level biomass and carbon map, the same can be represented in appropriate grids of 5 x 5 km and 10 x 10 km, based on the data base on grids of 5 and 10 km, prepared in GIS domain. This country level data can be made available to user communities (Ministry of Forests & Environment, State Forest Department, Scientists, and Researchers etc.) at National and International level.

## Trees Outside Forests

### TOF Status

<b>TOF type</b>	<b>District</b>	<b>No. of sites</b>	<b>Mean Tree Density</b>	<b>Mean Basal Area (m<sup>2</sup>)</b>	<b>Mean Volume</b>
Linear (Road)	Malappuram, Kozhikode	5	232/km	1.665	/km
Linear (Rail)	Kozhikode	1	120/km	0.959	/km
Linear (Canal)	Kozhikode	3	320/km	0.257	/km
Scattered (Agriculture)	Kasaragod	2	180/ha	0.607	/ha
Scattered (Urban)	Kannur	1	180/ha	1.950	/ha
Scattered (Rural)	Kasaragod	1	360/ha	2.729	/ha
Block Plantation	Kannur	1	940/ha	1.966	/ha
Others	Malappuram	1	640/ha	0.536	/ha



## TOF Vegetation Status of Selected Plots

### Plot No. 1

Form 2A

#### FORMAT FOR TREES OUT-SIDE FOREST (TOF)

##### CATEGORY 1: SITE AND OBSERVER

State: **Kerala** District: **Malappuram** GPS Point Name= **Kuttippuram**  
 Location/Road/Canal/Village: **NH-47 (Kuttippuram)**  
 Site Centre Coordinates : Lati. **10° 51' 42.23"** Longi. **76° 2' 14.82"**  
 Sample Site/Plot No.: **T- 01** Date: **12/10/2009** Time: **1.15 PM**  
 G.P.S. Reading (HHDD:MM:SS and WGS 84): Lati **10° 51' 42.23"** Longi. **76° 2' 14.82"**  
 Observer: **Deepu Divakaran** Altitude: Site/Plot: **93 m**  
 Marking on image: (Google/1:25,000 or larger)  
 (Tonal characteristics)  
 Slope (°): **1°** Photograph Number: **4248 - 4251**  
 Aspect : **N/E/S/W/NE /SE/SW/NW** Topography General observations: **Plain**

##### CATEGORY 2: FOREST AND SOIL- GENERAL:

TOF type: **Road side** Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
 Top Canopy species: *Syzygium cumini* var. *cumini*, *Mangifera indica*  
 Ground Cover(%): **40%** Stoniness(%): **0%** Rock Put-crop(%): **0%**  
 Soil Type: **Lateritic** Soil Texture : **Medium** Soil colour: **Reddish brown**  
 Litter thickness: **2 cm** Humus Colour: **Pale brown** Humus thickness: **0.5 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1260	2.6460	<b>9.8835</b>
0.15-0.30	1400	2.6040	
0.30-0.60	1330	3.3915	
0.60-1.00	1350	1.2420	

##### CATEGOREY 3: QUANTITATIVE MEASUREMENTS

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
 NW-SE: Steps: Hits: (Sky/Canopy)  
 Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: **20 +21 +22 = 21m**  
 At the base of ultimate branching 1<sup>st</sup> : **+ + = m**

### Very Important Guidelines

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20. m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/ scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation: four plots of 0.1 ha** (please do clustered sampling)

**Plot Size:** Linear = **50 m × 18 m** (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of **100×100m** in opposite corners within **250×250 m** and very sparse in agriculture areas: one of **250×250 m** or block plantation take four of **31.62×31.62 m**.

Width of tar on road / water channel in canal / railway track width = **10 m** (tar/rail)

Width with pavement of road/side of rail track = **17 m**

**Plot Size: 50 × 18 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Syzygium cumini</i> var. <i>cumini</i>	487.2	3	22	L	No
2	<i>Syzygium cumini</i> var. <i>cumini</i>	372.6	4	21	L	No
3	<i>Mangifera indica</i>	315.4	5	20	L	No
4	<i>Mangifera indica</i>	216.3	4	21	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

#### (a) North-East Corner (5×5m/0.1 ha plot)

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Pseudarthria viscida</i>	No: 1	No: 1	Thick															
	:%:	:%:	Medium															
			Thin			1			0.8			0.3			3.8			1.8
<i>Urena lobata</i>	No: 3	No: 1	Thick															
	:%:	:%:	Medium															
			Thin			1			1.5			0.2			1.7			0.5
<i>Sida acuta</i>	No: 4	No: 1	Thick															
	:%:	:%:	Medium															
			Thin			1			0.9			0.2			5.6			1.7

**(a) South-west Corner (5×5/0.1 ha plot)**

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Alternanthera sessilis</i>	No: 2	No: 2	Thick															
	%:	%:	Medium		4			2.2			1			16.5			2.6	
			Thin			1			1.3			0.75			9.5			1

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)

**(a)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m) : **No Bamboo**

1	Number of rosettes in the plot	% Cover=							
2	Rosettes circumference (m)	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	Avg.=

S. No	Species Rosettes /	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)			
			1	2	3	1	2	3	1	2	3			1	2	3	
1		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	
2		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m) **No Bamboo**

1	Number of rosettes in the plot	% Cover=							
2	Rosettes circumference (m)	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	Avg.=

S. No	Species Rosettes /	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)			
			1	2	3	1	2	3	1	2	3			1	2	3	
1		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	
2		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	

**(a) Herb 1 (1×1 m)** (record epiphytes/lithophytes/climbers etc. also) Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: **.0.106 gm** Dry Weight: **0.048gm** % Cover: **86**

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	<i>Pogostemon purpurascens</i>	4	6	<i>Commelina benghalensis</i>	2
2	<i>Synedrella nodiflora</i>	3	7	<i>Eclipta prostrata</i>	1
3	<i>Laportea interrupta</i>	1	8	<i>Cyperus rotundus</i>	14
4	<i>Peperomia pellucida</i>	1	9	<i>Cynodon dactylon</i>	10
5	<i>Ageratum conyzoides</i>	1	10	<i>Lindernia ciliata</i>	1

**(b) Herb 2 (1×1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: **0.102 gm** Dry Weight: **0.047gm** % Cover: **85**

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	<i>Synedrella nodiflora</i>	3	6	<i>Axonopus compressus</i>	20
2	<i>Mimosa pudica</i>	2	7	<i>Cardiospermum halicacabum</i>	1
3	<i>Ruellia tuberosa</i>	1	8	<i>Mukia maderaspatana</i>	1
4	<i>Commelina benghalensis</i>	3	9	<i>Dendrophthoe falcata</i>	1
5	<i>Cyperus rotundus</i>	8	10		

**(c) Herb 3 (1×1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: **0.098 gm** Dry Weight: **0.045gm** % Cover: **84**

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	<i>Commelina benghalensis</i>	2	6	<i>Ageratum conyzoides</i>	2
2	<i>Cyperus rotundus</i>	9	7	<i>Ruellia tuberosa</i>	4
3	<i>Axonopus compressus</i>	18	8	<i>Mimosa pudica</i>	3
4	<i>Synedrella nodiflora</i>	2	9		
5	<i>Lindernia ciliata</i>	2	10		

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.421	0.306	0.078	0.054	0.499	0.36
(b) NW	0.398	0.299	0.063	0.045	0.461	0.344
(c) SW	0.253	0.193	0.058	0.042	0.311	0.235
(d) SE	0.232	0.178	0.054	0.038	0.286	0.216
(e) Center						

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)****CATEGORY 1: SITE AND OBSERVER**State: **Kerala** District: **Malappuram** GPS Point Name = **Hamsappady**Location/Road/Canal/Village: **River side-Bharathapuzha (Kuttippuram – Thirur)**Site Centre Coordinates: Lati. **10° 51' 39.456"** Longi. **76° 1' 3.648"**Sample Site/Plot No.: **T- 02** Date: **13/10/ 2009** Time: **10.00 AM**G.P.S. Reading (HHDD: MM: SS and WGS 84): Lati **10° 51' 39.456"** Longi. **76° 1' 3.648"**Observer: **Deepu Divakaran** Altitude: Site/Plot: **18 m**Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)Slope (°): **2°**Photograph Number: **4222 - 4225**Aspect : **N/E/S/W/NE /SE/SW/NW**

Topography General observations):

**River side****CATEGORY 2: FOREST AND SOIL- GENERAL:**TOF type: **River side** Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
Top Canopy species: ***Terminalia catappa, Samanea saman, Cocos nucifera, Racosperma auriculiforme***Ground Cover (%): **70%** Stoniness (%): **0%** Rock Put-crop (%): **0%**Soil Type: **Sandy** Soil Texture : **Medium** Soil colour: **Yellowish brown**Litter thickness:**3 cm** Humus Colour: **Pale Gray** Humus thickness: **0.5 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1200	2.6640	<b>10.4448</b>
0.15-0.30	1460	2.6280	
0.30-0.60	1400	3.1080	
0.60-1.00	1420	2.0448	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
NW-SE: Steps: Hits: (Sky/Canopy)Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: **28 +15 +14 = 19m**  
At the base of ultimate branching 1<sup>st</sup>: **13 + 9 + 8 = 10 m**

### Very Important Guidelines

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 35 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = **850 m** (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 50 × 35 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Terminalia catappa</i>	107.1	5.00	15.0	L	No
2	<i>Terminalia catappa</i>	036.3	2.00	10.0	L	No
3	<i>Terminalia catappa</i>	018.8	1.50	03.5	L	No
4	<i>Mangifera indica</i>	016.1	0.75	04.0	L	No
5	<i>Cocos nucifera</i>	085.6	-	11.0	L	No
6	<i>Terminalia catappa</i>	038.2	6.00	10.0	L	No
7	<i>Cocos nucifera</i>	084.2	-	12.0	L	No
8	<i>Terminalia catappa</i>	033.1	-	09.0	L	No
9	<i>Cocos nucifera</i>	089.7	-	13.0	L	No
10	<i>Cocos nucifera</i>	083.6	-	09.0	L	No
11	<i>Cocos nucifera</i>	084.5	-	08.0	L	No
12	<i>Cocos nucifera</i>	085.3	-	09.0	L	No
13	<i>Cocos nucifera</i>	082.2	-	08.0	L	No
14	<i>Cocos nucifera</i>	082.9	-	07.5	L	No
15	<i>Cocos nucifera</i>	075.5	-	06.0	L	No
16	<i>Cocos nucifera</i>	068.3	-	05.0	L	No
17	<i>Briedelia retusa</i>	045.2	2.00	06.0	L	No
18	<i>Briedelia retusa</i>	025.2	3.00	04.0	L	No
19	<i>Bombax ceiba</i>	035.1	-	06.0	L	No
20	<i>Mangifera indica</i>	039.4	2.50	08.0	L	No
21	<i>Samanea saman</i>	285.9	2.50	28.0	L	No
22	<i>Racosperma auriculiforme</i>	149.3	2.00	14.0	L	No
23	<i>Erythrina variegata</i>	074.5	2.75	09.0	L	No
24	<i>Gliricidia sepium</i>	035.2	1.50	08.0	L	No
25	<i>Gliricidia sepium</i>	038.3	1.50	07.5	L	No

26	<i>Gliricidia sepium</i>	035.2	1.40	08.5	L	No
27	<i>Gliricidia sepium</i>	033.5	1.50	07.0	L	No
28	<i>Gliricidia sepium</i>	033.4	1.50	07.5	L	No
29	<i>Gliricidia sepium</i>	034.2	1.50	06.0	L	No
30	<i>Gliricidia sepium</i>	035.1	1.50	07.0	L	No
31	<i>Gliricidia sepium</i>	031.7	1.50	06.0	L	No
32	<i>Gliricidia sepium</i>	034.8	1.50	08.0	L	No
33	<i>Gliricidia sepium</i>	033.1	1.50	09.0	L	No
34	<i>Gliricidia sepium</i>	033.2	1.50	07.0	L	No
35	<i>Melicope lunu-ankenda</i>	049.5	4.50	08.0	L	No

**Shrubs in 5×5m in a plot of 50× 20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Urena lobata</i> ssp. <i>lobata</i>	12	2	Thick	2			3.9			0.75			0.134			0.047		
			Medium		1			3.5			0.65			0.072			0.023	
	0.50%	0.40%	Thin															
<i>Sida acuta</i>	23	6	Thick	1			2.5			0.78			0.041			0.014		
			Medium		1			2.3			0.69			0.035			0.010	
	2.00%	0.50%	Thin			1			1.9		0.65			0.031			0.0009	
<i>Solanum torvum</i>	5	1	Thick	2			2.6			50.00			0.013			0.005		
			Medium															
	0.02%	0.01%	Thin															
<i>Lawsonia inermis</i>	4	1	Thick	2			3.2			2.40			0.049			0.016		
			Medium															
	0.03%	0.02%	Thin															
<i>Urena lobata</i> ssp. <i>sinuata</i>	4	1	Thick	2			2.5			0.65			0.046			0.015		
			Medium															
	0.02%	0.01%	Thin															

**(b) South-west Corner (5×5/0.1 ha plot)**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Chromolaena odorata</i>	33	6	Thick	1			0.9			2.30			0.067			0.021		
			Medium		1			0.5			1.44			0.035			0.010	
	4.00%	2.00%	Thin			1			0.2		0.26			0.003			0.0009	
<i>Phyllanthus reticulatus</i>	4	2	Thick	1			1.8			1.65			0.189			0.055		
			Medium		1			0.7			0.75			0.023			0.004	
	0.02%	0.05%	Thin															
<i>Barleria courtallica</i>	3	1	Thick	1			0.9			0.61			0.013			0.005		
			Medium															
	0.01%	0.03%	Thin															



**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(a)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m )

1	Number of rosettes in the plot	2						% Cover = 0.005
2	Rosettes circumference (m)	8	7				Avg. = 7.5	
3	Number of culms in rosettes	26	22				Avg. = 24	

S . N o	Species/ Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
			1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
1	<i>Bambusa bambos</i>	Thick	11			28.1			22			0.287	0.165	0.038	0.153	0.087	0.020	
		Medium		10			17.2			15			0.138	0.074	0.037	0.072	0.040	0.020
		Thin			5			7.2			7			0.099	0.034	0.015	0.052	0.019

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m) **No Bamboo**

1	Number of rosettes in the plot	% Cover=					
2	Rosettes circumference (m)	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	Avg.=

S . N o	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1		Thick															
		Medium															
		Thin															

**(a) Herb 1 (1×1 m)** (record epiphytes/lithophytes/climbers etc. also) Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.095 gm Dry Weight: 0.044 gm % Cover: 79

S.No.	Species	No. of individuals
1	<i>Mitracarpus hirtus</i>	4
2	<i>Axonopus compressus</i>	1
3	<i>Alloteropsis cimicina</i>	3
4	<i>Synedrella nodiflora</i>	5
5	<i>Phyllanthus amarus</i>	1
6	<i>Achyranthes aspera</i> var. <i>aspera</i>	2
7	<i>Cyathula prostrata</i>	1
8	<i>Commelina benghalensis</i>	1
9	<i>Ruellia tuberosa</i>	1
10	<i>Laportea interrupta</i>	1

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.068 gm Dry Weight: 0.031gm % Cover: 63

S.No.	Species	No. of individuals
1	<i>Phyllanthus amarus</i>	1
2	<i>Synedrella nodiflora</i>	2
3	<i>Mitracarpus hirtus</i>	3
4	<i>Alloteropsis cimicina</i>	4
5	<i>Ageratum conyzoides</i>	2
6	<i>Mimosa pudica</i>	2

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.073 gm Dry Weight: 0.034 gm % Cover: 74

S.No.	Species	No. of individuals
1	<i>Mimosa pudica</i>	1
2	<i>Laportea interrupta</i>	2
3	<i>Alloteropsis cimicina</i>	3
4	<i>Mitracarpus hirtus</i>	5
5	<i>Synedrella nodiflora</i>	1
6	<i>Ageratum conyzoides</i>	1
7	<i>Commelina benghalensis</i>	2

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.521	0.381	0.098	0.069	0.619	0.45
(b) NW	0.458	0.354	0.088	0.063	0.546	0.417
(c) SW	0.453	0.350	0.085	0.061	0.538	0.411
(d) SE	0.432	0.334	0.083	0.059	0.515	0.393
(e) Center						

## FORMAT FOR TREES OUT-SIDE FOREST (TOF)

**CATEGORY 1: SITE AND OBSERVER**State: **Kerala** District: **Malappuram** GPS Point Name: **Igbal Nagar**Location/Road/Canal/Village: **Approach road**Site Centre Coordinates : **Lati. 10° 53' 54.49" Longi. 75° 59' 44.41"**Sample Site/Plot No.: **T-03** Date: **13/10/2009** Time: **2.00 PM**G.P.S. Reading (HHDD:MM:SS and WGS 84): **Lati. 10° 53' 54.49" Longi. 75° 59' 44.41"**Observer: **Deepu Divakaran** Altitude: Site/Plot: **20 m**Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)Slope (°): **15**Photograph Number: **4227 to 4229**Aspect : ~~N/E/S/W/NE /SE/SW/NW~~Topography General Observations): **Hilly****CATEGORY 2: FOREST AND SOIL- GENERAL:****TOF type:** Linear approach road Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**Top Canopy species: ***Swietenia macrophylla***Ground Cover (%): **77%**Stoniness (%): **1 %**Rock Put-crop(%): **0 %**Soil Type: **Lateritic** Soil Texture : **Silty** Soil colour: **Reddish brown**Litter thickness: **5 cm**Humus Colour: **Pale brown**Humus thickness: **0.5 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1220	3.0561	<b>9.1453</b>
0.15-0.30	1360	2.7540	
0.30-0.60	1420	2.2152	
0.60-1.00	1400	1.1200	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)

NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 23 +18 +17 = 19.33m

At the base of ultimate branching

1<sup>st</sup>: 6 + 4 + 8 = 6 m**Very Important Guidelines****(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 12 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = 6 m (tar/rail)

Width with pavement of road/side of rail track = 10 m

**Plot Size: 50 × 12 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut (C) Yes/No
1	<i>Swietenia macrophylla</i>	217.20	10	23	L	No
2	<i>Carallia brachiata</i>	011.30	-	06	L	No
3	<i>Caryota urens</i>	038.40	-	09	L	No
4	<i>Caryota urens</i>	024.60	-	04	L	No
5	<i>Swietenia macrophylla</i>	116.50	10	18	L	No
6	<i>Swietenia macrophylla</i>	093.20	11	17	L	No
7	<i>Swietenia macrophylla</i>	149.10	05	20	L	No
8	<i>Artocarpus hirsutus</i>	020.20	-	02	L	No
9	<i>Racosperma mangium</i>	012.50	04	06	L	No
10	<i>Swietenia macrophylla</i>	099.20	04	16	L	No
11	<i>Morinda pubescens</i>	094.10	04	08	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a)North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Urena lobata</i> ssp. <i>lobata</i>	14	2	Thick	1			3.5			0.73			0.130			0.046		
			Medium		1			3.0			0.63			0.069			0.022	
	0.50%	0.40%	Thin															
<i>Sida acuta</i>	25	7	Thick	1			2.7			0.75			0.042			0.013		
			Medium		1			2.3			0.67			0.035			0.010	
	2.00%	0.50%	Thin			1			1.7			0.61			0.029			0.0008
<i>Lantana camara</i> var. <i>camara</i>	5	1	Thick	2			2.9			0.59			0.017			0.006		
			Medium															
	0.02%	0.01%	Thin															
<i>Hibiscus hispidissimus</i>	4	1	Thick	1			3.1			2.30			0.052			0.017		
			Medium															
	0.03%	0.02%	Thin															
<i>Pseudarthria viscida</i>	2	1	Thick	1			2.7			0.75			0.049			0.016		
			Medium															
	0.01%	0.01%	Thin															

(c)South-west Corner (5×5/0.1 ha plot).

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Chromolaena odorata</i>	35	6	Thick	1			0.9			2.30			0.067			0.021		
			Medium		1			0.5			1.44			0.035			0.010	
	4.00%	2.00%	Thin			1			0.2			0.26			0.003			0.0009
<i>Clerodendrum infortunatum</i>	4	2	Thick	1			1.8			1.65			0.189			0.055		
			Medium		1			0.7			0.75			0.023			0.004	
	0.02%	0.05%	Thin															
<i>Chassalia curviflora</i> var. <i>ophioxyloides</i>	2	1	Thick	1			0.9			0.61			0.013			0.005		
			Medium															
	0.01%	0.03%	Thin															
<i>Canthium travancoricum</i>	5	1	Thick	1			3.1			2.30			0.052			0.017		
			Medium															
	0.03%	0.02%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(a)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : **No Bamboo**

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : **No Bamboo**

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m)** (recorded epiphytes/lithophytes/climbers etc. also) Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.097 gm Dry Weight: 0.045 gm % Cover: 74

S.No.	Species	No. of individuals
1	<i>Cyclea peltata</i>	2
2	<i>Tragia involucrata</i>	1
3	<i>Mukia maderaspatana</i>	2
4	<i>Dioscorea alata</i>	3
5	<i>Mimosa pudica</i>	8
6	<i>Ageratum conyzoides</i>	5
7	<i>Alloteropsis cimicina</i>	12
8	<i>Synedrella nodiflora</i>	3

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.054 gm Dry Weight: 0.024 gm % Cover: 59

S.No.	Species	No. of individuals
1	<i>Alloteropsis cimicina</i>	10
2	<i>Ageratum conyzoides</i>	4
3	<i>Commelina benghalensis</i>	16
4	<i>Mimosa pudica</i>	11
5	<i>Achyranthes aspera</i> var. <i>aspera</i>	4

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.062 gm Dry Weight: 0.028gm % Cover: 64

S.No.	Species	No. of individuals
1	<i>Ruellia tuberosa</i>	2
2	<i>Achyranthes aspera</i> var. <i>aspera</i>	6
3	<i>Ageratum conyzoides</i>	5
4	<i>Laportea interrupta</i>	2
5	<i>Peperomia pellucida</i>	6
6	<i>Cyperus rotundus</i>	9

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.245	0.177	0.052	0.037	0.297	0.214
(b) NW	0.284	0.205	0.048	0.034	0.332	0.239
(c) SW	0.228	0.164	0.043	0.030	0.271	0.194
(d) SE	0.251	0.181	0.054	0.038	0.305	0.219



**Plot No. 4**

**Form 2A**

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Malappuram** GPS Point Name= **Beauty spot (Calicut University)**

Location/Road/Canal/Village: **Wasteland**

Site Centre Coordinates : **Lati. 11° 8' 34.80" Longi. 75° 53' 12.70"**

Sample Site/Plot No.: **T- 04** Date: **14/10/2009** Time: **11.20 AM**

G.P.S. Reading (HHDD:MM:SS and WGS 84): **Lati 11° 8' 34.80" Longi. 75° 53' 12.70"**

Observer: **Deepu Divakaran** Altitude: Site/Plot: **58 m**

Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)

Slope (°): **2°**

Photograph Number: **4253 to 4255**

Aspect : **N/E/S/W/NE/SE/SW/NW**

Topography General observations): **Hilly**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**TOF type:** Visual evidence of disturbance lopping/ fire/ cutting/grazing etc:

Top Canopy species: ***Gliricidia sepium, Falconeria insignis***

Ground Cover (%): **64%** Stoniness (%): **20%** Rock Put-crop(%): **15%**

Soil Type: **Rocky** Soil Texture : **Massive** Soil colour: **Yelloish Red**

Litter thickness: **0.2 cm** Humus Colour: **Nil** Humus thickness: -

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1320	1.2672	<b>3.1576</b>
0.15-0.30	1440	0.5184	
0.30-0.60	1400	0.8400	
0.60-1.00	1330	0.5320	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 8.5 + 8.5 + 7 = 8 m  
At the base of ultimate branching 1<sup>st</sup> : 4.5 + 4.5 + 3 = 4 m

**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 31.62 m × 31.62 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 31.62 × 31.62 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Gliricidia sepium</i>	23.2	3	5	L	No
2	<i>Gliricidia sepium</i>	21.3	-	4.5	L	No
3	<i>Gliricidia sepium</i>	20.4	-	3.5	L	No
4	<i>Gliricidia sepium</i>	24.5	-	4.5	L	No
5	<i>Gliricidia sepium</i>	25.2	-	5	L	No
6	<i>Gliricidia sepium</i>	23.6	-	5	L	No
7	<i>Gliricidia sepium</i>	21.7	-	3.5	L	No
8	<i>Gliricidia sepium</i>	24.4	-	4	L	No
9	<i>Gliricidia sepium</i>	28.3	2	5	L	No
10	<i>Gliricidia sepium</i>	18.1	-	5	L	No
11	<i>Gliricidia sepium</i>	17.2	-	3	L	No
12	<i>Gliricidia sepium</i>	15.1	-	4	L	No
13	<i>Gliricidia sepium</i>	18.2	-	4.5	L	No
14	<i>Gliricidia sepium</i>	17.1	-	3	L	No
15	<i>Gliricidia sepium</i>	23.2	-	4	L	No
16	<i>Gliricidia sepium</i>	18.4	-	4.5	L	No
17	<i>Gliricidia sepium</i>	26.6	3	5	L	No
18	<i>Gliricidia sepium</i>	15.7	-	3.5	L	No
19	<i>Gliricidia sepium</i>	23.9	-	4	L	No
20	<i>Gliricidia sepium</i>	25.8	-	5	L	No
21	<i>Gliricidia sepium</i>	25.6	-	3	L	No
22	<i>Gliricidia sepium</i>	20.4	-	3.5	L	No
23	<i>Gliricidia sepium</i>	17.3	-	4	L	No
24	<i>Gliricidia sepium</i>	18.2	2	4.5	L	No
25	<i>Gliricidia sepium</i>	16.1	2.5	5	L	No
26	<i>Gliricidia sepium</i>	22.4	2.5	4	L	No
27	<i>Gliricidia sepium</i>	23.5	3	5	L	No
28	<i>Gliricidia sepium</i>	24.6	2.75	6	L	No
29	<i>Gliricidia sepium</i>	18.7	3	5	L	No
30	<i>Gliricidia sepium</i>	20.8	1.5	4	L	No
31	<i>Gliricidia sepium</i>	15.6	2.25	4	L	No

32	<i>Gliricidia sepium</i>	12.9	3	6.5	L	No
33	<i>Gliricidia sepium</i>	20.1	4	5	L	No
34	<i>Gliricidia sepium</i>	22.2	3	4	L	No
35	<i>Gliricidia sepium</i>	18.3	3.5	4	L	No
36	<i>Gliricidia sepium</i>	17.4	2	5	L	No
37	<i>Gliricidia sepium</i>	44.5	1.75	6.5	L	No
38	<i>Gliricidia sepium</i>	58.6	1.55	7	L	No
39	<i>Macaranga peltata</i>	15.8	2.25	7	L	No
40	<i>Gliricidia sepium</i>	13.9	2	6	L	No
41	<i>Gliricidia sepium</i>	12.1	1.75	3.5	L	No
42	<i>Gliricidia sepium</i>	23.6	3.5	8.5	L	No
43	<i>Caryota urens</i>	84.7	-	8.5	L	No
44	<i>Macaranga peltata</i>	29.8	3	7	L	No
45	<i>Macaranga peltata</i>	34.7	-	2.25	L	No
46	<i>Falconeria insignis</i>	34.4	2	5	L	No
47	<i>Falconeria insignis</i>	41.3	2.25	5.5	L	No
48	<i>Falconeria insignis</i>	45.6	1.85	5.5	L	No
49	<i>Falconeria insignis</i>	19.7	1.5	2	L	No
50	<i>Falconeria insignis</i>	37.8	1.75	5.5	L	No
51	<i>Falconeria insignis</i>	23.3	-	2.5	L	No
52	<i>Falconeria insignis</i>	47.4	1.5	6	L	No
53	<i>Falconeria insignis</i>	22.5	-	6.5	L	No
54	<i>Falconeria insignis</i>	31.6	2	6	L	No
55	<i>Falconeria insignis</i>	20.4	3	4.5	L	No
56	<i>Falconeria insignis</i>	13.3	-	4	L	No
57	<i>Falconeria insignis</i>	33.1	2.25	6.5	L	No
58	<i>Falconeria insignis</i>	43.2	2.258	7	L	No
59	<i>Morinda pubescens</i>	26.2	2	5	L	No
60	<i>Alstonia scholaris</i>	23.3	2.5	3	L	Yes
61	<i>Macaranga peltata</i>	37.4	1.45	3	L	No
62	<i>Macaranga peltata</i>	23.4	-	2.5	L	Yes
63	<i>Macaranga peltata</i>	33.2	3.25	4.5	L	No
64	<i>Macaranga peltata</i>	129.1	1.85	3.5	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(A) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)				
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
<i>Calycopteris floribunda</i>	14	2	Thick	1			3.5			0.73			0.130			0.046			
			Medium		1			3.0			0.63			0.069			0.022		
	0.50%	0.40%	Thin																
<i>Clerodendrum infortunatum</i>	5	1	Thick	2			2.9			0.59			0.017			0.006			
			Medium																
	0.02%	0.01%	Thin																
<i>Canthium travancoricum</i>	2	1	Thick	1			2.7			0.75			0.049			0.016			
			Medium																
	0.006%	0.01%	Thin																
<i>Chromolaena odorata</i>	35	3	Thick	1			1.0			1.20			0.074			0.022			
			Medium		1			0.7			0.73			0.048			0.014		
	4%	1%	Thin			1			0.5			0.36			0.007			0.0020	

**(B) South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Chromolaena odorata</i>	35	6	Thick	1			0.9			2.30			0.067			0.021		
			Medium		1			0.5			1.44			0.035			0.010	
	4.00%	2.00%	Thin			1			0.2			0.26			0.003			0.0009
<i>Ziziphus oenoplia</i>	2	1	Thick	1			0.9			0.61			0.013			0.005		
			Medium															
	0.01%	0.03%	Thin															
<i>Canthium travancoricum</i>	2	1	Thick	1			3.1			2.30			0.052			0.017		
			Medium															
	0.006%	0.01%	Thin															
<i>Sida cordifolia</i>	25	7	Thick	1			2.7			0.75			0.042			0.013		
			Medium		1			2.3			0.67			0.035			0.010	
	2.00%	0.50%	Thin			1			1.7			0.61			0.029			0.0008
<i>Rauvolfia tetraphylla</i>	5	2	Thick	1			1.0			0.68			0.015			0.006		
			Medium		1			0.5			0.55			0.004			0.002	
	0.05%	0.1%	Thin															
<i>Lantana camara</i> var. <i>camara</i>	18	2	Thick	1			1.0			0.68			0.015			0.006		
			Medium		1			0.5			0.55			0.004			0.002	
	0.5%	0.1%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(a)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.067 gm Dry Weight: 0.030gm % Cover: 65

S.No.	Species	No. of individuals
1	<i>Naregamia alata</i>	5
2	<i>Desmodium triflorum</i>	15
3	<i>Mollugo pentaphylla</i>	20
4	<i>Mimosa pudica</i>	4
5	<i>Tragia involucrata</i>	2
6	<i>Desmodium motorium</i>	3
7	<i>Elephantopus scaber</i>	2

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.053 gm Dry Weight: 0.024 gm % Cover: 58

S.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	8
2	<i>Leucas aspera</i>	8
3	<i>Cynodon dactylon</i>	8
4	<i>Senna tora</i>	4
5	<i>Hemidesmus indicus</i> var. <i>indicus</i>	3
6	<i>Mimosa pudica</i>	2
7	<i>Ageratum conyzoides</i>	3

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.039 gm Dry Weight: 0.017gm % Cover: 51

S.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	6
2	<i>Senna tora</i>	5
3	<i>Mimosa pudica</i>	8
4	<i>Ageratum conyzoides</i>	2
5	<i>Leucas aspera</i>	2
6	<i>Naregamia alata</i>	1
7	<i>Mollugo pentaphylla</i>	4

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
<b>(a) NE</b>	0.075	0.055	0.009	0.007	0.084	0.062
<b>(b) NW</b>	0.079	0.058	0.008	0.006	0.087	0.064
<b>(c) SW</b>	0.069	0.050	0.007	0.005	0.076	0.055
<b>(d) SE</b>	0.073	0.053	0.007	0.005	0.080	0.058
<b>(e) Center</b>						

## FORMAT FOR TREES OUT-SIDE FOREST (TOF)

**CATEGORY 1: SITE AND OBSERVER**State: **Kerala** District: **Kozhikode** GPS Point Name: **Chemancheri**Location/Road/Canal/Village: **Railway track side (Chemancheri)**Site Centre Coordinates : **Lati. 11° 24' 20.48" Longi. 75° 43' 10.06"**Sample Site/Plot No.: **T- 05** Date: **14/10/2009** Time: **3.20 PM**G.P.S. Reading (HHDD:MM:SS and WGS 84): **Lati 11° 24' 20.48" Longi. 75° 43' 10.06"**Observer: **Deepu Divakaran** Altitude: Site/Plot: **28 m**Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)Slope (°): **0.1°**Photograph Number: **4264 to 4267**Aspect : **N ~~E/S/W/NE/SE/SW/NW~~**Topography General Observations): **Plane****CATEGORY 2: FOREST AND SOIL- GENERAL:****TOF type:** Linear Railway track side Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
Top Canopy species: ***Samanea saman*, *Terminalia catappa***Ground Cover (%): **85%** Stoniness (%): **10%** Rock Put-crop (%): **0%**Soil Type: **Sandy** Soil Texture : **Moderate** Soil colour: **Reddish brown**Litter thickness: **1cm** Humus Colour: **Gray** Humus thickness: **0.2 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1300	2.4765	<b>7.9674</b>
0.15-0.30	1370	0.9453	
0.30-0.60	1420	2.3856	
0.60-1.00	1350	2.1600	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)

NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 18+19+18 = 18.33 mAt the base of ultimate branching 1<sup>st</sup>: 8+7 + 8 = 7.66 m**Very Important Guidelines****(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width****(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/ scattered trees take one plot of 250×250 m)



**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 20 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = 1.8 m (tar/rail) Width with pavement of road/side of rail track = m

**Plot Size: 50 × 20 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Samanea saman</i>	105.5	4	18	L	No
2	<i>Terminalia catappa</i>	85.4	-	19	L	No
3	<i>Samanea saman</i>	120.2	4	18	L	No
4	<i>Samanea saman</i>	135.6	5.5	19	L	No
5	<i>Artocarpus heterophyllus</i>	47.8	5.5	13	L	No
6	<i>Psidium guajava</i>	36.7	2.25	8	L	No
7	<i>Psidium guajava</i>	37.4	1.4	7	L	No
8	<i>Psidium guajava</i>	28.1	1.45	8	L	No
9	<i>Tamarindus indica</i>	35.5	2	7	L	No
10	<i>Tamarindus indica</i>	33.3	1.5	8	L	No
11	<i>Tamarindus indica</i>	34.2	1.75	8	L	No
12	<i>Tamarindus indica</i>	30.1	2	8	L	No
13	<i>Tamarindus indica</i>	32.6	1.5	8	L	No
14	<i>Tamarindus indica</i>	28.7	2	7	L	No
15	<i>Albizia odoratissima</i>	75.9	3	14	L	No
16	<i>Mangifera indica</i>	30.1	2	4	L	No
17	<i>Mangifera indica</i>	25.3	2	4.5	L	No
18	<i>Mangifera indica</i>	27.2	1.5	4	L	No
19	<i>Albizia odoratissima</i>	55.1	3.5	15	L	No
20	<i>Albizia odoratissima</i>	75.1	3.5	17	L	No
21	<i>Albizia odoratissima</i>	60.2	4	16	L	No
22	<i>Albizia odoratissima</i>	63.4	7	15	L	No
23	<i>Samanea saman</i>	85.5	8	18	L	No
24	<i>Albizia odoratissima</i>	70.6	2.5	15	L	No
25	<i>Delonix regia</i>	71.8	2.5	14	L	No
26	<i>Delonix regia</i>	72.9	2.5	14	L	No
27	<i>Psidium guajava</i>	29.1	1.5	11	L	No
28	<i>Albizia odoratissima</i>	55.7	2	11	L	No
29	<i>Albizia odoratissima</i>	48.4	3	9	L	No
30	<i>Albizia odoratissima</i>	60.2	1.5	11	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Chromolaena odorata</i>	21	6	Thick	1			0.9			2.33			0.068			0.021		
			Medium		1			0.6			1.45			0.037			0.012	
	0.50%	1%	Thin			1			0.3			0.29			0.004			0.001
<i>Hibiscus hispidissimus</i>	18	4	Thick	1			2.5			1.60			0.068			0.022		
			Medium		1			2.3			1.35			0.038			0.017	
	0.05%	0.1%	Thin			1			1.3			0.80			0.011			0.005
<i>Chassalia curviflora</i> var. <i>ophioxyloides</i>	12	3	Thick	1			2.8			1.15			0.095			0.027		
			Medium		1			2.1			0.95			0.083			0.023	
	0.03%	0.08%	Thin			1			1.9			0.85			0.051			0.013
<i>Urena lobata</i> ssp. <i>lobata</i>	28	6	Thick	1			1.1			0.55			0.010			0.003		
			Medium		1			1.0			0.55			0.009			0.002	
	0.08%	0.1%	Thin			1			0.7			0.51			0.004			0.001
<i>Ziziphus oenoplia</i>	10	6	Thick	1			2.1			0.70			0.068			0.027		
			Medium		1			1.9			0.60			0.032			0.013	
	0.001%	0.003%	Thin			1			1.3			0.35			0.010			0.004

(c)South-west Corner (5×5/0.1 ha plot) Plot Size: .....

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Chassalia curviflora</i> var. <i>ophioxyloides</i>	12	4	Thick	1			2.9			1.25			0.099			0.029		
			Medium		1		2.2				1.00			0.085			0.024	
	0.03%	0.08%	Thin			1			1.8			0.80			0.048			0.012
<i>Ziziphus oenoplia</i>	10	4	Thick	1			1.1			1.00			0.072			0.021		
			Medium		1		0.9				0.70			0.041			0.012	
	0.001%	0.003%	Thin			1			0.7			0.51			0.005			0.001
<i>Sida acuta</i>	18	2	Thick	1			0.9			0.70			0.020			0.007		
			Medium		1		0.4				0.36			0.011			0.003	
	0.02%	0.01%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(A)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.087 gm Dry Weight: 0.038 gm % Cover: 76 %

S.No.	Species	No. of individuals
1	<i>Ruellia tuberosa</i>	5
2	<i>Phyllanthus amarus</i>	2
3	<i>Justicia japonica</i>	6
4	<i>Mukia maderaspatana</i>	2
5	<i>Vernonia cinerea</i>	2
6	<i>Tridax procumbens</i>	3
7	<i>Commelina benghalensis</i>	12
8	<i>Mitracarpus hirtus</i>	8

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.073 gm Dry Weight: 0.032 gm % Cover: 70 %

S.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	3
2	<i>Leucas aspera</i>	3
3	<i>Tridax procumbens</i>	8
4	<i>Senna tora</i>	4
5	<i>Mitracarpus hirtus</i>	13
6	<i>Mimosa pudica</i>	2
7	<i>Ageratum conyzoides</i>	3

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.069 gm Dry Weight: 0.030 gm % Cover: 68 %

S.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	6
2	<i>Senna tora</i>	3
3	<i>Mimosa pudica</i>	8
4	<i>Ageratum conyzoides</i>	2
5	<i>Leucas aspera</i>	2
6	<i>Mitracarpus hirtus</i>	11
7	<i>Vernonia cinerea</i>	3

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.153	0.111	0.042	0.033	0.195	0.144
(b) NW	0.147	0.108	0.037	0.029	0.184	0.137
(c) SW	0.138	0.101	0.032	0.025	0.170	0.126
(d) SE	0.129	0.093	0.030	0.023	0.159	0.116
(e) Center						

VCP – IGBP

FORMAT FOR TREES OUT-SIDE FOREST (TOF)

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Kozhikode** GPS Point Name: **Kottapally-Veliyarmuthu**  
 Location/Road/Canal/Village: **Canal bund**  
 Site Centre Coordinates : **Lati. 11° 35' 50.10" Longi. 75° 39' 51.34"**  
 Sample Site/Plot No.: **T- 06** Date: **15/10/2009** Time: **9.30 AM**  
 G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 11° 35' 50.10" Longi. 75° 39' 51.34"**  
 Observer: **Deepu Divakaran** Altitude: Site/Plot: **110 m**  
 Marking on image: (Google/1:25,000 or larger)  
 (Tonal characteristics)  
 Slope (°): **0.2°** Photograph Number: **4273 to 4276**  
 Aspect : **N/E/S/W/NE/SE/SW /NW** Topography General observations): **Paddy field**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**TOF type:** Linear Canal bund medium Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
 Top Canopy species: **Racosperma auriculiforme, Paraserianthes falcataria**  
 Ground Cover (%): **55%** Stoniness (%): **2%** Rock Put-crop(%): **0%**  
 Soil Type: **Lateritic** Soil Texture : **Moderate** Soil colour: **Reddish Brown**  
 Litter thickness: **0.5 cm** Humus Colour: **Pale brown** Humus thickness: **0.1 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1360	3.2232	<b>8.2176</b>
0.15-0.30	1380	2.4840	
0.30-0.60	1400	1.8480	
0.60-1.00	1380	0.6624	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
 NW-SE: Steps: Hits: (Sky/Canopy)  
 Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 10+9+7 = 8.67 m  
 At the base of ultimate branching 1<sup>st</sup> : 6.5+6.5 + 6 = 6.33 m

**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × ..... m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 34 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = 14 m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 50 × 34 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Racosperma auriculiforme</i>	52.3	2	5	L	No
2	<i>Racosperma auriculiforme</i>	46.5	1.5	6.5	L	No
3	<i>Racosperma auriculiforme</i>	29.4	2	4	L	No
4	<i>Racosperma auriculiforme</i>	43.7	3	5.5	L	No
5	<i>Macaranga peltata</i>	59.9	5	7	L	No
6	<i>Racosperma auriculiforme</i>	70.6	2	10	L	No
7	<i>Racosperma auriculiforme</i>	70.3	2	9	L	No
8	<i>Paraserianthes falcataria</i>	36.1	2	6.5	L	No
9	<i>Paraserianthes falcataria</i>	22.5	1.75	3.5	L	No
10	<i>Paraserianthes falcataria</i>	37.3	1.95	4	L	No
11	<i>Paraserianthes falcataria</i>	13.4	-	2	L	Yes
12	<i>Paraserianthes falcataria</i>	43.7	1.45	6.5	L	No
13	<i>Paraserianthes falcataria</i>	39.2	2	6	L	No
14	<i>Paraserianthes falcataria</i>	38.9	1.95	6	L	No
15	<i>Paraserianthes falcataria</i>	21.1	2.5	2.75	L	No
16	<i>Paraserianthes falcataria</i>	31.5	2.25	5.5	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm )			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Chromolaena odorata</i>	8	4	Thick	1			0.9			2.33			0.068			0.021		
			Medium		1		0.6				1.4			0.037			0.012	
	0.01%	0.1%	Thin			1			0.3			0.29			0.004			0.001
<i>Passiflora foetida</i> var. <i>foetida</i>	1	1	Thick	1			2.5			1.60			0.068			0.022		
			Medium															
	0.001%	0.0%	Thin															
<i>Ixora finlaysoniana</i>	2	1	Thick	1			1.1			0.55			0.010			0.003		
			Medium															
	0.001%	0.1%	Thin															
<i>Ziziphus oenoplia</i>	5	1	Thick	1			2.1			0.70			0.068			0.027		
			Medium															
	0.0006%	0.001 %	Thin															



(c)South-west Corner (5×5/0.1 ha plot).

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Clerodendrum infortunatum</i>	12	4	Thick	1			2.9			1.25			0.099			0.029		
			Medium		1			2.2			1.00			0.085			0.024	
	0.03%	0.08%	Thin			1			1.8			0.80			0.048			0.012
<i>Ziziphus oenoplia</i>	5	2	Thick	1			1.1			1.00			0.072			0.021		
			Medium		1			0.9			0.70			0.041			0.012	
	0.0006%	0.002%	Thin															
<i>Ixora finlaysoniana</i>	2	1	Thick	1			0.9			0.70			0.020			0.007		
			Medium															
	0.001%	0.1%	Thin															
<i>Chromolaena odorata</i>	8	3	Thick	1			0.9			2.30			0.067			0.021		
			Medium		1			0.5			1.44			0.035			0.010	
	0.01%	0.09%	Thin			1			0.2			0.26			0.003			0.0009
<i>Solanum torvum</i>	4	2	Thick	1			1.1			0.55			0.010			0.003		
			Medium		1			1.0			0.55			0.009			0.002	
	0.02%	0.1%	Thin															
<i>Tinospora cordifolia</i>	2	1	Thick	1			0.9			0.28			0.004			0.001		
			Medium															
	0.001%	0.01%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)

**(a) North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.159 gm Dry Weight: 0.070 gm % Cover: 79 %

S.No.	Species	No. of individuals
1	<i>Centella asiatica</i>	15
2	<i>Phyllanthus amarus</i>	2
3	<i>Justicia japonica</i>	15
4	<i>Elephantopus scaber</i>	4
5	<i>Emilia sonchifolia</i>	1
6	<i>Mimosa pudica</i>	2
7	<i>Desmodium triflorum</i>	20
8	<i>Mitracarpus hirtus</i>	4
9	<i>Alloteropsis cimicina</i>	30

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.193 gm Dry Weight: 0.084 gm % Cover: 85 %

S.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	8
2	<i>Centella asiatica</i>	6
3	<i>Vernonia cinerea</i>	3
4	<i>Desmodium triflorum</i>	50
5	<i>Alloteropsis cimicina</i>	60
6	<i>Mitracarpus hirtus</i>	2
7	<i>Phyllanthus amarus</i>	5
8	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	20
9	<i>Amorphophallus commutatus</i>	2

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.139 gm Dry Weight: 0.060 gm % Cover: 73 %

S.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	6
2	<i>Desmodium triflorum</i>	13
3	<i>Mimosa pudica</i>	8
4	<i>Mitracarpus hirtus</i>	8
5	<i>Alloteropsis cimicina</i>	22
6	<i>Justicia japonica</i>	11
7	<i>Vernonia cinerea</i>	3

Litter in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.095	0.069	0.030	0.023	0.125	0.092
(b) NW	0.098	0.072	0.028	0.022	0.126	0.094
(c) SW	0.087	0.062	0.029	0.023	0.116	0.085
(d) SE	0.091	0.066	0.031	0.024	0.122	0.090
(e) Center						

## FORMAT FOR TREES OUT-SIDE FOREST (TOF)

**CATEGORY 1: SITE AND OBSERVER**State: **Kerala** District: **Kozhikode** GPS Point Name: **Pathiyarakara (Bank road)**Location/Road/Canal/Village: **Linear - Minor canal**Site Centre Coordinates : **Lati. 11° 35' 8.88" Longi. 75° 37' 37.92"**Sample Site/Plot No.: **T- 07** Date: **15/10/2009** Time: **11.30 PM**G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 11° 35' 8.88" Longi. 75° 37' 37.92"**Observer: **Deepu Divakaran** Altitude: Site/Plot: **20 m**Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)Slope (°): **0.1°**Photograph Number: **4281 to 4284**Aspect : **N/E/S/W/NE/SE/SW/NW**Topography General observations): **Hilly area****CATEGORY 2: FOREST AND SOIL- GENERAL:****TOF type:** Linear - Minor canal Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
Top Canopy species: *Macaranga peltata*Ground Cover (%): **80%**Stoniness (%): **0%**Rock Put-crop(%): **0%**Soil Type: **Lataeritic** Soil Texture : **Medium**Soil colour: **Reddish Yellow**Litter thickness: **0.5cm**Humus Colour: **Pale brown**Humus thickness: **0.1 cm**

Depth (M)	Bulk Density (Kg/m <sup>3</sup> )	Organic carbon (Kg)	Carbon mass (Kg/m <sup>2</sup> )
0.00-0.15	1300	1.9500	<b>11.9464</b>
0.15-0.30	1370	1.8084	
0.30-0.60	1400	3.6120	
0.60-1.00	1430	4.5760	

**CATEGORY 3: QUANTITATIVE MEASUREMENTS**Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
NW-SE: Steps: Hits: (Sky/Canopy)Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 6+7+ = 6.5 m

At the base of ultimate branching

1<sup>st</sup>: ++ = m**Very Important Guidelines****(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × ..... m width****(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 8 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = 2.5 m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 50 × 8 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Macaranga peltata</i>	45.2	3	6	L	No
2	<i>Macaranga peltata</i>	60.3	2.5	7	L	No
3	<i>Cycas circinalis</i>	55.1	-	0.5	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Clerodendrum infortunatum</i>	8	4	Thick	1			1.2			1.35			0.143			0.045		
			Medium		1			0.8			1.00			0.073			0.023	
	0.02%	0.2%	Thin			1			0.5			0.45			0.019			0.006
<i>Ocimum americanum</i>	5	3	Thick	1			0.9			1.15			0.125			0.029		
			Medium		1			0.7			0.85			0.048			0.011	
	0.01%	1%	Thin			1			0.5			0.42		0.006				0.001
<i>Chromolaena odorata</i>	26	3	Thick	1			1.0			1.20			0.072			0.021		
			Medium		1			0.7			0.07			0.044			0.013	
	0.08%	1.0%	Thin			1			0.5			0.36			0.006			0.001
<i>Cyclea peltata</i>	3	1	Thick	1			0.8			0.61			0.005			0.001		
			Medium															
	0.001%	0.01%	Thin															
<i>Sida cordifolia</i>	8	2	Thick	1			0.8			0.64			0.014			0.005		
			Medium		1			0.5			0.32			0.010			0.003	
	0.01%	0.1%	Thin															
<i>Urena lobata ssp. lobata</i>	10	2	Thick	1			1.1			0.55			0.010			0.003		
			Medium		1			1.0			0.55			0.009			0.002	
	0.01%	0.1%	Thin			1			0.7			0.51		0.004				0.001
<i>Cissus latifolia</i>	2	1	Thick	1			2.6			1.35			0.115			0.046		
			Medium															
	0.001%	0.1%	Thin															

**(c)South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Clerodendrum infortunatum</i>	8	1	Thick	1			0.7			0.51			0.005			0.001		
			Medium															
	0.02%	0.1%	Thin															
<i>Glycosmis pentaphylla</i>	91	4	Thick	1			1.0			1.25			0.139			0.048		
			Medium		1			0.9			0.95			0.075			0.026	
	4.5%	1%	Thin			1			0.5			0.37			0.015			0.005
<i>Sida cordifolia</i>	8	2	Thick	1			0.8			0.68			0.018			0.006		
			Medium		1			0.5			0.38			0.013			0.004	
	0.01%	0.1%	Thin															
<i>Chromolaena odorata</i>	26	3	Thick	1			1.1			1.29			0.080			0.024		
			Medium		1			0.9			0.85			0.053			0.016	
	0.08%	1.0%	Thin			1			0.7			0.49			0.012			0.004
<i>Hibiscus hispidissimus</i>	4	1	Thick	2			3.2			2.40			0.049			0.016		
			Medium															
	0.03%	0.02%	Thin															
<i>Cissus latifolia</i>	2	1	Thick	2			2.5			0.65			0.046			0.015		
			Medium															
	0.001%	0.1%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(A)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.199 gm Dry Weight: 0.086 gm % Cover: 83 %

S.No.	Species	No. of individuals
1	<i>Cardiospermum halicacabum</i>	2
2	<i>Eclipta prostrata</i> var. <i>prostrata</i>	3
3	<i>Justicia japonica</i>	18
4	<i>Scoparia dulcis</i>	1
5	<i>Mimosa pudica</i>	12
6	<i>Desmodium triflorum</i>	76
7	<i>Mitracarpus hirtus</i>	6
8	<i>Naregamia alata</i>	1
9	<i>Synedrella nodiflora</i>	1
10	<i>Amomum</i> sp.	1
11	<i>Elephantopus scaber</i>	20
12	<i>Alloteropsis cimicina</i>	15



**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.123 gm Dry Weight: 0.052 gm % Cover: 72 %

S.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	3
2	<i>Commelina benghalensis</i>	6
3	<i>Ageratum conyzoides</i>	3
4	<i>Desmodium triflorum</i>	12
5	<i>Mitracarpus hirtus</i>	2
6	<i>Phyllanthus amarus</i>	3
7	<i>Caladium bicolor</i>	1
8	<i>Synedrella nodiflora</i>	1
9	<i>Mimosa pudica</i>	4
10	<i>Centella asiatica</i>	6

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.142 gm Dry Weight: 0.061 gm % Cover: 74 %

S.No.	Species	No. of individuals
1	<i>Centella asiatica</i>	8
2	<i>Elephantopus scaber</i>	6
3	<i>Desmodium triflorum</i>	13
4	<i>Vernonia cinerea</i>	3
5	<i>Mimosa pudica</i>	8
6	<i>Mitracarpus hirtus</i>	8
7	<i>Justicia japonica</i>	11
8	<i>Alloteropsis cimicina</i>	22

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
<b>(a) NE</b>	0.089	0.065	0.025	0.020	0.114	0.085
<b>(b) NW</b>	0.079	0.058	0.023	0.018	0.102	0.076
<b>(c) SW</b>	0.081	0.060	0.019	0.015	0.100	0.075
<b>(d) SE</b>	0.073	0.053	0.027	0.021	0.100	0.074
<b>(e) Center</b>						

**Plot No.8.**

**VCP – IGBP**

**Form 2A**

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Kozhikode** GPS Point Name: **Canoli canal**  
 Location/Road/Canal/Village: **Canoli canal**  
 Site Centre Coordinates : **Lati. 11° 15' 57.64" Longi. 75° 47' 40.42"**  
 Sample Site/Plot No.: **T- 08** Date: **15/10/2009** Time: **4.15 PM**  
 G.P.S. Reading (HHDD:MM:SS and WGS 84): **Lati 11° 15' 57.64" Longi. 75° 47' 40.42"**  
 Observer: **Deepu Divakaran** Altitude: Site/Plot: **15 m**  
 Marking on image: (Google/1:25,000 or larger)  
 (Tonal characteristics)  
 Slope (°): **0.1°** Photograph Number: **4285 to 4288**  
 Aspect : ~~N/E/S/W/NE/SE/SW/NW~~ Topography General observations): **Plane**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**TOF type:** Linear Major Canal Side Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: Nil  
 Top Canopy species: *Macaranga peltata*, *Samanea saman*, *Albizia odoratissima*  
 Ground Cover(%): **65%** Stoniness(%): **0%** Rock Put-crop(%): **0%**  
 Soil Type: **Lateritic** Soil Texture : **Medium** Soil colour: **Reddish Yellow**  
 Litter thickness: **1cm** Humus Colour: **Pale Brown** Humus thickness: **0.1 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1230	2.2509	<b>10.3428</b>
0.15-0.30	1300	1.6575	
0.30-0.60	1340	3.0552	
0.60-1.00	1320	3.3792	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
 NW-SE: Steps: Hits: (Sky/Canopy)  
 Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 10+9+9 = 9.33 m  
 At the base of ultimate branching 1<sup>st</sup>: 4.5+3.5 + 4.5 = 4.16 m

**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 6 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = 25 m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 50 × 6 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Macaranga peltata</i>	35.2	-	5.5	L	No
2	<i>Macaranga peltata</i>	30.1	-	5	L	No
3	<i>Macaranga peltata</i>	33.3	-	5.5	L	No
4	<i>Macaranga peltata</i>	28.4	-	5	L	No
5	<i>Ficus tsjahela</i>	33.7	-	4.5	L	No
6	<i>Ficus tsjahela</i>	25.5	-	4.5	L	No
7	<i>Macaranga peltata</i>	38.4	2	4	L	No
8	<i>Samanea saman</i>	55.1	2	5.5	L	No
9	<i>Samanea saman</i>	130.2	1.5	10	L	No
10	<i>Samanea saman</i>	85.6	2.5	9	L	No
11	<i>Albizia odoratissima</i>	23.8	-	4.5	L	No
12	<i>Albizia odoratissima</i>	25.9	-	4.5	L	No
13	<i>Albizia odoratissima</i>	32.4	2.5	8.5	L	No
14	<i>Macaranga peltata</i>	35.5	3.5	8.5	L	No
15	<i>Macaranga peltata</i>	28.2	2.25	5	L	No
16	<i>Macaranga peltata</i>	23.8	2.5	3.5	L	No
17	<i>Macaranga peltata</i>	37.9	4.5	9	L	No
18	<i>Macaranga peltata</i>	27.0	-	4	L	No
19	<i>Macaranga peltata</i>	31.3	4.5	7	L	No
20	<i>Macaranga peltata</i>	33.6	3	4.5	L	No
21	<i>Lannea coromandelica</i>	36.7	1.5	3	L	No
22	<i>Lannea coromandelica</i>	30.4	-	2.5	L	No
23	<i>Lannea coromandelica</i>	28.2	-	2.5	L	No
24	<i>Paraserianthes falcataria</i>	75.1	2	9	L	No
25	<i>Macaranga peltata</i>	32.1	-	5	L	No
26	<i>Macaranga peltata</i>	33.4	-	5.4	L	No
27	<i>Macaranga peltata</i>	28.2	-	4.5	L	No
28	<i>Macaranga peltata</i>	24.3	-	3	L	No
29	<i>Macaranga peltata</i>	31.3	-	4	L	No

**Shrubs in 5×5m in a plot of 50× 20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Derris scandens</i>	4	1	Thick	1			0.9			1.17			0.134			0.047		
			Medium															
	0.001%	0.1%	Thin															
<i>Chromolaena odorata</i>	26	4	Thick	1			0.9			2.30			0.067			0.021		
			Medium		1			0.5		1.44			0.035			0.010		
	2%	1%	Thin			1			0.2		0.26			0.003			0.0009	
<i>Stachytarpheta jamaicensis</i>	18	2	Thick	1			1.8			1.65			0.189			0.055		
			Medium		1			0.7		0.75			0.023			0.004		
	0.5%	0.1%	Thin															
<i>Centrosema molle</i>	4	1	Thick	1			0.6			0.32			0.006			0.003		
			Medium															
	0.05%	0.1%	Thin															
<i>Passiflora foetida</i> var. <i>foetida</i>	6	1	Thick	1			0.4			0.23			0.004			0.001		
			Medium															
	0.05%	0.1%	Thin															

(c) South-west Corner (5×5/0.1 ha plot).

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Triumfetta rhomboidea</i>	14	3	Thick	1			1.0			1.25			0.141			0.044		
			Medium		1			0.9			1.12			0.079			0.025	
	0.5%	2%	Thin			1			0.5			0.45			0.021			0.007
<i>Achyranthes aspera</i> var. <i>aspera</i>	23	6	Thick	1			0.8			1.05			0.121			0.029		
			Medium		1			0.6			0.75			0.043			0.010	
	2.00%	2%	Thin			1			0.4			0.32			0.005			0.0010
<i>Ziziphus oenoplia</i>	8	1	Thick	1			0.7			0.51			0.004			0.001		
			Medium															
	0.001%	0.01%	Thin															
<i>Urena lobata</i> ssp. <i>lobata</i>	18	1	Thick	1			0.5			0.38			0.010			0.003		
			Medium															
	0.04%	0.01%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)

**(a)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× ... m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**((A) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.154 gm Dry Weight: 0.066 gm % Cover: 71 %

S.No.	Species	No. of individuals
1	<i>Mimosa pudica</i>	8
2	<i>Scoparia dulcis</i>	4
3	<i>Pennisetum polystachyon</i>	18
4	<i>Commelina benghalensis</i>	14
5	<i>Desmodium triflorum</i>	12
6	<i>Amomum</i> sp.	4
7	<i>Alternanthera bettzickiana</i>	24

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.102 gm Dry Weight: 0.044 gm % Cover: 63 %

S.No.	Species	No. of individuals
1	<i>Synedrella nodiflora</i>	3
2	<i>Commelina benghalensis</i>	16
3	<i>Ageratum conyzoides</i>	2
4	<i>Desmodium triflorum</i>	8
5	<i>Mitracarpus hirtus</i>	2
6	<i>Phyllanthus amarus</i>	3
7	<i>Elephantopus scaber</i>	3
8	<i>Mimosa pudica</i>	4

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.091 gm Dry Weight: 0.039 gm % Cover: 58 %

S.No.	Species	No. of individuals
1	<i>Axonopus compressus</i>	18
2	<i>Elephantopus scaber</i>	2
3	<i>Mimosa pudica</i>	10
4	<i>Vernonia cinerea</i>	3
5	<i>Alloteropsis cimicina</i>	17
6	<i>Mitracarpus hirtus</i>	2
7	<i>Justicia japonica</i>	3

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.082	0.061	0.022	0.017	0.104	0.078
(b) NW	0.076	0.055	0.029	0.023	0.105	0.078
(c) SW	0.069	0.051	0.021	0.017	0.09	0.068
(d) SE	0.065	0.047	0.018	0.014	0.083	0.061
(e) Center						

Plot No.9.

VCP – IGBP

Form 2A

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Malappuram** GPS Point Name: **Cherukara**

Location/Road/Canal/Village: **Cherukara (Pattambi – Perumthalmanna)**

Site Centre Coordinates : **Lati. 10° 55' 29.50" Longi. 76° 13' 16.90"**

Sample Site/Plot No.: **T- 09** Date: **14/10/2009** Time: **3.20 PM**

G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 10° 55' 29.50" Longi. 76° 13' 16.90"**

Observer: **Deepu Divakaran** Altitude: Site/Plot: **40 m**

Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)

Slope (°): **0.5°** Photograph Number: **4301 to 4304**

Aspect : ~~N/E/S/W/NE/SE/SW/NW~~ Topography General observations): **Hilly**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**TOF type:** Linear Road (SH) side Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
**Top Canopy species:** ***Swietenia macrophylla, Terminalia catappa***

Ground Cover (%): **73%** Stoniness (%): **0%** Rock Put-crop(%): **0%**

Soil Type: **Lateritic** Soil Texture : **Medium** Soil colour: **Yellowish Red**

Litter thickness: **0.5cm** Humus Colour: **Pale brown** Humus thickness: **0.1 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1240	2.6598	<b>11.1183</b>
0.15-0.30	1270	2.3813	
0.30-0.60	1320	3.8412	
0.60-1.00	1300	2.2360	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) ( sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 18+17+15 = 16.66 m  
At the base of ultimate branching 1<sup>st</sup> : + + = m



**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × ..... m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 24 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = 8 m (tar/rail)

Width with pavement of road/side of rail track = 12 m

**Plot Size: 50 × 24 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Swietenia macrophylla</i>	190.2	5	18	L	No
2	<i>Swietenia macrophylla</i>	144.4	6	17	L	No
3	<i>Terminalia catappa</i>	144.1	-	15	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Calycopteris floribunda</i>	2	1	Thick	1			1.2			1.35			0.143			0.045		
			Medium															
	0.001%	1.0%	Thin															
<i>Chromolaena odorata</i>	39	3	Thick	1			1.0			1.20			0.072			0.021		
			Medium		1			0.7			0.07			0.044			0.013	
	3%	1.0%	Thin			1			0.5			0.36			0.006			0.001
<i>Urena lobata ssp. lobata</i>	8	1	Thick	1			0.8			0.61			0.005			0.001		
			Medium															
	0.001%	0.50%	Thin															
<i>Sida cordifolia</i>	28	2	Thick	1			0.8			0.64			0.014			0.005		
			Medium		1			0.5			0.32			0.010			0.003	
	0.50%	0.4%	Thin															

**(c)South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Tiliacora acuminata</i>	8	1	Thick	1			0.7			0.51			0.005			0.001		
			Medium															
	1.000%	0.50%	Thin															
<i>Lantana camara var. camara</i>	23	3	Thick	1			1.0			0.81			0.015			0.004		
			Medium		1			0.6		0.74			0.008			0.002		
	2%	1.5%	Thin			1			0.3		0.49			0.005			0.001	
<i>Ocimum gratissimum</i>	21	4	Thick	1			1.0			1.25			0.139			0.048		
			Medium		1			0.9		0.95			0.075			0.026		
	3.0%	2%	Thin			1			0.5		0.37			0.015			0.005	
<i>Sida acuta</i>	28	2	Thick	1			0.8			0.68			0.018			0.006		
			Medium		1			0.5		0.38			0.013			0.004		
	2.00%	0.10%	Thin															
<i>Chromolaena odorata</i>	39	6	Thick	1			1.1			1.29			0.080			0.024		
			Medium		1			0.9		0.85			0.053			0.016		
	3%	2.0%	Thin			1			0.7		0.49			0.012			0.004	
<i>Canthium travancoricum</i>	8	1	Thick	1			0.9			2.33			0.068			0.021		
			Medium															
	0.50%	0.1%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(a)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.178 gm Dry Weight: 0.076 gm % Cover: 75 %

S.No.	Species	No. of individuals
1	<i>Boerhavia diffusa</i>	8
2	<i>Mitracarpus hirtus</i>	4
3	<i>Centella asiatica</i>	6
4	<i>Ageratum conyzoides</i>	3
5	<i>Eclipta prostrata</i> var. <i>prostrata</i>	12
6	<i>Synedrella nodiflora</i>	4
7	<i>Phyllanthus amarus</i>	3
8	<i>Vernonia cinerea</i>	2
9	<i>Cynodon dactylon</i>	8
10	<i>Biophytum sensitivum</i> var. <i>sensitivum</i>	2
11	<i>Alternanthera bettzickiana</i>	4

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.125 gm Dry Weight: 0.054 gm % Cover: 69 %

S.No.	Species	No. of individuals
1	<i>Lindernia ciliata</i>	8
2	<i>Mitracarpus hirtus</i>	3
3	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	12
4	<i>Stachytarpheta jamaicensis</i>	2
5	<i>Phyllanthus amarus</i>	2
6	<i>Mimosa pudica</i>	3
7	<i>Mollugo pentaphylla</i>	3
8	<i>Emilia sonchifolia</i>	2

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.109 gm Dry Weight: 0.047 gm % Cover: 62 %

S.No.	Species	No. of individuals
1	<i>Axonopus compressus</i>	8
2	<i>Elephantopus scaber</i>	2
3	<i>Mimosa pudica</i>	10
4	<i>Vernonia cinerea</i>	3
5	<i>Lindernia ciliata</i>	12
6	<i>Mitracarpus hirtus</i>	4
7	<i>Justicia japonica</i>	3
8	<i>Synedrella nodiflora</i>	2

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.073	0.054	0.019	0.015	0.092	0.069
(b) NW	0.079	0.057	0.022	0.017	0.101	0.074
(c) SW	0.071	0.052	0.024	0.019	0.095	0.071
(d) SE	0.065	0.048	0.016	0.012	0.081	0.060
(e) Center						

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)****CATEGORY 1: SITE AND OBSERVER**State: **Kerala** District: **Malappuram** GPS Point Name: **Perumthalmanna**Location/Road/Canal/Village: **Perumthalmanna (Town)**Site Centre Coordinates : **Lati. 10° 58' 43.21" Longi. 76° 13' 32.23"**Sample Site/Plot No.: **T- 10** Date: **16/10/2009** Time: **12.15 PM**G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 10° 58' 43.21" Longi. 76° 13' 32.23"**Observer: **Deepu Divakaran** Altitude: Site/Plot: **50 m**Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)Slope (°): **0.5°**Photograph Number: **4308 to 4311**Aspect : **N ~~E/S/W/NE/SE/SW/NW~~**Topography General Observations): **Plane****CATEGORY 2: FOREST AND SOIL- GENERAL:****TOF type:** Linear Road side (Town) Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
Top Canopy species: ***Samanea saman, Terminalia catappa,***Ground Cover (%): **15%**Stoniness(%): **0%**Rock Put-crop(%): **0%**Soil Type: **Lateritic** Soil Texture : **Medium**Soil colour: **Dark brown**Litter thickness: **0.1cm**Humus Colour: **Nil**Humus thickness: **Nil**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1260	3.5154	<b>8.5384</b>
0.15-0.30	1320	2.0790	
0.30-0.60	1380	1.6560	
0.60-1.00	1400	1.2880	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
NW-SE: Steps: Hits: (Sky/Canopy)Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 20+18+14 = 17.33 m

At the base of ultimate branching

1<sup>st</sup>: + + = m

**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 21 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = 10 m (tar/rail)

Width with pavement of road/side of rail track = 4 m

**Plot Size: 50 × 21 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Samanea saman</i>	264.3	1.5	20	L	No
2	<i>Samanea saman</i>	185.9	1.75	18	L	No
3	<i>Terminalia catappa</i>	85.2	2	14	L	No
4	<i>Gliricidia sepium</i>	55.1	3	12	L	No
5	<i>Pongamia pinnata</i>	57.4	3.25	8.5	L	No

**Shrubs in 5×5m in a plot of 50× 20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(A) North-East Corner (5×5m/0.1 ha plot). Nil**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick															
			Medium															
			Thin															

**(C) South-west Corner (5×5/0.1 ha plot). Nil**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick															
			Medium															
			Thin															



**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(A)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**((a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.021 gm Dry Weight: 0.009 gm % Cover: 12 %

S.No.	Species	No. of individuals
1	<i>Ageratum conyzoides</i>	2
2	<i>Commelina benghalensis</i>	2
3	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	2
4	<i>Mollugo pentaphylla</i>	2
5	<i>Vernonia cinerea</i>	1

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.015 gm Dry Weight: 0.006 gm % Cover: 8 %

S.No.	Species	No. of individuals
1	<i>Commelina benghalensis</i>	3
2	<i>Mollugo pentaphylla</i>	1
3	<i>Cyperus rotundus ssp. rotundus</i>	2

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.011 gm Dry Weight: 0.004 gm % Cover: 5 %

S.No.	Species	No. of individuals
1	<i>Vernonia cinerea</i>	1
2	<i>Lindernia ciliata</i>	3

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.014	0.010	-	-	0.014	0.010
(b) NW	0.016	0.012	-	-	0.016	0.012
(c) SW	0.021	0.016	-	-	0.021	0.016
(d) SE	0.018	0.013	-	-	0.018	0.013
(e) Center						

**Plot No.11**

VCP – IGBP

Form 2A

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Kannur** GPS Point Name: **Chalakunnu**

Location/Road/Canal/Village: **Chalakunnu**

Site Centre Coordinates : **Lati. 11° 51' 41.85" Longi. 75° 24' 46.38"**

Sample Site/Plot No.: **T- 11** Date: **17/11/2009** Time: **11.45 AM**

G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 11° 51' 41.85" Longi. 75° 24' 46.38"**

Observer: **Deepu Divakaran** Altitude: Site/Plot: **40 m**

Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)

Slope (°): **5°** Photograph Number:

Aspect : ~~N/E/S/W/NE/SE/SW/NW~~ Topography General Observations): **Hilly**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**TOF type:** Acacia plantation Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**

Top Canopy species: ***Racosperma auriculiforme***

Ground Cover (%): **85%** Stoniness (%): **0%** Rock Put-crop (%): **0%**

Soil Type: **Lateritic** Soil Texture : **Medium** Soil colour: **Reddish Brown**

Litter thickness: **2 cm** Humus Colour: **Pale Brown** Humus thickness: **0.1cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1250	3.0375	<b>8.5199</b>
0.15-0.30	1330	2.0748	
0.30-0.60	1400	2.6460	
0.60-1.00	1360	0.7616	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 17 + 16 + 18 = 17 m  
At the base of ultimate branching 1<sup>st</sup>: + + = m

### Very Important Guidelines

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 31.62 x 31.62 m × m (width at outer margins touching agri. field); Scattered-dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 31.62 × 31.62 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Racosperma auriculiforme</i>	76.9	8	15	L	No
2	<i>Racosperma auriculiforme</i>	49.2	4.5	9	L	No
3	<i>Racosperma auriculiforme</i>	36.8	1.75	7	L	No
4	<i>Racosperma auriculiforme</i>	67.4	8	18	L	No
5	<i>Racosperma auriculiforme</i>	41.9	2.3	8	L	No
6	<i>Racosperma auriculiforme</i>	49.6	4	9	L	No
7	<i>Racosperma auriculiforme</i>	60.3	1.75	16	L	No
8	<i>Racosperma auriculiforme</i>	35.2	3.75	8	L	No
9	<i>Racosperma auriculiforme</i>	33.6	3.5	6.5	L	No
10	<i>Racosperma auriculiforme</i>	59.1	4.2	9	L	No
11	<i>Racosperma auriculiforme</i>	101.8	1.65	16	L	No
12	<i>Racosperma auriculiforme</i>	32.4	2.2	7	L	No
13	<i>Racosperma auriculiforme</i>	74.3	2	11	L	No
14	<i>Racosperma auriculiforme</i>	33.8	3	6.5	L	No
15	<i>Racosperma auriculiforme</i>	48.2	2.2	10	L	No
16	<i>Racosperma auriculiforme</i>	44.6	6	12	L	No
17	<i>Racosperma auriculiforme</i>	45.5	7	14	L	No
18	<i>Racosperma auriculiforme</i>	44.6	7.5	16	L	No
19	<i>Racosperma auriculiforme</i>	53.1	2.7	16	L	No
20	<i>Racosperma auriculiforme</i>	71.2	2.1	15	L	No
21	<i>Racosperma auriculiforme</i>	43.8	5	12	L	No
22	<i>Racosperma auriculiforme</i>	68.6	5.5	16	L	No
23	<i>Racosperma auriculiforme</i>	59.2	12	17	L	No
24	<i>Racosperma auriculiforme</i>	39.1	9	13	L	No

25	<i>Racosperma auriculiforme</i>	40.8	7	14	L	No
26	<i>Racosperma auriculiforme</i>	47.1	6.5	12	L	No
27	<i>Racosperma auriculiforme</i>	46.1	7	14	L	No
28	<i>Racosperma auriculiforme</i>	36.2	2.1	7	L	No
29	<i>Racosperma auriculiforme</i>	40.9	3	13	L	No
30	<i>Racosperma auriculiforme</i>	42.9	9	14	L	No
31	<i>Racosperma auriculiforme</i>	52.6	5	15	L	No
32	<i>Racosperma auriculiforme</i>	27.2	3.7	7	L	No
33	<i>Racosperma auriculiforme</i>	72.6	10	16	L	No
34	<i>Racosperma auriculiforme</i>	44.2	4.5	7	L	No
35	<i>Racosperma auriculiforme</i>	64.4	6.5	13	L	No
36	<i>Racosperma auriculiforme</i>	61.8	8	16	L	No
37	<i>Racosperma auriculiforme</i>	29.6	3.5	7	L	No
38	<i>Racosperma auriculiforme</i>	57.8	14	17	L	No
39	<i>Racosperma auriculiforme</i>	43.5	6.5	12	L	No
40	<i>Racosperma auriculiforme</i>	38.6	6.5	14	L	No
41	<i>Racosperma auriculiforme</i>	42.2	10	16	L	No
42	<i>Racosperma auriculiforme</i>	31.7	5	12	L	No
43	<i>Racosperma auriculiforme</i>	38.9	2	11	L	No
44	<i>Racosperma auriculiforme</i>	38.2	2.3	11	L	No
45	<i>Racosperma auriculiforme</i>	101.2	4.5	16	L	No
46	<i>Racosperma auriculiforme</i>	52.6	11	15	L	No
47	<i>Racosperma auriculiforme</i>	44.2	3.5	12	L	No
48	<i>Racosperma auriculiforme</i>	37.1	8	13	L	No
49	<i>Racosperma auriculiforme</i>	39.1	3.5	10	L	No
50	<i>Racosperma auriculiforme</i>	72.3	1.5	14	L	No
51	<i>Racosperma auriculiforme</i>	42.9	7	15	L	No
52	<i>Racosperma auriculiforme</i>	38.9	2.3	9	L	No
53	<i>Racosperma auriculiforme</i>	63.6	2.1	16	L	No
54	<i>Racosperma auriculiforme</i>	36.8	3.2	9	L	No
55	<i>Racosperma auriculiforme</i>	89.5	11	16	L	No
56	<i>Racosperma auriculiforme</i>	42.7	8	14	L	No
57	<i>Racosperma auriculiforme</i>	33.2	5	12	L	No
58	<i>Racosperma auriculiforme</i>	54.6	3.2	13	L	No
59	<i>Racosperma auriculiforme</i>	55.6	3	14	L	No
60	<i>Racosperma auriculiforme</i>	49.6	7	14	L	No
61	<i>Racosperma auriculiforme</i>	48.6	8	15	L	No
62	<i>Racosperma auriculiforme</i>	46.6	3.3	13	L	No
63	<i>Racosperma auriculiforme</i>	27.8	3	7	L	No
64	<i>Racosperma auriculiforme</i>	44.8	2.2	13	L	No
65	<i>Racosperma auriculiforme</i>	36.1	2.1	11	L	No
66	<i>Racosperma auriculiforme</i>	34.6	4.5	11	L	No
67	<i>Racosperma auriculiforme</i>	70.2	2	12	L	No
68	<i>Racosperma auriculiforme</i>	84.4	4.2	16	L	No
69	<i>Racosperma auriculiforme</i>	36.2	3.7	11	L	No
70	<i>Racosperma auriculiforme</i>	45.8	7	13	L	No
71	<i>Racosperma auriculiforme</i>	32.2	6	10	L	No
72	<i>Racosperma auriculiforme</i>	37.9	3.5	6	L	No

73	<i>Racosperma auriculiforme</i>	33.8	3.7	7.5	L	No
74	<i>Racosperma auriculiforme</i>	43.8	1.5	6.5	L	No
75	<i>Racosperma auriculiforme</i>	48.2	5	12	L	No
76	<i>Racosperma auriculiforme</i>	36.3	6	17	L	No
77	<i>Racosperma auriculiforme</i>	18.4	2.2	16	L	No
78	<i>Racosperma auriculiforme</i>	24.2	2	5	L	No
79	<i>Racosperma auriculiforme</i>	50.6	5.5	12	L	No
80	<i>Racosperma auriculiforme</i>	77.6	12	17	L	No
81	<i>Racosperma auriculiforme</i>	87.2	2.5	17	L	No
82	<i>Racosperma auriculiforme</i>	41.5	7	9	L	No
83	<i>Racosperma auriculiforme</i>	45.1	4	11	L	No
84	<i>Racosperma auriculiforme</i>	34.9	6.5	10	L	No
85	<i>Racosperma auriculiforme</i>	62.1	12	16	L	No
86	<i>Racosperma auriculiforme</i>	50.1	4	9	L	No
87	<i>Racosperma auriculiforme</i>	40.2	4.2	11	L	No
88	<i>Racosperma auriculiforme</i>	54.8	2	13	L	No
89	<i>Racosperma auriculiforme</i>	51.6	3.6	12	L	No
90	<i>Racosperma auriculiforme</i>	56.7	2.6	14	L	No
91	<i>Racosperma auriculiforme</i>	50.9	2.5	12	L	No
92	<i>Racosperma auriculiforme</i>	33.5	6	11	L	No
93	<i>Racosperma auriculiforme</i>	29.9	6	7.5	L	No
94	<i>Racosperma auriculiforme</i>	28	3.5	6	L	No

**Shrubs in 5×5m in a plot of 50× 20 width m, in 0.1 ha in 100×100 m plot and 250×250 m (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)**

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)		
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2
<i>Chromolaena odorata</i>	35	5	Thick	2			2.8			1.40	
			Medium		1			2.2			1.10
	3%	2%	Thin			1			1.4		0.65
<i>Sida acuta</i>	28	4	Thick	1			0.9			0.70	
			Medium		1			0.8			0.65
	1.00%	0.50%	Thin			1			0.6		0.65
<i>Urena lobata ssp. lobata</i>	14	3	Thick	1			1.8			1.10	
			Medium		1			1.6			1.01
	0.500%	0.50%	Thin			1			1.3		0.65
<i>Sida cordifolia</i>	6	1	Thick	1			0.9			0.65	
			Medium								
	0.20%	0.10%	Thin								
<i>Ziziphus oenoplia</i>	8	2	Thick	1			3.2			3.00	
			Medium		1			2.8			2.20
	1.00%	1.00%	Thin								

**(b) South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)		
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2
<i>Chromolaena odorata</i>	35	5	Thick	1			2.6			0.98	
			Medium		1			0.9			0.85
	3%	2%	Thin			1			0.8		0.65
<i>Ziziphus oenoplia</i>	8	2	Thick	1			2.8			2.20	
			Medium		1			2.6			0.65
	1.00%	1.00%	Thin								
<i>Lantana camara var. camara</i>	18	2	Thick	1			0.9			0.45	
			Medium								
	0.5%	0.1%	Thin								

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)

**(a) North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.112 gm Dry Weight: 0.049 gm % Cover: 72 %

S.No.	Species	No. of individuals
1	<i>Ageratum conyzoides</i>	19
2	<i>Mitracarpus hirtus</i>	30
3	<i>Synedrella nodiflora</i>	3
4	<i>Alloteropsis cimicina</i>	150
5	<i>Justicia japonica</i>	5



**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.091 gm Dry Weight: 0.040 gm % Cover: 68 %

S.No.	Species	No. of individuals
1	<i>Mimosa pudica</i>	4
2	<i>Synedrella nodiflora</i>	9
3	<i>Mitracarpus hirtus</i>	10
4	<i>Alloteropsis cimicina</i>	102
5	<i>Achyranthes aspera</i> var. <i>aspera</i>	1

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.074 gm Dry Weight: 0.033 gm % Cover: 60 %

S.No.	Species	No. of individuals
1	<i>Alloteropsis cimicina</i>	98
2	<i>Synedrella nodiflora</i>	3
3	<i>Ageratum conyzoides</i>	2
4	<i>Mimosa pudica</i>	8

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.143	0.103	0.033	0.025	0.176	0.128
(b) NW	0.152	0.111	0.038	0.030	0.19	0.141
(c) SW	0.133	0.098	0.029	0.023	0.162	0.121
(d) SE	0.128	0.093	0.031	0.024	0.159	0.117
(e) Center						

Plot No.12

VCP – IGBP

Form 2A

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Kannur** GPS Point Name: **Kannur Civil station**

Location/Road/Canal/Village: **Kannur (City)**

Site Centre Coordinates : **12** Date: **17/11/2009** Time: **1.15 PM**

G.P.S. Reading (HHDD:MM:SS and WGS 84): **Lati 11° 52' 31.85" Longi. 75° 21' 53.82"**

Observer: **Deepu Divakaran** Altitude: Site/Plot: **12 m**

Marking on image: (Google/1:25,000 or larger)

(Tonal characteristics)

Slope (°): **0.1°**

Photograph Number:

Aspect : **N/E/S/W/NE /SE/SW/NW**

Topography General Observations): **Plane**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

TOF type: **Settlement (City)** Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**

Top Canopy species: **Macaranga peltata, Spathodea campanulata**

Ground Cover (%): **25%** Stoniness(%): **0%** Rock Put-crop(%): **0%**

Soil Type: **Lateritic** Soil Texture : **Medium** Soil colour: **Reddish brown**

Litter thickness: **1 cm** Humus Colour: **Pale brown** Humus thickness: **0.3**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1200	2.4120	<b>6.7605</b>
0.15-0.30	1270	1.7145	
0.30-0.60	1350	2.1060	
0.60-1.00	1320	0.5280	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)

NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 13 + 13 + 13 = 13 m

At the base of ultimate branching 1<sup>st</sup> : + + = m

**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/ scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 31.62 m × 31.62 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = m (tam

**Plot Size: 31.62 × 31.62 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Macaranga peltata</i>	180.2	8	13	L	No
2	<i>Macaranga peltata</i>	190.3	7.5	13	L	No
3	<i>Macaranga peltata</i>	105.3	4.5	12	L	No
4	<i>Terminalia catappa</i>	25	-	7.5	L	No
5	<i>Spathodea campanulata</i>	185.5	5.5	11	L	No
6	<i>Paraserianthes falcataria</i>	135.8	2.5	7	L	Yes
7	<i>Spathodea campanulata</i>	205.4	2.5	12	L	No
8	<i>Samanea saman</i>	245.5	3.5	14	L	No
9	<i>Spathodea campanulata</i>	95.7	7.5	13	L	No

**Shrubs in 5×5m in a plot of 50× 20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species				Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)		
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick															
			Medium															
			Thin															

**(b) South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species				Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)		
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Sida acuta</i>	3	1	Thick	1			0.9			0.35			0.027			0.008		
			Medium															
	0.005%	0.01%	Thin															
<i>Lantana camara</i> var. <i>camara</i>	4	1	Thick	1			1.8			0.85			0.052			0.015		
			Medium															
	0.008%	0.02%	Thin															

**Bamboo** (50× 0 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)

**(A)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.024 gm Dry Weight: 0.011 gm % Cover: 20 %

S.No.	Species	No. of individuals
1	<i>Cyathula prostrata</i>	4
2	<i>Cyperus rotundus ssp. rotundus</i>	8

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.023 gm Dry Weight: 0.010 gm % Cover: 19 %

S.No.	Species	No. of individuals
1	<i>Mimosa pudica</i>	2
2	<i>Synedrella nodiflora</i>	1
3	<i>Alloteropsis cimicina</i>	7

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.022 gm Dry Weight: 0.009 gm % Cover: 19 %

S.No.	Species	No. of individuals
1	<i>Synedrella nodiflora</i>	2
2	<i>Alloteropsis cimicina</i>	5
3	<i>Ageratum conyzoides</i>	2

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.062	0.045	0.018	0.014	0.080	0.059
(b) NW	0.056	0.041	0.016	0.012	0.072	0.053
(c) SW	0.068	0.049	0.021	0.016	0.089	0.065
(d) SE	0.047	0.034	0.014	0.011	0.061	0.045
(e) Center						

**Plot No.13**

VCP – IGBP

Form 2A

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)**

**CATEGORY 1: SITE AND OBSERVER**  
 State: **Kerala** District: **Kasargod** GPS Point Name: **Madivayal (Cheruvathur)**  
 Location/Road/Canal/Village: **Paddy field**  
 Site Centre Coordinates : **Lati. 12° 12' 22.97" Longi. 75° 9' 19.89"**  
 Sample Site/Plot No.: **T- 13** Date: **18/11/2009** Time: **11.30 AM**  
 G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 12° 12' 22.97" Longi. 75° 9' 19.89"**  
 Observer: **Deepu Divakaran** Altitude: Site/Plot: **40 m**  
 Marking on image: (Google/1:25,000 or larger)  
 (Tonal characteristics)  
 Slope (°): **0.2°** Photograph Number:  
 Aspect : **N/E/S/W/NE/SE /SW/NW** Topography General observations): **Paddy field**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**  
 TOF type: **Paddy field** Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Nil**  
 Top Canopy species: **Cocos nucifera, Racosperma mangium**  
 Ground Cover (%): **93%** Stoniness (%): **0%** Rock Put-crop (%): **0%**  
 Soil Type: **Claye** Soil Texture : **Fine** Soil colour: **Dark brown**  
 Litter thickness: **0.2cm** Humus Colour: **Nil** Humus thickness: **Nil**

Depth (M)	Bulk Density (Kg/m <sup>3</sup> )	Organic carbon (Kg)	Carbon mass (Kg/m <sup>2</sup> )
0.00-0.15	1300	2.5740	<b>8.6856</b>
0.15-0.30	1340	2.3316	
0.30-0.60	1400	2.2680	
0.60-1.00	1400	1.5120	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) ( sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
 NW-SE: Steps: Hits: (Sky/Canopy)  
 Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 6 + 6.5 + 6 = 6.17 m  
 At the base of ultimate branching 1<sup>st</sup> : + + = m

### Very Important Guidelines

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/ scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 31.62 m × 31.62 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 31.62 × 31.62 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Cocos nucifera</i>	84.2	-	6	L	No
2	<i>Cocos nucifera</i>	85.7	-	6.5	L	No
3	<i>Cocos nucifera</i>	74.7	-	6	L	No
4	<i>Racosperma mangium</i>	24.3	1.5	4	L	No



**Shrubs in 5×5m in a plot of 50× 20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(A) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Hygrophila schulli</i>	22	3	Thick	3			2.7			1.10			0.089			0.026		
			Medium		2		2.2			0.92			0.081			0.024		
	3.00%	2.00%	Thin			1			1.8			0.83			0.076			0.022

**(B) South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Hygrophila schulli</i>	22	4	Thick	3			2.6			0.95			0.083			0.024		
			Medium		2		1.8			0.85			0.071			0.021		
	3.00%	3.0%	Thin			2			1.4			0.80			0.063			0.019
<i>Barleria courtallica</i>	6	3	Thick	2			3.1			1.20			0.102			0.030		
			Medium		2		2.9			1.00			0.082			0.024		
	1.00%	2%	Thin			1			2.2			0.92			0.069			0.020
<i>Phyllanthus reticulatus</i>	26	3	Thick	1			0.9			0.34			0.072			0.020		
			Medium		1		0.7			0.22			0.041			0.012		
	3.00%	1.0%	Thin			1			0.5			0.10			0.019			0.005
<i>Ixora coccinea</i>	3	1	Thick	1			0.8			0.61			0.005			0.001		
			Medium															
	0.001%	0.01%	Thin															

**Bamboo** (50× ... m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(a)North-East Corner** (50× ... m width or 0.1 ha plot or 100×100m, or 250×250 m) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× ... m width or 0.1 ha plot or 100×100m or 250×250 m) : Nil

1	Number of rosettes in the plot	% Cover=						
2	Rosettes circumference (m)	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.123 gm Dry Weight: 0.053 gm % Cover: 85 %

S.No.	Species	No. of individuals
1	<i>Bidens pilosa</i> var. <i>minor</i>	2
2	<i>Biophytum sensitivum</i> var. <i>sensitivum</i>	3
3	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	12
4	<i>Brassica juncea</i>	3
5	<i>Phyllanthus amarus</i>	2
6	<i>Mimosa pudica</i>	3
7	<i>Mollugo pentaphylla</i>	8
8	<i>Axonopus compressus</i>	22

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.098 gm Dry Weight: 0.045 gm % Cover: 79 %

S.No.	Species	No. of individuals
1	<i>Axonopus compressus</i>	32
2	<i>Elephantopus scaber</i>	2
3	<i>Mimosa pudica</i>	6
4	<i>Heliotropium indicum</i>	3
5	<i>Lindernia ciliata</i>	12
6	<i>Mitracarpus hirtus</i>	4
7	<i>Justicia japonica</i>	3
8	<i>Synedrella nodiflora</i>	2
9	<i>Oldenlandia corymbosa</i>	5

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.128 gm Dry Weight: 0.056 gm % Cover: 95 %

S.No.	Species	No. of individuals
1	<i>Heliotropium indicum</i>	1
2	<i>Sida beddomei</i>	2
3	<i>Centella asiatica</i>	12
4	<i>Mimosa pudica</i>	3
5	<i>Commelina benghalensis</i>	1
6	<i>Phyllanthus amarus</i>	1
7	<i>Alternanthera bettzickiana</i>	4
8	<i>Mollugo pentaphylla</i>	1
9	<i>Desmodium triflorum</i>	2
10	<i>Axonopus compressus</i>	28
11	<i>Oldenlandia corymbosa</i>	4
12	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	21
13	<i>Ageratum conyzoides</i>	4

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.041	0.030	0.011	0.009	0.052	0.038
(b) NW	0.048	0.035	0.016	0.013	0.064	0.048
(c) SW	0.028	0.020	0.012	0.009	0.040	0.030
(d) SE	0.039	0.028	0.014	0.011	0.053	0.039
(e) Center						

**Plot No14**

**VCP – IGBP**

**Form 2A**

**FORMAT FOR TREES OUT-SIDE FOREST (TOF)**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Kasrgod** GPS Point Name: **Kannankai**

Location/Road/Canal/Village: **Peelikode - Madakara**

Site Centre Coordinates : **Lati. 12° 12' 13.07" Longi. 75° 8' 50.82"**

Sample Site/Plot No.: **T- 14** Date: **18/11/2009** Time: **12.30 PM**

G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 12° 12' 13.07" Longi. 75° 8' 50.82"**

Observer: **Deepu Divakaran** Altitude: Site/Plot: **18 m**

Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics)

Slope (°): **0.1°**

Photograph Number:

Aspect : ~~N/E/S/W/NE /SE/SW/NW-~~

Topography General Observations): **Paddy field**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

TOF type: **Linear (Bund)** Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Grazing**

Top Canopy species: **Cocos nucifera**

Ground Cover (%): **85%**

Stoniness (%): **0%**

Rock Put-crop (%): **0%**

Soil Type: **Claye** Soil Texture : **Fine**

Soil colour: **Dark brown**

Litter thickness: **Nil**

Humus Colour: **Nil**

Humus thickness: **Nil**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1280	1.9200	<b>5.8530</b>
0.15-0.30	1350	1.1138	
0.30-0.60	1420	1.3632	
0.60-1.00	1400	1.4560	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)

NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 11 + 11 + 11 = 11 m

At the base of ultimate branching

1<sup>st</sup> : + + = m

**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/ scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 50 m × 10 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 50 × 10 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Cocos nucifera</i>	95.4	-	10	L	No
2	<i>Cocos nucifera</i>	92.3	-	11	L	No
3	<i>Cocos nucifera</i>	96.2	-	13	L	No
4	<i>Cocos nucifera</i>	90.1	-	9.5	L	No
5	<i>Cocos nucifera</i>	89.5	-	9	L	No
6	<i>Cocos nucifera</i>	85.0	-	7.5	L	No
7	<i>Cocos nucifera</i>	88.3	-	11	L	No
8	<i>Cocos nucifera</i>	89.1	-	12.5	L	No
9	<i>Cocos nucifera</i>	88.7	-	10.5	L	No
10	<i>Cocos nucifera</i>	86.3	-	11	L	No
11	<i>Cocos nucifera</i>	91.6	-	9.5	L	No
12	<i>Cocos nucifera</i>	93.7	-	10	L	No
13	<i>Cocos nucifera</i>	96.3	-	9.5	L	No
14	<i>Cocos nucifera</i>	88.3	-	11	L	No
15	<i>Cocos nucifera</i>	89.0	-	9.5	L	No
16	<i>Cocos nucifera</i>	91.3	-	10.5	L	No

**Shrubs in 5×5m in a plot of 50×20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Hygrophila schulli</i>	16	3	Thick	1			3.5			0.65			0.092			0.026		
			Medium		1			2.5			0.62			0.083			0.023	
	2.00%	2.00%	Thin			1			2.0			0.60			0.065			0.018
<i>Acrostichum Sp.</i>	35	2	Thick	1			2.8			1.50			0.074			0.020		
			Medium		1			1.2			1.00			0.042			0.012	
	3.00%	1.0%	Thin															

**(b)South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Derris scandens</i>	1	1	Thick	1			2.2			1.80			0.092			0.026		
			Medium															
	0.0001%	0.006%	Thin															
<i>Hygrophila schulli</i>	16	3	Thick	2			2.1			0.85			0.081			0.023		
			Medium		1			1.8			0.74			0.075			0.022	
	2.00%	2.00%	Thin			1			1.4			0.62			0.033			0.009

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)  
**(A)North-East Corner** (50× 20 m width or 0.1 ha plot or 100×100m, or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=							
2	Rosettes circumference (m)	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(b) South-West Corner** (50× 20 m width or 0.1 ha plot or 100×100m or 250×250 m ) : Nil

1	Number of rosettes in the plot	% Cover=							
2	Rosettes circumference (m)	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	
2		Thick	+	+		+	+		+	+		+	+	+	+	
		Medium	+	+		+	+		+	+		+	+	+	+	
		Thin	+	+		+	+		+	+		+	+	+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.128 gm Dry Weight: 0.056 gm % Cover: 80 %

S.No.	Species	No. of individuals
1	<i>Desmodium triflorum</i>	35
2	<i>Sida beddomei</i>	8
3	<i>Scoparia dulcis</i>	2
4	<i>Lindernia ciliata</i>	20
5	<i>Mollugo pentaphylla</i>	15
6	<i>Bidens pilosa var. minor</i>	1
7	<i>Centella asiatica</i>	1
8	<i>Mitracarpus hirtus</i>	4
9	<i>Commelina benghalensis</i>	1

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.116 gm Dry Weight: 0.051 gm % Cover: 78 %

S.No.	Species	No. of individuals
1	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	28
2	<i>Sida beddomei</i>	2
3	<i>Centella asiatica</i>	12
4	<i>Mimosa pudica</i>	3
5	<i>Commelina benghalensis</i>	1
6	<i>Brassica juncea</i>	1
7	<i>Alternanthera bettzickiana</i>	3
8	<i>Mollugo pentaphylla</i>	16
9	<i>Desmodium triflorum</i>	2
10	<i>Oldenlandia corymbosa</i>	3
11	<i>Ageratum conyzoides</i>	3

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.148 gm Dry Weight: 0.065 gm % Cover: 83 %

S.No.	Species	No. of individuals
1	<i>Centella asiatica</i>	100
2	<i>Desmodium triflorum</i>	30
3	<i>Selaginella</i> Sp.	1
4	<i>cynodon dactylon</i>	1
5	<i>Commelina benghalensis</i>	2
6	<i>Nymphaea nouchali</i>	1
7	<i>Salvinia</i> Sp.	6
8	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	24
9	<i>Axonopus compressus</i>	20
10	<i>Alternanthera bettzickiana</i>	15

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.: **Nil**

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE						
(b) NW						
(c) SW						
(d) SE						
(e) Center						



## FORMAT FOR TREES OUT-SIDE FOREST (TOF)

**CATEGORY 1: SITE AND OBSERVER**State: **Kerala**District: **Kasargod**GPS Point Name: **Valliyot**Location/Road/Canal/Village: **Valliyot (Periya – Bakal)**Site Centre Coordinates : **Lati. 12° 23' 28.92" Longi. 75° 2' 49.18"**Sample Site/Plot No.: **T- 15**Date: **18/11/2009**Time: **2.10 PM**G.P.S. Reading (HHDD:MM:SS and WGS 84): **Lati 12° 23' 28.92" Longi. 75° 2' 49.18"**Observer: **Deepu Divakaran**Altitude: Site/Plot: **22 m**

Marking on image: (Google/1:25,000 or larger)

(Tonal characteristics)

Slope (°): **3°**

Photograph Number:

Aspect : **N/E/S/W/NE/SE/SW/NW**

Topography General observations):

**Hilly****CATEGORY 2: FOREST AND SOIL- GENERAL:****TOF type:** Settelement (Village) Visual evidence of disturbance lopping/ fire/ cutting/grazing etc: **Grazing**Top Canopy species: ***Mangifera indica, Cocos nucifera***Ground Cover (%): **75%**Stoniness (%): **3 %**Rock Put-crop(%): **0 %**Soil Type: **Lateritic** Soil Texture : **Medium** Soil colour: **Pale Brown**Litter thickness: **1 cm**Humus Colour: **Pale Brown**Humus thickness: **0.1 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.15	1240	2.1390	<b>6.6950</b>
0.15-0.30	1340	1.6080	
0.30-0.60	1380	2.1528	
0.60-1.00	1420	0.7952	

**CATEGOREY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (sky hit numbers and steps): NE-SW: Steps: Hits: (Sky/Canopy)  
NW-SE: Steps: Hits: (Sky/Canopy)

Stand Height (m) (Average from 3-4 trees of top and 1<sup>st</sup> canopy): Top: 14 + 15 + 16 = 15 m  
At the base of ultimate branching 1<sup>st</sup>: + + = m

**Very Important Guidelines**

**(a) Plot Size for Linear Plantation:** Roads (NH, SH, Lane, etc.), Canals (Major – one side, Minor – both sides, etc.), Bunds (e.g. shelter belts) in agriculture fields, Rail, etc. = **50 m × 20 m width**

**(b) Plot Size for Scattered Trees in Agriculture, Settlements, etc. areas:** For very dense and medium density trees take 2 plots of 100×100m within 250×250 m on opposite corners and for open/scattered trees take one plot of 250×250 m)

**(c) Plot Size for Block Plantation:** four plots of 0.1 ha (please do clustered sampling)

**Plot Size:** Linear = 31.62 m × 31.62 m (width at outer margins touching agri. field); Scattered- dense trees e.g. cities (Chandigarh, N. Delhi, Bangalore, Mt. Abu,) two of 100×100m in opposite corners within 250×250 m and very sparse in agriculture areas: one of 250×250 m or block plantation take four of 31.62×31.62 m.

Width of tar on road / water channel in canal / railway track width = m (tar/rail)

Width with pavement of road/side of rail track = m

**Plot Size: 31.62 × 31.62 m**

**L= Leaves, NL= No leaves**

S. no.	Species	Cbh (≥ 10 cm)	Height (m) at 1 <sup>st</sup> forking	Height (m) ultimate forking	Phenology (L/NL)	Cut Yes/No
1	<i>Mangifera indica</i>	165.1	2	10	L	No
2	<i>Mangifera indica</i>	205	3.5	11	L	No
3	<i>Artocarpus heterophyllus</i>	85.3	6	9	L	No
4	<i>Cocos nucifera</i>	72.5	-	8	L	No
5	<i>Cocos nucifera</i>	84.1	-	11	L	No
6	<i>Cocos nucifera</i>	86.2	-	13	L	No
7	<i>Cocos nucifera</i>	86.4	-	16	L	No
8	<i>Cocos nucifera</i>	89.2	-	15	L	No
9	<i>Cocos nucifera</i>	88.1	-	14	L	No
10	<i>Cocos nucifera</i>	89.3	-	14	L	No
11	<i>Cocos nucifera</i>	94.1	-	15	L	No
12	<i>Cocos nucifera</i>	78.2	-	9	L	No
13	<i>Cocos nucifera</i>	74.1	-	9	L	No
14	<i>Cocos nucifera</i>	88.2	-	12	L	No
15	<i>Cocos nucifera</i>	92.1	-	14	L	No
16	<i>Cocos nucifera</i>	86.1	-	13	L	No
17	<i>Cocos nucifera</i>	89.2	-	14	L	No
18	<i>Cocos nucifera</i>	92.3	-	14	L	No
19	<i>Cocos nucifera</i>	78.1	-	10	L	No
20	<i>Cocos nucifera</i>	93.4	-	14	L	No
21	<i>Cocos nucifera</i>	92.1	-	13	L	No
22	<i>Cocos nucifera</i>	86.2	-	12	L	No
23	<i>Cocos nucifera</i>	85.6	-	13	L	No

24	<i>Cocos nucifera</i>	92.5	-	14	L	No
25	<i>Cocos nucifera</i>	95.2	-	15	L	No
26	<i>Cocos nucifera</i>	86.3	-	12	L	No
27	<i>Cocos nucifera</i>	84.2	-	12	L	No
28	<i>Cocos nucifera</i>	92.1	-	14	L	No
29	<i>Cocos nucifera</i>	79.7	-	9	L	No
30	<i>Cocos nucifera</i>	86.1	-	12	L	No
31	<i>Cocos nucifera</i>	85.3	-	13	L	No
32	<i>Cocos nucifera</i>	92.1	-	14	L	No
33	<i>Cocos nucifera</i>	82.5	-	12	L	No
34	<i>Mangifera indica</i>	140.2	3.5	11	L	No
35	<i>Mangifera indica</i>	125.3	4.5	8	L	No
36	<i>Anacardium occidentale</i>	65.2	3.75	8	L	No

**Shrubs in 5×5m in a plot of 50× 20 width m, in 0.1 ha in 100×100 m plot and 250×250 m** (girth at 30 cm above base): (Please bring representative stem of all shrub species either entire or approximately 20 cm long from base, middle and upper, observe 4-5 bushes of each species for better averaging and estimations)

**(a) North-East Corner (5×5m/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)				
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
<i>Sida acuta</i>	8	3	Thick	1			3.1			0.80			0.035			0.012			
			Medium		1			1.8			0.70			0.018			0.006		
	0.05%	0.5%	Thin			1			0.7			0.60			0.009			0.003	
<i>Chromolaena odorata</i>	28	4	Thick	2			2.1			1.00			0.077			0.024			
			Medium		1			1.8			0.80			0.065			0.021		
	1.00%	1.00%	Thin			1			0.8			0.30			0.007			0.002	
<i>Clerodendrum infortunatum</i>	18	4	Thick	1			2.0			0.41			0.043			0.014			
			Medium		1			1.8			0.38			0.032			0.010		
	1.50%	1.0%	Thin			1			1.4			0.31			0.018			0.006	
<i>Ocimum americanum</i>	15	3	Thick	1			3.2			1.80			0.128			0.036			
			Medium		1			2.3			1.10			0.088			0.026		
	1.30%	1%	Thin			1			1.8			0.80			0.036			0.011	
<i>Urena lobata</i> ssp. <i>lobata</i>	20	3	Thick	1			1.0			0.42			0.014			0.004			
			Medium		1			0.9			0.40			0.011			0.003		
	1.50%	0.5%	Thin			1			0.8			0.38			0.007			0.002	
<i>Wattakaka volubilis</i>	4	1	Thick	1			0.9			0.38			0.009			0.003			
			Medium																
	0.01%	0.01%	Thin																
<i>Sida cordifolia</i>	6	1	Thick	1			0.9			0.45			0.014			0.004			
			Medium																
	0.02%	0.01%	Thin																

**(b) South-west Corner (5×5/0.1 ha plot).**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Clerodendrum paniculatum</i>	8	4	Thick	1			3.1			1.00			0.113			0.035		
			Medium		1			1.8			0.75			0.071			0.022	
	0.02%	0.2%	Thin			1			0.9			0.30			0.015			0.005
<i>Sida acuta</i>	8	2	Thick	1			0.8			0.63			0.014			0.005		
			Medium		1			0.5			0.31			0.010			0.003	
	0.05%	0.2%	Thin															
<i>Chromolaena odorata</i>	28	3	Thick	1			1.8			0.85			0.081			0.024		
			Medium		1			0.8			0.50			0.053			0.016	
	1.00%	0.90%	Thin			1			0.5			0.35			0.006			0.002
<i>Kalanchoe schweinfurthii</i>	3	1	Thick	1			3.2			0.36			0.032			0.009		
			Medium															
	0.01%	0.01%	Thin															
<i>Wattakaka volubilis</i>	4	1	Thick	1			0.9			0.36			0.009			0.003		
			Medium															
	0.01%	0.01%	Thin															
<i>Stachytarpheta jamaicensis</i>	18	2	Thick	1			0.9			0.20			0.009			0.003		
			Medium		1			0.8			0.15			0.007			0.002	
	0.5%	0.1%	Thin															
<i>Urena lobata</i> ssp. <i>lobata</i>	20	2	Thick	1			2.1			0.50			0.009			0.003		
			Medium		1			0.9			0.30			0.007			0.002	
	1.50%	0.2%	Thin															
<i>Ocimum americanum</i>	15	2	Thick	1			2.0			0.55			0.009			0.003		
			Medium		1			0.8			0.33			0.006			0.002	
	1.30%	0.5%	Thin															
<i>Canthium coromandelicum</i>	5	1	Thick	1			2.1			0.72			0.019			0.006		
			Medium															
	0.03%	0.02%	Thin															

**Bamboo** (50× 20 m width, 100×100m or 250×250 m plot and circumference at 30 cm above ground.)

**(a)North-East Corner** (50×20m width or 0.1 ha plot or 100×100m, or 250×250 m): Nil

1	Number of rosettes in the plot	% Cover=							
2	Rosettes circumference (m)	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)	Dry Weight (gm)				
			1	2	3	1	2	3	1	2	3		1	2	3		
1		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	
2		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	

**(b) South-West Corner** (50×20 m width or 0.1 ha plot or 100×100m or 250×250 m): Nil

1	Number of rosettes in the plot	% Cover=							
2	Rosettes circumference (m)	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	Avg.=

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)	Dry Weight (gm)				
			1	2	3	1	2	3	1	2	3		1	2	3		
1		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	
2		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	

**(a) Herb 1 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)** Took fresh weight in all plots and if the cover is similar then selected only one sample from a plot for drying and weighing.

In 1×1 m: Fresh weight: 0.138 gm Dry Weight: 0.059 gm % Cover: 81 %

S.No.	Species	No. of individuals
1	<i>Naregamia alata</i>	4
2	<i>Mimosa pudica</i>	8
3	<i>Mitracarpus hirtus</i>	18
4	<i>Desmodium triflorum</i>	12
5	<i>Justicia japonica</i>	4
6	<i>Axonopus compressus</i>	8
7	<i>Biophytum sensitivum</i> var. <i>sensitivum</i>	5
8	<i>Hemidesmus indicus</i> var. <i>indicus</i>	1
9	<i>Selaginella</i> Sp.	6
10	<i>Adiantum</i> Sp.	1
11	<i>Synedrella nodiflora</i>	2
12	<i>Peperomia pellucida</i>	3

**(b) Herb 2 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.130 gm Dry Weight: 0.057 gm % Cover: 80 %

S.No.	Species	No. of individuals
1	<i>Mimosa pudica</i>	4
2	<i>Biophytum sensitivum</i> var. <i>sensitivum</i>	3
3	<i>Axonopus compressus</i>	62
4	<i>Desmodium triflorum</i>	10
5	<i>Mitracarpus hirtus</i>	12
6	<i>Cyathula prostrata</i>	2
7	<i>Justicia japonica</i>	3
8	<i>Brassica juncea</i>	3
9	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	4
10	<i>Commelina benghalensis</i>	2
11	<i>Ageratum conyzoides</i>	3
12	<i>Synedrella nodiflora</i>	4

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.125 gm Dry Weight: 0.055 gm % Cover: 79 %

S.No.	Species	No. of individuals
1	<i>Axonopus compressus</i>	48
2	<i>Desmodium triflorum</i>	22
3	<i>Selaginella</i> Sp.	4
4	<i>Cyathula prostrata</i>	3
5	<i>Commelina benghalensis</i>	8
6	<i>Ageratum conyzoides</i>	2
7	<i>Mimosa pudica</i>	4
8	<i>Cyperus rotundus</i> ssp. <i>rotundus</i>	18
9	<i>Synedrella nodiflora</i>	2
10	<i>Hemidesmus indicus</i> var. <i>indicus</i>	3

**Litter** in four plots of 1×1 m laid randomly – leaves + twigs+ branches+ fruits+ etc.

Plots	Twigs+ Branches + Leaves(gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
(a) NE	0.139	0.101	0.041	0.032	0.180	0.133
(b) NW	0.148	0.108	0.032	0.025	0.180	0.133
(c) SW	0.126	0.092	0.028	0.022	0.154	0.114
(d) SE	0.130	0.095	0.025	0.019	0.155	0.114
(e) Center						



## Status of Forest Vegetation

### Plot No. 1. Udayakara (Wayanad)

#### PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS

##### CATEGORY 1: SITE AND OBSERVER

State: **Kerala** District: **Wayanad** Plot GPS Point Name: **Udayakara**  
Location/Forest division/Range/Compartment or any landmark: **Wayanad South Division, Chedleth range, Pathiri RF**  
Site Centre GPS co-ordinates: **Lat. 11° 50' 6.141" Long. 76° 8' 33.823"**  
Sample Site-/Plot No.: **02/01** /NE/NW/SW/SE Date: **23/02/ 2010** Time: **10.00am**  
G.P.S. Reading (HHDD: MM:SS and WGS 84): Lat **10° 50' 7.914" Long: 76° 8' 37.211"**  
Observer: **Deepu Divakaran** Altitude: Site/Plot: **730 m**  
Marking on image: (Google/1:25,000 or larger) (Tonal characteristics on FCC)  
Slope (°): **8°** Photograph Number: **110-0374 to 110-0383**  
Aspect : **SE**  
Topography General Observations: **Almost flat with slight slop**

##### CATEGORY 2: FOREST AND SOIL- GENERAL:

Forest Type: **Moist deciduous**  
Number of storey and description: **03**  
Top canopy species (Leaves/~~No leaves~~): ***Tectona grandis, Anogeissus latifolia***  
1<sup>st</sup> storey species (Leaves): ***Butea monosperma, Canthium travancoricum, Cipadessa baccifera***  
Second storey species (Leaves/~~No leaves~~): ***Glycosmis pentaphylla, Chromolaena odorata***  
Regeneration – only tree species (in general - very good, good and poor): **Good**  
Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.): **Nil**  
Wildlife evidence (Sighting/pug marks/droppings/horns/sound/burrows): Sighting-**Elephant**  
Grass Cover (%): **80%** Ground Cover (overall % including grasses): **90%**  
Stoniness (pebbles/boulders %): **0%** Rock Out-crop (%): **0%**  
Soil Type: **Forest Soil** Colour: **Pale Brown** Soil Texture: **Medium**  
Litter thickness: **9 cm** Humus Colour: **Brown** Humus thickness: **1 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0214	7.3660	15.73775
0.30-0.60	0.0104	3.9900	
0.60-1.00	0.0086	4.4720	

### **CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: 40 Hits: 31 (Canopy/Sky)  
NW-SE: Steps: 40 Hits: 30 (Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: 35 + 36 + 35 + 39 = 36.25  
at base of ultimate branch forking 1<sup>st</sup> : 15 + 12 + 09 + 08 = 11

**Size of Quadrat for Trees (31.62×31.62 m i.e. 0.1 ha)/ Scrub (10×10 m –pl. take more plots)**

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	<i>Tectona grandis</i>	94.80	12.00	15.00	L
2	<i>Terminalia bellirica</i>	145.50	28.00	35.00	L
3	<i>Terminalia elliptica</i>	185.50	15.00	30.00	L
4	<i>Tectona grandis</i>	195.00	30.00	35.00	L
5	<i>Terminalia bellirica</i>	56.50	–	8.00	L
6	<i>Tectona grandis</i>	116.00	7.00	22.00	L
7	<i>Lagerstroemia microcarpa</i>	18.00	–	7.00	NL
8	<i>Briedelia retusa</i>	195.90	13.00	26.00	L
9	<i>Terminalia elliptica</i>	27.00	6.00	7.00	L
10	<i>Butea monosperma</i>	27.00	–	15.00	L
11	<i>Holarrhena pubescens</i>	16.70	1.75	5.50	L
12	<i>Lagerstroemia microcarpa</i>	19.50	4.00	7.00	L
13	<i>Tectona grandis</i>	209.00	28.00	33.00	L
14	<i>Terminalia elliptica</i>	137.20	30.00	35.00	L
15	<i>Kydia calycina</i>	45.00	9.00	14.00	L
16	<i>Holarrhena pubescens</i>	25.00	4.00	5.00	L
17	<i>Mallotus philippensis</i> var. <i>philippensis</i>	41.50	3.00	7.00	L
18	<i>Grewia tiliifolia</i>	39.80	10.00	12.00	L
19	<i>Canthium travancoricum</i>	16.50	–	4.00	L
20	<i>Aporosa cardiosperma</i>	22.80	–	3.00	L
21	<i>Stereospermum colais</i> var. <i>colais</i>	11.50	–	3.00	L
22	<i>Schleichera oleosa</i>	12.40	2.25	4.00	L
23	<i>Lagerstroemia microcarpa</i>	12.50	–	3.50	L
24	<i>Canthium travancoricum</i>	20.20	–	7.00	NL
25	<i>Canthium travancoricum</i>	13.00	2.00	4.00	L
26	<i>Canthium travancoricum</i>	14.01	–	2.50	L

27	<i>Canthium travancoricum</i>	12.00	1.40	2.00	L
28	<i>Lagerstroemia microcarpa</i>	32.00	6.00	7.50	L
29	<i>Cipadessa baccifera</i>	27.10	3.00	7.00	L
30	<i>Holarrhena pubescens</i>	43.00	–	8.00	NL
31	<i>Cipadessa baccifera</i>	11.20	2.50	4.00	L
32	<i>Holarrhena pubescens</i>	29.00	3.00	5.00	NL
33	<i>Holarrhena pubescens</i>	27.00	1.75	6.00	L
34	<i>Pterocarpus marsupium</i>	313.00	14.00	29.00	L
35	<i>Hydnocarpus alpina</i>	108.50	2.00	14.00	L
36	<i>Cipadessa baccifera</i>	14.20	2.25	4.00	L
37	<i>Diospyros nilagirica</i>	12.00	–	3.50	L
38	<i>Cipadessa baccifera</i>	15.00	1.50	3.50	L
39	<i>Pajanelia longifolia</i>	12.10	–	5.00	L
40	<i>Stereospermum colais</i> var. <i>colais</i>	14.00	1.50	4.50	L
41	<i>Briedelia retusa</i>	21.50	3.25	8.00	L
42	<i>Cipadessa baccifera</i>	39.40	2.00	5.50	L
43	<i>Cassia fistula</i>	11.00	2.30	5.00	L
44	<i>Canthium travancoricum</i>	27.00	–	9.00	L
45	<i>Cipadessa baccifera</i>	12.50	2.00	3.25	NL
46	<i>Mallotus philippensis</i> var. <i>philippensis</i>	15.50	3.50	6.00	L
47	<i>Canthium travancoricum</i>	17.50	2.25	7.00	NL
48	<i>Canthium travancoricum</i>	18.40	6.50	8.00	L
49	<i>Canthium travancoricum</i>	12.80	2.00	4.00	L
50	<i>Terminalia bellirica</i>	81.00	14.00	26.00	L
51	<i>Anogeissus latifolia</i>	101.80	26.00	30.00	L
52	<i>Lagerstroemia microcarpa</i>	308.00	29.00	39.00	L
53	<i>Tectona grandis</i>	96.80	12.00	14.00	L
54	<i>Tectona grandis</i>	309.80	2.25	36.00	L
55	<i>Canthium travancoricum</i>	10.00	–	4.50	L
56	<i>Canthium travancoricum</i>	12.00	–	5.00	L
57	<i>Tectona grandis</i>	241.00	23.00	36.00	L
58	<i>Stereospermum colais</i> var. <i>colais</i>	15.00	1.50	5.50	NL
59	<i>Canthium travancoricum</i>	14.00	–	3.50	L
60	<i>Canthium travancoricum</i>	26.00	8.00	10.00	L

**(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base)** (Please bring representative stem of all shrub species either **entire stem or pieces of 15 cm long from base, middle and top of the tiller**)  
Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Glycosmis pentaphylla</i>	98	4	Thick	1			0.9			1.17			0.134			0.047		
			Medium		1			0.8			0.85			0.072			0.023	
	5%	4%	Thin			1			0.4			0.28		0.011				0.004
<i>Chromolaena odorata</i>	103	6	Thick	1			0.9			2.30			0.067			0.021		
			Medium		1			0.5			1.44			0.035			0.010	
	9%	8%	Thin			1			0.2			0.26		0.003				0.0009
<i>Embelia tsjeriam-cottam</i>	21	3	Thick	1			1.8			1.65			0.189			0.055		
			Medium		1			0.7			0.75			0.023			0.004	
	0.5%	3%	Thin			1			0.2			0.16		0.002				0.0005
<i>Lantana camara</i> var. <i>camara</i>	70	4	Thick	1			0.9			0.61			0.013			0.005		
			Medium		1			0.4			0.65			0.005			0.002	
	6%	5%	Thin			1			0.2			0.42		0.004				0.001
<i>Chassalia curviflora</i> var. <i>ophioxylodes</i>	4	1	Thick	1			0.6			0.32			0.006			0.003		
			Medium															
	0.50%	1%	Thin															
<i>Helicteres isora</i>	3	1	Thick	1			0.4			0.23			0.004			0.001		
			Medium															
	0.40%	0.5%	Thin															

**(2) Shrubs (South-West) Size = 5× 5 m (girth at 30 cm above base)**

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Glycosmis pentaphylla</i>	98	4	Thick	1			1.0			1.25			0.141			0.044		
			Medium		1			0.9			1.12			0.079			0.025	
	5%	4%	Thin			1			0.5			0.45		0.021				0.007
<i>Helicteres isora</i>	3	6	Thick	1			0.8			1.05			0.121			0.029		
			Medium		1			0.6			0.75			0.043			0.010	
	0.40%	8%	Thin			1			0.4			0.32		0.005				0.0010
<i>Chromolaena odorata</i>	103	3	Thick	1			1.0			1.20			0.074			0.022		
			Medium		1			0.7			0.07			0.048			0.014	
	9%	3%	Thin			1			0.5			0.36		0.007				0.0020
<i>Ziziphus oenoplia</i>	8	1	Thick	1			0.7			0.51			0.004			0.001		
			Medium															
	0.001%	0.05%	Thin															
<i>Sida acuta</i>	28	2	Thick	1			0.7			0.54			0.013			0.004		
			Medium		1			0.4			0.28			0.009			0.003	
	0.05%	0.1%	Thin															
<i>Urena lobata</i> ssp. <i>lobata</i>	18	1	Thick	1			0.5			0.38			0.010			0.003		
			Medium															
	0.04%	0.05%	Thin															

(a) Tree Saplings (North-East) 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.

Sl.No.	Species	Number	Girth (cm)					Height (m)				
1	<i>Cipadessa baccifera</i>	6	8.2	7.2	7.7	5.1	6.5	2.1	2.0	2.0	1.5	1.8

(b) Tree Saplings (South-West) Size: 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm)

Sl.No.	Species	Number	Girth (cm)				Height (m)			
1	<i>Cipadessa baccifera</i>	3	7.1	5.2	5.8		2.1	1.4	1.6	
2	<i>Canthium travancoricum</i>	2	6.4	6.1			1.9	1.7		
3	<i>Tectona grandis</i>	1	5.8				1.5			

(a) Tree Seedling (North-East) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

Sl.No.	Species	Number	Diameter (cm)				Height (m)			
1	<i>Canthium travancoricum</i>	4	0.6	0.2	0.2	0.7	0.38	0.37	0.35	0.59
2	<i>Diospyros montana</i>	3	0.3	0.9	1.0		0.37	0.57	0.28	
3	<i>Cassia fistula</i>	1	0.4				0.71			
4	<i>Schleichera oleosa</i>	1	0.5				0.26			
5	<i>Aporosa cardiosperma</i>	2	0.2	0.3			0.23	0.25		

(b) Tree Seedling (South-West) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

Sl.No.	Species	Number	Diameter (cm)				Height (m)			
1	<i>Cassia fistula</i>	2	0.3	0.4			0.35	0.39		
2	<i>Tectona grandis</i>	1	0.5				0.30			
3	<i>Canthium travancoricum</i>	3	0.4	0.5	0.4		0.29	0.32	0.30	
4	<i>Cipadessa baccifera</i>	2	0.2	0.2			0.24	0.23		

(a) Herb 1 (NE) (1 × 1 m) (record epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous.

In 1 × 1 m: Fresh weight: 0.080 gm Dry Weight: 0.035 gm % Cover: 85%

Sl.No.	Species	No. of individuals
1	<i>Cyathula prostrata</i>	10
2	<i>Justicia japonica</i>	3
3	<i>Dipteracanthus prostratus</i>	1
4	<i>Axonopus compressus</i>	6
5	<i>Alloteropsis cimicina</i>	6

(b) Herb 2 (SW) (1 × 1 m) (record epiphytes/lithophytes/climbers etc. also)

In 1 × 1 m: Fresh weight: 0.093 gm Dry Weight: 0.046 gm % Cover: 86%

Sl.No.	Species	No. of individuals
1	<i>Axonopus compressus</i>	4
2	<i>Elephantopus scaber</i>	2
3	<i>Synedrella nodiflora</i>	2
4	<i>Justicia japonica</i>	3
5	<i>Alloteropsis cimicina</i>	3
6	<i>Ageratum conyzoides</i>	2

**(c) Herb 3 (NW) (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.102 gm Dry Weight: 0.050 gm % Cover: 89%

Sl.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	4
2	<i>Synedrella nodiflora</i>	2
3	<i>Alloteropsis cimicina</i>	2
4	<i>Ageratum conyzoides</i>	3
5	<i>Senna tora</i>	2

**(d) Herb 4 (SE) (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.089 gm Dry Weight: 0.043 gm % Cover: 86%

Sl.No.	Species	No. of individuals
1	<i>Ageratum conyzoides</i>	2
2	<i>Synedrella nodiflora</i>	2
3	<i>Justicia japonica</i>	3
4	<i>Alloteropsis cimicina</i>	3
5	<i>Senna tora</i>	2

**(e) Herb 5 (Center) (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.091 gm Dry Weight: 0.044 gm % Cover: 87%

Sl.No.	Species	No. of individuals
1	<i>Cyathula prostrata</i>	2
2	<i>Elephantopus scaber</i>	2
3	<i>Justicia japonica</i>	3
4	<i>Alloteropsis cimicina</i>	3
5	<i>Cyperus rotundus</i>	8

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs + Branches (gm)		Leaves (gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
<b>NE</b>	0.209	0.205	0.126	0.118	0.008	0.004	0.343	0.327
<b>NW</b>	0.128	0.121	0.097	0.09	0.024	0.018	0.249	0.229
<b>SW</b>	0.193	0.187	0.107	0.099	0.057	0.045	0.357	0.331
<b>SE</b>	0.098	0.093	0.201	0.196	0.043	0.031	0.342	0.320
<b>Center</b>	0.021	0.019	0.221	0.213	0.127	0.116	0.369	0.348

## Plot 2: Madal 1. (Wayanad)

### PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS

#### CATEGORY 1: SITE AND OBSERVER

State: **Kerala** District: **Wayanad** Plot GPS Point Name = **Madal (1)**  
 Location/Forest division/Range/Compartment or any landmark: **Wayanad South Division, Chedleth range, Pathiri RF**  
 Site Centre GPS co-ordinates: **Lat. 11° 50' 6.141" Long. 76° 8' 33.823"**  
 Sample Site-/Plot No.: **02/02** /NE/NW/SW/SE Date: **17/03/ 2010** Time: **8.00 am**  
 G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lat. 11° 50' 6.864" Long. 76° 8' 1.392"**  
 Observer: **Deepu Divakaran** Altitude: Site/Plot: **750m**  
 Marking on image: (Google/1:25,000 or larger) (Tonal characteristics on FCC)  
 Slope (°): **30** Photograph Number:  
 Aspect : **NW** Topography General Observations): **Hilly with, moderate slop**

#### CATEGORY 2: FOREST AND SOIL- GENERAL:

Forest Type: **Moist deciduous**  
 Number of storeys and description: **03**  
 Top canopy species: *Pterocarpus marsupium, Lagerstroemia microcarpa, Terminalia elliptica*  
 First storey species: *Wrightia tinctoria, Canthium travancoricum, Bambusa bambos*  
 Second storey species: *Cipadessa baccifera, Glycosmis pentaphylla, Chromolaena odorata*  
 Regeneration – only **tree species** (in general - very good, good and poor): **Good**  
 Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.): **Cattle sighting**  
 Wildlife evidence (Sighting/pug marks/droppings/horns/sound/burrows): **Dung & sound of Elephant**  
 Grass Cover (%): **60%** Ground Cover (overall % including grasses): **80%**  
 Stoniness (pebbles/boulders %):**0%**, Rock Out-crop (%):**0%**, Soil Type: **Forest Soil**  
 Soil Colour: **Brown** Soil Texture: **Fine**  
 Litter thickness: **5 cm** Humus Colour: **Brown** Humus thickness: **1.5 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0193	6.7164	<b>14.25840</b>
0.30-0.60	0.0100	3.510	
0.60-1.00	0.0080	4.0320	

### **CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: 40 Hits: 29 (Canopy)

NW-SE: Steps: 40 Hits: 38 (Canopy)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: 30 + 29 + 31 + 28 = 29.5  
at base of ultimate branch forking 1<sup>st</sup> : 11 + 10 + 09 + 10 = 10

**Size of Quadrat for Trees** (31.62×31.62 m i.e. 0.1 ha)/ **Scrub** (10×10 m –pl. take more plots)

(a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –gbh up to mm level.

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	<i>Lagerstroemia microcarpa</i>	20.10	6.00	6.50	NL
2	<i>Lagerstroemia microcarpa</i>	20.70	6.50	7.50	NL
3	<i>Helicteres isora</i>	18.40	3.00	5.00	L
4	<i>Wrightia tinctoria</i>	21.50	3.00	4.50	L
5	<i>Wrightia tinctoria</i>	26.00	2.50	5.50	L
6	<i>Wrightia tinctoria</i>	14.00	1.75	3.00	L
7	<i>Cipadessa baccifera</i>	10.00	1.90	3.50	L
8	<i>Canthium coromandelicum</i>	17.60	2.00	3.25	L
9	<i>Helicteres isora</i>	14.60	3.00	5.50	L
10	<i>Tectona grandis</i>	34.80	7.50	10.00	L
11	<i>Melicope lunu-ankenda</i>	21.50	–	5.00	L
12	<i>Spathodea campanulata</i>	42.70	–	15.00	L
13	<i>Lagerstroemia microcarpa</i>	16.30	–	5.00	NL
14	<i>Helicteres isora</i>	10.00	2.00	3.00	L
15	<i>Canthium coromandelicum</i>	27.00	–	5.00	L
16	<i>Grewia tiliifolia</i>	149.60	14.00	23.00	L
17	<i>Canthium coromandelicum</i>	87.50	1.80	8.00	L
18	<i>Canthium coromandelicum</i>	42.50	4.50	11.00	L
19	<i>Olea dioica</i>	35.20	–	7.00	L
20	<i>Lagerstroemia microcarpa</i>	30.80	–	12.00	NL
21	<i>Diospyros nilagirica</i>	45.00	–	9.00	L
22	<i>Canthium coromandelicum</i>	10.10	1.50	3.50	L
23	<i>Wrightia tinctoria</i>	18.60	–	3.00	NL
24	<i>Radermachera sp.</i>	110.90	10.00	18.00	L
25	<i>Canthium coromandelicum</i>	14.00	4.00	6.00	L
26	<i>Helicteres isora</i>	21.20	–	2.00	L
27	<i>Aporosa cardiosperma</i>	13.20	–	5.00	L
28	<i>Flacourtia montana</i>	15.00	–	6.00	L
29	<i>Lagerstroemia microcarpa</i>	50.70	16.00	3.50	L
30	<i>Wrightia tinctoria</i>	11.00	–	2.50	L
31	<i>Lagerstroemia microcarpa</i>	51.00	–	16.00	NL
32	<i>Lagerstroemia microcarpa</i>	27.70	–	8.00	NL
33	<i>Cipadessa baccifera</i>	12.90	–	4.00	L



34	<i>Canthium coromandelicum</i>	17.10	—	3.00	L
35	<i>Canthium coromandelicum</i>	18.70	—	3.00	L
36	<i>Wrightia tinctoria</i>	30.70	1.80	3.50	L
37	<i>Wrightia tinctoria</i>	12.30	1.45	2.00	L
38	<i>Helicteres isora</i>	22.50	—	3.50	L
39	<i>Pterocarpus marsupium</i>	170.00	6.50	30.00	L
40	<i>Wrightia tinctoria</i>	24.50	5.00	7.00	L
41	<i>Lagerstroemia microcarpa</i>	18.30	2.00	6.50	NL
42	<i>Canthium coromandelicum</i>	13.50	—	2.00	L
43	<i>Trichilia connaroides</i>	169.50	11.00	17.00	L
44	<i>Lagerstroemia microcarpa</i>	14.00	—	3.40	NL
45	<i>Diospyros nilagirica</i>	13.80	—	5.00	L
46	<i>Trichilia connaroides</i>	223.00	6.50	15.00	L
47	<i>Wrightia tinctoria</i>	18.50	1.65	4.00	L
48	<i>Canthium coromandelicum</i>	19.10	—	5.00	L
49	<i>Tectona grandis</i>	24.10	—	4.50	L
50	<i>Wrightia tinctoria</i>	19.70	3.50	4.50	L
51	<i>Alstonia scholaris</i>	167.50	13.00	21.00	L
52	<i>Helicteres isora</i>	30.50	1.90	6.00	L
53	<i>Wrightia tinctoria</i>	27.50	—	2.00	L
54	<i>Wrightia tinctoria</i>	20.50	—	1.80	L
55	<i>Cipadessa baccifera</i>	15.60	1.90	6.00	L
56	<i>Trichilia connaroides</i>	113.50	4.00	12.00	L
57	<i>Canthium coromandelicum</i>	13.20	2.25	5.00	L
58	<i>Canthium coromandelicum</i>	11.60	2.20	5.50	L
59	<i>Melicope lunu-ankenda</i>	17.40	—	5.00	L
60	<i>Canthium coromandelicum</i>	19.90	4.00	6.50	L
61	<i>Wrightia tinctoria</i>	39.00	—	7.50	L
62	<i>Terminalia paniculata</i>	201.20	17.00	25.00	L
63	<i>Terminalia elliptica</i>	124.90	5.00	11.00	L
64	<i>Wrightia tinctoria</i>	17.50	—	2.50	L
65	<i>Wrightia tinctoria</i>	41.50	6.00	8.00	L
66	<i>Wrightia tinctoria</i>	50.70	5.00	10.00	L
67	<i>Wrightia tinctoria</i>	73.40	4.50	10.00	L
68	<i>Wrightia tinctoria</i>	25.20	2.25	5.50	L
69	<i>Wrightia tinctoria</i>	18.70	—	4.00	L
70	<i>Diospyros nilagirica</i>	12.00	—	3.00	L
71	<i>Wrightia tinctoria</i>	16.60	3.00	6.00	L
72	<i>Wrightia tinctoria</i>	10.30	4.00	5.00	L
73	<i>Wrightia tinctoria</i>	17.80	3.00	5.00	L
74	<i>Cassia fistula</i>	11.50	—	4.00	L
75	<i>Holarrhena pubescens</i>	16.90	2.00	4.00	L
76	<i>Canthium coromandelicum</i>	12.20	—	5.00	L
77	<i>Canthium coromandelicum</i>	11.50	1.50	2.50	L
78	<i>Helicteres isora</i>	12.50	—	3.50	L
79	<i>Wrightia tinctoria</i>	10.20	—	5.00	L
80	<i>Wrightia tinctoria</i>	87.00	1.50	12.00	L
81	<i>Wrightia tinctoria</i>	10.10	—	3.50	L
82	<i>Helicteres isora</i>	13.50	—	3.50	L
83	<i>Helicteres isora</i>	11.60	2.50	4.00	L
84	<i>Helicteres isora</i>	20.60	4.00	5.50	L

85	<i>Helicteres isora</i>	14.60	4.50	6.50	L
86	<i>Wrightia tinctoria</i>	132.50	5.50	11.00	L
87	<i>Wrightia tinctoria</i>	19.60	4.25	6.00	L
88	<i>Canthium coromandelicum</i>	12.60	2.00	4.00	L
89	<i>Canthium coromandelicum</i>	11.70	2.75	3.50	L
90	<i>Radermachera xylocarpa</i>	80.20	1.90	7.00	L
91	<i>Wrightia tinctoria</i>	13.40	3.00	4.50	L
92	<i>Wrightia tinctoria</i>	17.20	–	3.50	L
93	<i>Wrightia tinctoria</i>	29.40	4.50	7.50	L
94	<i>Wrightia tinctoria</i>	16.70	–	7.00	L
95	<i>Wrightia tinctoria</i>	12.00	–	3.50	L
96	<i>Lagerstroemia microcarpa</i>	13.40	–	4.00	NL
97	<i>Holarrhena pubescens</i>	17.00	2.00	3.00	L
98	<i>Spathodea campanulata</i>	46.20	–	10.00	L
99	<i>Kydia calycina</i>	24.90	3.50	6.00	L
100	<i>Canthium coromandelicum</i>	12.00	–	4.50	L
101	<i>Helicteres isora</i>	18.50	2.00	6.00	L
102	<i>Grewia tiliifolia</i>	165.00	8.00	15.00	L
103	<i>Stereospermum colais</i> var. <i>colais</i>	23.10	1.80	6.00	L
104	<i>Stereospermum colais</i> var. <i>colais</i>	19.60	2.50	5.50	L
105	<i>Callicarpa tomentosa</i>	12.00	–	2.00	L
106	<i>Holarrhena pubescens</i>	21.30	5.00	6.50	L
107	<i>Ficus exasperata</i>	45.00	5.50	10.00	L
108	<i>Canthium coromandelicum</i>	15.50	1.50	5.00	L
109	<i>Lagerstroemia microcarpa</i>	18.20	4.25	6.00	NL
110	<i>Naringi crenulata</i>	29.00	–	6.20	L
111	<i>Naringi crenulata</i>	28.50	2.30	5.20	L
112	<i>Cassia fistula</i>	30.10	1.90	6.00	L
113	<i>Stereospermum colais</i> var. <i>colais</i>	219.30	10.00	27.00	L
114	<i>Canthium coromandelicum</i>	19.70	1.75	3.00	L
115	<i>Wrightia tinctoria</i>	47.80	–	10.00	L
116	<i>Wrightia tinctoria</i>	14.60	–	3.00	L
117	<i>Wrightia tinctoria</i>	13.30	–	3.00	L
118	<i>Wrightia tinctoria</i>	15.50	1.90	5.00	L
119	<i>Lagerstroemia microcarpa</i>	38.50	5.80	7.50	NL
120	<i>Diospyros nilagirica</i>	15.60	2.00	4.00	NL
121	<i>Canthium coromandelicum</i>	15.50	1.80	6.00	L

**(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base)** (Please bring representative stem of all shrub species either **entire stem or pieces of 15 cm long from base, middle and top of the tiller**) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

**(2) Shrubs (South-West) Size = 5× 5 m (girth at 30 cm above base)**

**(a) Tree Saplings (North-East)** 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.

**(b) Tree Saplings (South-West)** Size: 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm)

**(a) Tree Seedling (North-East)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

**(b) Tree Seedling (South-West)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

**Bamboo (plot size 0.1 ha) (circumference to be taken about 30 cm above ground)**

1	Number of rosettes in the plot	=							% Cover=
2	Rosettes circumference (m)	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	Avg.=

Girth Class: e.g. thick (>20), medium (>10-≤20) and thin (≤10) cm. Please collect **three** samples of 30 cm long for each girth class of culms from base, middle and upper part of the same culms.

**(a) Herb 1 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also).** Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous.

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

**(b) Herb 2 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

**(c) Herb 3 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

**(d) Herb 4 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

**(e) Herb 5 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

**Number of dead/dry, stumps of trees /cut but live (0.1 ha plot)**

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

### Plot 3: Madal (2). Wayanad

#### PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS

##### CATEGORY 1: SITE AND OBSERVER

State: **Kerala** District: **Wayanad** Plot GPS Point Name = **Madal (2)**

Location/Forest division/Range/Compartment or any landmark:

Site Centre GPS co-ordinates: **Lat. 11° 49'8.712" Long. 76° 09' 35.253"**

Sample Site-/Plot No.: /NE/NW/SW/SE Date: **18/03/ 2010** Time: **10 am**

G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lat. 11°51'5.421" Long. 76° 09' 32.223"**

Observer: **Deepu Divakaran** Altitude: Site/Plot: **740 m / m**

Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics on FCC)

Slope (°): **35** Photograph Number:

Aspect : N/E/S/W/NE/SE/SW/NW Topography General observations): **Hilly**

##### CATEGORY 2: FOREST AND SOIL- GENERAL:

**Forest Type: Moist Deciduous**

Number of storeys and description: **3**

Top canopy species (Leaves/No leaves): **Tectona, Dalbergia, Terminalia paniculata, Weldenia cordifolia**

First storey species (Leaves/No leaves): **Canthium, Syzigium, Wrightia, Bamboo**

Second storey species (Leaves/No leaves): **Glycosmis, Cepadessa**

Regeneration – only tree species (in general - very good, good and poor): **Good**

Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.): **Cattle sighting**

Wildlife evidence (Sighting/pug marks/droppings/horns/sound/burrows): **Sound**

Grass Cover (%): **60** Ground Cover (overall % including grasses): **80**

Stoniness (pebbles/boulders %): **0.01** Rock Out-crop (%): **0**

Soil Type: **Forest soil** Soil Colour: **Brown** Soil Texture: **Fine**

Litter thickness: **5cm** Humus Colour: **Brown** Humus thickness: **1cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0205	7.4540	14.97803
0.30-0.60	0.0132	5.1480	
0.60-1.00	0.0045	2.3760	

### **CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: Hits:  
(Canopy/Sky)

NW-SE: Steps: Hits:  
(Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: + + + =  
at base of ultimate branch forking 1<sup>st</sup> : + + + =

**Size of Quadrat for Trees** (31.62×31.62 m i.e. 0.1 ha)/ **Scrub** (10×10 m –pl. take more plots)

(a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –gbh up to mm level.

Tree id.	Species	Gbh (≥ 10 cm all plants)	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	Wrightia tinctoria	23.50	3.50	5.00	L
2	Wrightia tinctoria	34.20	–	7.50	L
3	Haldina cordifolia	131.20	11.00	45.00	L
4	Canthium coromandelicum	21.90	2.25	3.50	L
5	Lagerstroemia microcarpa	41.20	8.00	11.00	L
6	Canthium coromandelicum	15.50	–	3.50	L
7	Canthium coromandelicum	13.10	–	2.75	L
8	Canthium coromandelicum	17.50	–	4.50	L
9	Wrightia tinctoria	14.50	–	5.00	L
10	Canthium coromandelicum	16.10	–	3.00	L
11	Canthium coromandelicum	10.10	–	2.50	L
12	Syzygium cumini var. cumini	18.90	4.50	5.50	L
13	Canthium coromandelicum	14.00	2.00	5.50	L
14	Canthium coromandelicum	10.00	2.00	3.00	L
15	Anogeissus latifolia	12.00	–	4.60	L
16	Tectona grandis	82.50	10.00	13.00	L
17	Butea monosperma	48.00	2.00	3.50	L
18	Canthium coromandelicum	15.60	1.75	3.00	L

19	Lagerstroemia microcarpa	25.90	_	7.50	L
20	Phyllanthus emblica	63.90	3.00	9.00	L
21	Tectona grandis	118.00	5.00	13.00	L
22	Dalbergia sissooides	131.50	17.00	26.50	L
23	Lagerstroemia microcarpa	63.20	12.00	15.00	L
24	Canthium coromandelicum	15.40	_	7.00	L
25	Canthium coromandelicum	10.80	3.50	4.25	L
26	Canthium coromandelicum	20.00	_	2.50	L
27	Canthium coromandelicum	10.70	_	2.00	L
28	Canthium coromandelicum	19.00	1.30	5.00	L
29	Lagerstroemia microcarpa	29.50	7.00	8.50	L
30	Spathodea campanulata	109.20	15.00	17.00	L
31	Lagerstroemia microcarpa	33.40	9.00	9.50	L
32	Canthium coromandelicum	15.00	_	6.00	L
33	Canthium coromandelicum	12.00	_	6.00	L
34	Canthium coromandelicum	17.50	_	5.00	L
35	Haldina cordifolia	36.80	6.00	7.50	NL
36	Canthium coromandelicum	34.20	2.00	7.80	L
37	Canthium coromandelicum	13.20	_	6.00	L
38	Canthium coromandelicum	14.20	_	3.50	L
39	Cipadessa baccifera	14.00	_	3.50	L
40	Spathodea campanulata	26.50	_	3.00	L
41	Spathodea campanulata	93.20	12.50	13.50	L
42	Glycosmis pentaphylla	13.00	_	3.00	L
43	Dalbergia sissooides	50.00	2.20	9.50	L
44	Lagerstroemia microcarpa	15.50	2.50	4.50	L
45	Canthium coromandelicum	15.20	1.50	5.60	L
46	Spathodea campanulata	34.70	2.25	3.25	L
47	Canthium coromandelicum	14.50	_	5.00	L
48	Canthium coromandelicum	15.50	_	4.00	L
49	Cipadessa baccifera	12.70	1.75	3.00	L
50	Canthium coromandelicum	19.70	_	6.00	L
51	Canthium coromandelicum	16.00	_	3.50	L
52	Helicteres isora	23.10	3.50	6.00	L
53	Canthium coromandelicum	16.50	_	2.10	L
54	Canthium coromandelicum	21.20	4.25	5.50	L
55	Canthium coromandelicum	16.00	_	1.40	L
56	Canthium coromandelicum	17.00	1.50	5.00	L
57	Canthium coromandelicum	16.20	_	4.00	L
58	Lagerstroemia microcarpa	19.70	5.00	6.50	NL
59	Canthium coromandelicum	19.00	1.40	4.10	L
60	Canthium coromandelicum	18.90	1.90	6.00	L
61	Wrightia tinctoria	15.50	_	4.50	L
62	Canthium coromandelicum	18.20	1.60	5.50	L
63	Canthium coromandelicum	19.00	_	6.50	L
64	Tectona grandis	312.10	12.00	19.00	L
65	Canthium coromandelicum	18.50	_	3.50	L

66	Canthium coromandelicum	28.00	3.00	11.00	L
67	Canthium coromandelicum	11.00	2.50	4.00	L
68	Canthium coromandelicum	11.20	4.00	5.00	L
69	Cassia fistula	16.50	3.50	5.00	NL
70	Canthium coromandelicum	15.00	2.00	4.00	L
71	Canthium coromandelicum	12.70	1.90	3.50	L
72	Canthium coromandelicum	22.00	1.90	6.00	L
73	Canthium coromandelicum	17.90	1.95	6.00	L
74	Canthium coromandelicum	17.50	1.90	4.00	L
75	Canthium coromandelicum	13.00	_	4.50	L
76	Dalbergia sissooides	396.50	20.00	45.00	L
77	Tectona grandis	128.60	11.00	14.00	L
78	Tectona grandis	173.50	12.50	19.00	L
79	Canthium coromandelicum	16.90	2.75	4.50	L
80	Canthium coromandelicum	21.30	3.75	5.50	L
81	Canthium coromandelicum	20.40	1.45	7.50	L
82	Canthium coromandelicum	24.50	3.00	5.80	L
83	Canthium coromandelicum	14.70	_	3.50	L
84	Cipadessa baccifera	38.90	1.95	5.00	L
85	Lagerstroemia microcarpa	364.50	14.00	28.00	L
86	Canthium coromandelicum	11.70	2.00	3.50	L
87	Canthium coromandelicum	11.30	1.80	3.00	L
88	Canthium coromandelicum	17.60	_	6.00	L

**(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base)** (Please bring representative stem of all shrub species either **entire stem or pieces of 15 cm long from base, middle and top of the tiller**) Girth class e.g.: Thick ≥15 cm, Medium 7- <15 cm and Thin <7 cm, it will vary with species and site-to-site

pecies/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species		Girth/Diam. (cm)		Height (m)		Fresh Weight (gm)		Dry Weight (gm)	
	0.1h a	5×5 m	Bush No. 3	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	
			Thick	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
			Mediu m	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
			Thin	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
			Thick	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
			Mediu m	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
			Thin	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	

**(2) Shrubs (South-West) Size = 5 × 5 m (girth at 30 cm above base)**

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)		Height (m)		Fresh Weight (gm)		Dry Weight (gm)	
	0.1ha	5×5m	Bush No. 3	1	2	1	2	1	2	1	2	1	2
			Thick	+	+	+	+	+	+	+	+	+	+
			Medium	+	+	+	+	+	+	+	+	+	+
			Thin	+	+	+	+	+	+	+	+	+	+
			Thick	+	+	+	+	+	+	+	+	+	+
			Medium	+	+	+	+	+	+	+	+	+	+
			Thin	+	+	+	+	+	+	+	+	+	+

**(a) Tree Saplings (North-East) 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)			
1			+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+

**(b) Tree Saplings (South-West) Size: 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)			
1			+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+

**(a) Tree Seedling (North-East) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)			
1			+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+

**(b) Tree Seedling (South-West) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)			
1			+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+



**Bamboo** (plot size 0.1 ha) (circumference to be taken about 30 cm above ground)

1	Number of rosettes in the plot	=	% Cover=						
2	Rosettes circumference (m)	+ + + + + + + +	Avg.=						
3	Number of culms in rosettes	+ + + + + + + +	Avg.=						

Girth Class: e.g. thick (>20), medium (>10-≤20) and thin (≤10) cm. Please collect **three** samples of 30 cm long for each girth class of culms from base, middle and upper part of the same culms.

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	
2		Thick	+	+		+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+		+	+	

(a) **Herb 1 (1×1 m)** (record epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous.

In 1×1 m: Fresh weight: ..... gm                      Dry Weight: .....gm                      % Cover: ...

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

(b) **Herb 2 (1×1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1×1 m: Fresh weight: ..... gm                      Dry Weight: .....gm                      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

**(c) Herb 3 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

**(d) Herb 4 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

**(e) Herb 5 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

**Number of dead/dry, stumps of trees /cut but live (0.1 ha plot)**

S. No	Species	Dead			Stumps		
		Nos.	Girth (Cm)	Height (m)	Nos.	Girth (cm)	Height (m)
1			+ + +	+ + +		+ + +	+ + +
2			+ + +	+ + +		+ + +	+ + +
3			+ + +	+ + +		+ + +	+ + +

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs+ Branches (gm)		Leaves (gm)		Humus (gm)		Total
	Fresh	Dry	Fresh	Dry	Fresh	Dry	
(a) NE							
(b) NW							
(c) SW							
(d) SE							
(e) Center							

**Plot 4: Madal 3. (Wayanad)**

**PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Wayanad** Plot GPS Point Name = **Madal (3)**

Location/Forest division/Range/Compartment or any landmark:

Site Centre GPS co-ordinates: **Lati. 11° 48' 6.234" Longi.76° 06' 30.184"**

Sample Site-/Plot No.: ~~NE/NW/SW/SE~~ Date: **19/03/ 2010** Time: **08.00 am**

G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 11° 49' 4.810" Longi 76° 08' 2.841"**

Observer: Altitude: Site/Plot: **745 m**

Marking on image: (Google/1:25,000 or larger)

(Tonal characteristics on FCC)

Slope (°): **20°** Photograph Number:

Aspect : ~~NE/SAW/NE/SE/SW/NW~~ Topography General observations):

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**Forest Type: Moist deciduous**

Number of storeys and description: **03**

Top canopy species (Leaves): ***Dalbergia latifolia, Terminalia crenulata, Lagerstroemia microcarpa***

First storey species (Leaves/No leaves): ***Swietenia macrophylla, Bambusa bambos, Wrightia tinctoria***

Second storey species (Leaves/No leaves): ***Cipadessa baccifera, Glycosmis pentaphylla***

Regeneration – only tree species (in general - very good, good and poor): ...**Poor**.....

Disturbance evidence (**Lopping/Cutting/Cattle sighting**/hoof marks/dung/fire/ etc.): .....

Wildlife evidence (Sighting/pug marks/droppings/horns/**sound**/burrows): .....

Grass Cover (%): **20** Ground Cover (overall % including grasses):**75**

Stoniness (pebbles/boulders %): **0** Rock Out-crop (%): **0**

Soil Type: **Forest soil** Soil Colour: **Brown** Soil Texture: **Fine**

Litter thickness: **5 cm**

Humus Colour: **Brown**

Humus thickness: **1cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0220	7.9200	<b>16.92100</b>
0.30-0.60	0.0155	5.6730	
0.60-1.00	0.0064	3.3280	

**CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: Hits: (Canopy/Sky)  
NW-SE: Steps: Hits: (Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: + + + =  
At base of ultimate branch forking 1<sup>st</sup>: + + + =

**Size of Quadrat for Trees (31.62×31.62 m i.e. 0.1 ha)/ Scrub (10×10 m –pl. take more plots)**

(a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –gbh up to mm level.

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	<i>Terminalia paniculata</i>	26.60	4.50	6.50	L
2	<i>Cipadessa baccifera</i>	11.70	1.90	2.50	L
3	<i>Cipadessa baccifera</i>	11.20	1.40	2.50	L
4	<i>Cipadessa baccifera</i>	10.20	1.80	3.00	L
5	<i>Radermachera xylocarpa</i>	60.10	6.00	16.00	L
6	<i>Oroxylum indicum</i>	72.70	7.50	15.00	L
7	<i>Swietenia macrophylla</i>	37.00	–	12.00	L
8	<i>Diospyros montana</i>	11.50	2.25	16.00	L
9	<i>Radermachera xylocarpa</i>	14.50	4.70	6.30	L
10	<i>Canthium coromandelicum</i>	27.20	1.90	5.00	L
11	<i>Terminalia crenulata</i>	15.60	5.00	5.50	L
12	<i>Dalbergia latifolia</i>	115.00	14.50	19.00	L
13	<i>Swietenia macrophylla</i>	19.70	–	9.00	L
14	<i>Cipadessa baccifera</i>	16.80	–	3.80	L
15	<i>Holarrhena pubescens</i>	11.10	2.00	4.00	L
16	<i>Canthium coromandelicum</i>	11.20	1.55	2.50	L
17	<i>Terminalia crenulata</i>	46.30	1.95	2.00	L
18	<i>Diospyros montana</i>	16.30	5.50	6.50	L
19	<i>Wrightia tinctoria</i>	19.30	4.25	5.50	L
20	<i>Naringi crenulata</i>	20.50	4.80	6.00	L
21	<i>Cipadessa baccifera</i>	13.00	1.50	2.80	L
22	<i>Terminalia paniculata</i>	14.50	4.00	5.50	NL
23	<i>Terminalia paniculata</i>	14.70	5.00	4.50	NL
24	<i>Oroxylum indicum</i>	22.60	–	7.00	NL
25	<i>Terminalia paniculata</i>	25.10	3.50	5.50	L
26	<i>Melicope lunu-ankenda</i>	111.00	11.50	20.00	L
27	<i>Cipadessa baccifera</i>	15.90	5.50	7.00	L
28	<i>Cipadessa baccifera</i>	15.20	–	3.50	L
29	<i>Terminalia paniculata</i>	81.90	4.50	7.00	L
30	<i>Terminalia crenulata</i>	173.20	2.00	20.50	L
31	<i>Cipadessa baccifera</i>	11.90	–	5.00	L

32	<i>Cipadessa baccifera</i>	14.60	3.00	5.00	L
33	<i>Canthium coromandelicum</i>	10.50	—	3.70	L
34	<i>Cipadessa baccifera</i>	10.70	—	3.50	L
35	<i>Cipadessa baccifera</i>	11.20	2.25	4.00	L
36	<i>Melicope lunu-ankenda</i>	68.00	3.60	14.50	L
37	<i>Cipadessa baccifera</i>	10.90	—	3.00	L
38	<i>Cipadessa baccifera</i>	13.50	—	1.80	L
39	<i>Canthium coromandelicum</i>	13.50	1.60	5.00	L
40	<i>Cipadessa baccifera</i>	11.80	—	2.50	L
41	<i>Cipadessa baccifera</i>	11.20	—	4.50	L
42	<i>Cipadessa baccifera</i>	10.30	1.70	2.75	L
43	<i>Lagerstroemia microcarpa</i>	68.60	11.50	18.50	L
44	<i>Naringi crenulata</i>	19.80	1.60	5.00	L
45	<i>Radermachera xylocarpa</i>	79.80	10.00	12.00	L
46	<i>Cipadessa baccifera</i>	12.20	1.80	3.00	L
47	<i>Cipadessa baccifera</i>	12.80	2.00	2.50	L
48	<i>Callicarpa tomentosa</i>	13.90	3.00	6.00	L
49	<i>Schleichera oleosa</i>	103.40	3.50	18.00	L
50	<i>Melicope lunu-ankenda</i>	68.60	12.50	16.50	L
51	<i>Bauhinia</i> sps.	61.80	1.40	6.00	L
52	<i>Melicope lunu-ankenda</i>	99.80	11.00	18.00	L
53	<i>Dalbergia latifolia</i>	133.50	8.00	24.00	L
54	<i>Cipadessa baccifera</i>	12.20	—	3.50	L
55	<i>Cipadessa baccifera</i>	14.20	—	4.00	L
56	<i>Haldina cordifolia</i>	75.50	—	16.00	L
57	<i>Lagerstroemia microcarpa</i>	155.60	8.70	15.80	L
58	<i>Cipadessa baccifera</i>	13.50	1.90	3.00	L
59	<i>Helicteres isora</i>	17.50	1.90	3.00	L

(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base) (Please bring representative stem of all shrub species either entire stem or pieces of 15 cm long from base, middle and top of the tiller) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	

**(2) Shrubs (South-West) Size = 5 × 5 m (girth at 30 cm above base)**

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	

**(a) Tree Saplings (North-East) 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)				
1			+	+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+	+

**(b) Tree Saplings (South-West) Size: 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)				
1			+	+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+	+

**(a) Tree Seedling (North-East) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)				
1			+	+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+	+

**(b) Tree Seedling (South-West) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)				
1			+	+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+	+

**Bamboo (plot size 0.1 ha) (circumference to be taken about 30 cm above ground)**

1	Number of rosettes in the plot	=	% Cover=								
2	Rosettes circumference (m)	+	+	+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes	+	+	+	+	+	+	+	+	+	Avg.=

Girth Class: e.g. thick (>20), medium (>10-≤20) and thin (≤10) cm. Please collect **three** samples of 30 cm long for each girth class of culms from base, middle and upper part of the same culms.

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)	Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3				
1		Thick	+	+		+	+		+	+		+	+		
		Medium	+	+		+	+		+	+		+	+		
		Thin	+	+		+	+		+	+		+	+		

**(a) Herb 1 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous.

In 1 × 1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		

**(b) Herb 2 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1 × 1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

**(c) Herb 3 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1 × 1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

**(d) Herb 4 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1 × 1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

**(e) Herb 5 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1 × 1 m: Fresh weight: ..... gm      Dry Weight: .....gm      % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			5		
2			6		
3			7		
4			8		



**Number of dead/dry, stumps of trees /cut but live (0.1 ha plot)**

S. No.	Species	Dead			Stumps		
		Nos.	Girth (Cm)	Height (m)	Nos.	Girth (cm)	Height (m)
1			+ + +	+ + +		+ + +	+ + +
2			+ + +	+ + +		+ + +	+ + +
3			+ + +	+ + +		+ + +	+ + +

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs+ Branches (gm)		Leaves (gm)		Humus (gm)		Total
	Fresh	Dry	Fresh	Dry	Fresh	Dry	
(a) NE							
(b) NW							
(c) SW							
(d) SE							
(e) Center							

**Plot 5: Vattikkal -1 (Malappuram)**

**PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Malappuram** Plot GPS Point Name = **Vattikkal -1**  
 Forest division: **Nilambur South Range: Karulai**  
 Site Centre GPS co-ordinates: **Lati. 11° 17' 27.4" Longi. 76° 21' 47.1"**  
 Sample Site-/Plot No.: **04/01 NE** Date: **01/06/ 2010** Time: **10.00 am**  
 G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 11° 17' 28.2" Longi 76° 21' 51.2"**  
 Observer: **Deepu Divakaran** Altitude: Site/Plot: **70 m/ 70 m**  
 Marking on image: (Google/1:25,000 or larger)  
 (Tonal characteristics on FCC)  
 Slope (°): **0.01°** Photograph Number:  
 Aspect : **SE** Topography General Observations): **Almost flat**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**Forest Type: Moist Deciduous**  
 Number of storeys and description: **03**  
 Top canopy species (Leaves): ***Terminalia paniculata, Lagerstroemia microcarpa, Briedelia retusa***  
 First storey species (Leaves): ***Hydnocarpus pentandra, Schleicheria oleosa, Helicteres isora***  
 Second storey species (Leaves): ***Allophylus serratus, Ziziphus oenoplia, Glycosmis pentaphylla***  
 Regeneration – only **tree species** (in general - very good, good and poor): **Poor**  
 Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.): **Nil**  
 Wildlife evidence (Sighting/pug marks/droppings/horns/sound/burrows): **Sound**  
 Grass Cover (%): **75** Ground Cover (overall % including grasses): **95**  
 Stoniness (pebbles/boulders %): **0** Rock Out-crop (%): **0**  
 Soil Type: **Loamy** Soil Colour: **Dark brown** Soil Texture: **Medium**  
 Litter thickness: **6 cm** Humus Colour: **Pale brown** Humus thickness: **1.5 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0236	7.9481	<b>16.87973</b>
0.30-0.60	0.0156	5.7564	
0.60-1.00	0.0063	3.1752	

**CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: 40 Hits: 34 (Canopy/Sky)  
NW-SE: Steps: 40 Hits: 35 (Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: 31+30+27+26 = 28.5  
at base of ultimate branch forking 1<sup>st</sup> : 8 + 7.5 +9+8.5= 8.25

**Size of Quadrat for Trees (31.62×31.62 m i.e. 0.1 ha)/ Scrub (10×10 m –pl. take more plots)**

(a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –**gbh up to mm level.**

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	<i>Hydnocarpus pentandra</i>	55.80	3.00	9.00	L
2	<i>Hydnocarpus pentandra</i>	13.80	–	2.50	L
3	<i>Persea macrantha</i>	46.50	–	8.50	L
4	<i>Terminalia paniculata</i>	136.10	12.50	19.00	L
5	<i>Terminalia paniculata</i>	166.00	12.50	23.00	L
6	<i>Terminalia paniculata</i>	174.20	13.00	24.00	L
7	<i>Terminalia paniculata</i>	27.50	–	3.00	L
8	<i>Hydnocarpus pentandra</i>	110.20	4.20	11.00	L
9	<i>Hydnocarpus pentandra</i>	52.10	3.80	4.50	L
10	<i>Hydnocarpus pentandra</i>	13.10	–	1.70	L
11	<i>Hydnocarpus pentandra</i>	14.20	–	3.10	L
12	<i>Hydnocarpus pentandra</i>	14.00	2	3.50	L
13	<i>Hydnocarpus pentandra</i>	12.00	–	3.30	L
14	<i>Haldina cordifolia</i>	108.40	–	17.00	L
15	<i>Hydnocarpus pentandra</i>	203.50	7.5	15.50	L
16	<i>Stereospermum colais var. colais</i>	85.10	9.5	19.00	L
17	<i>Terminalia paniculata</i>	258.10	17.0	26.00	L
18	<i>Spondias pinnata</i>	168.20	18.0	25.50	L
19	<i>Persea macrantha</i>	202.10	19.0	27.00	L
20	<i>Hydnocarpus pentandra</i>	229.40	3.5	13.50	L
21	<i>Hydnocarpus pentandra</i>	92.10	1.5	4.50	L
22	<i>Hydnocarpus pentandra</i>	28.50	4.5	6.50	L
23	<i>Dillenia pentagyna</i>	242.30	5.5	21.00	L
24	<i>Briedelia retusa</i>	278.50	7.5	20.00	L
25	<i>Lagerstroemia microcarpa</i>	276.20	18.0	30.00	L
26	<i>Persea macrantha</i>	200.10	22.0	31.00	L
27	<i>Hydnocarpus pentandra</i>	22.00	–	6.50	L
28	<i>Hydnocarpus pentandra</i>	27.50	–	8.00	L
29	<i>Hydnocarpus pentandra</i>	18.10	–	5.50	L
30	<i>Hydnocarpus pentandra</i>	29.90	4.5	7.50	L
31	<i>Schleichera oleosa</i>	11.80	–	4.00	L

(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base) (Please bring representative stem of all shrub species either entire stem or pieces of 15 cm long from base, middle and top of the tiller) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Allophylus serratus</i>	20	5	Thick	1			2.4			1.0			0.10			0.04		
			Medium		1			2.3			1.2			0.06			0.02	
	0.05 %	0.1%	Thin			1			2.0			0.9			0.06			0.02
<i>Dalbergia horrida var. horrida</i>	18	4	Thick	1			2.5			1.6			0.06			0.02		
			Medium		1			2.3			1.3			0.03			0.01	
	0.03 %	0.1%	Thin			1			1.3			0.8			0.01			0.00
<i>Chassalia curviflora var. ophioxylodes</i>	12	3	Thick	1			2.8			1.1			0.09			0.02		
			Medium		1			2.1			0.9			0.08			0.02	
	0.03 %	0.08 %	Thin			1			1.9			0.8			0.05			0.01
<i>Urena lobata ssp. lobata</i>	28	6	Thick	1			1.1			0.5			0.01			0.00		
			Medium		1			1.0			0.5			0.00			0.00	
	0.08 %	0.1%	Thin			1			0.7			0.5			0.00			0.00
<i>Glycosmis pentaphylla</i>	22	6	Thick	1			2.1			0.7			0.06			0.02		
			Medium		1			1.9			0.6			0.03			0.01	
	0.07 %	0.1%	Thin			1			1.3			0.3			0.01			0.00

(2) Shrubs (South-West) Size = 5× 5 m (girth at 30 cm above base)

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(c m)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Glycosmis pentaphylla</i>	22	7	Thick	1			2.2			0.7			0.07			0.02		
			Medium		1		1.8				0.6			0.03			0.01	
	0.07%	0.1%	Thin			1			1.2			0.3			0.00			0.00
<i>Chassalia curviflora var. ophioxylodes</i>	12	4	Thick	1			2.9			1.2			0.09			0.02		
			Medium		1		2.2				1.0			0.08			0.02	
	0.03%	0.08%	Thin			1			1.8			0.8			0.04			0.01
<i>Ziziphus oenoplia</i>	10	4	Thick	1			1.1			1.0			0.07			0.02		
			Medium		1		0.9				0.7			0.04			0.01	
	0.001 %	0.003 %	Thin			1			0.7			0.5			0.00			0.00
<i>Sida acuta</i>	18	2	Thick	1			0.9			0.7			0.02			0.00		
			Medium		1		0.4				0.3			0.01			0.00	
	0.02%	0.01%	Thin															
<i>Allophylus serratus</i>	20	6	Thick	1			2.5			1.1			0.11			0.04		
			Medium		1		2.4				1.2			0.07			0.02	
	0.05%	0.1%	Thin			1			1.9			0.8			0.06			0.02

(a) Tree Saplings (North-East) 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.

Sl.No.	Species	Number	Girth/Diameter (cm)				Height (m)			
1	<i>Mallotus philippensis</i> var. <i>philippensis</i>	4	4.6	3.8	3.2	3.1	0.82	0.75	0.71	0.69
2	<i>Briedelia retusa</i>	1	3.1				1.00			
3	<i>Dillenia pentagyna</i>	1	3.6				0.22			
4	<i>Schleichera oleosa</i>	1	3.1				0.65			

(b) Tree Saplings (South-West) Size: 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm)

Sl.No.	Species	Number	Girth/Diameter (cm)				Height (m)			
1	<i>Hydnocarpus pentandra</i>	2	3.6	4.1			0.67	0.71		
2	<i>Persea macrantha</i>	3	6.8	4.6	4.7		2.89	1.48	1.46	
3	<i>Schleichera oleosa</i>	1	3.6				0.47			

(a) Tree Seedling (North-East) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

Sl.No.	Species	Number	Diameter (cm)				Height (m)			
1	<i>Schleichera oleosa</i>	2	0.8	0.9			0.30	0.34		
2	<i>Cipadessa baccifera</i>	1	1.3				0.39			
3	<i>Persea macrantha</i>	2	1.2	1.7			0.40	0.48		

(b) Tree Seedling (South-West) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

Sl.No.	Species	Number	Diameter (cm)				Height (m)			
1	<i>Hydnocarpus pentandra</i>	1	1.9				0.70			
2	<i>Persea macrantha</i>	3	2.1	2.3	1.6		0.59	0.66	0.41	
3	<i>Schleichera oleosa</i>	2	2.3	1.7			0.75	0.54		

(a) Herb 1 (1 × 1 m) (record epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous.

In 1 × 1 m: Fresh weight: 0.470 gm Dry Weight: 0.163gm % Cover: 90

Sl.No.	Species	No. of individuals
1	<i>Amomum</i> sps	6
2	<i>Dolichos trilobus</i>	3
3	<i>Piper longum</i>	5
4	<i>Cyperus rotundus</i>	6
5	<i>Pothos scandens</i>	2
6	<i>Commelina benghalensis</i>	6

(b) Herb 2 (1 × 1 m) (record epiphytes/lithophytes/climbers etc. also)

In 1 × 1 m: Fresh weight: 0.463 gm Dry Weight: 0.157gm % Cover: 88

Sl.No.	Species	No. of individuals
1	<i>Amomum</i> sps	4
2	<i>Dolichos trilobus</i>	2
3	<i>Alloteropsis cimicina</i>	10
4	<i>Piper longum</i>	5
5	<i>Axonopus compressus</i>	6
6	<i>Commelina benghalensis</i>	2

**(c) Herb 3 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.459 gm Dry Weight: 0.160gm % Cover: 86

Sl.No.	Species	No. of individuals
1	<i>Synedrella nodiflora</i>	2
2	<i>Elephantopus scaber</i>	2
3	<i>Alloteropsis cimicina</i>	12
4	<i>Piper longum</i>	3
5	<i>Commelina benghalensis</i>	4

**(d) Herb 4 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.453 gm Dry Weight: 0.154gm % Cover: 85

Sl.No.	Species	No. of individuals
1	<i>Elephantopus scaber</i>	2
2	<i>Cyathula prostrata</i>	6
3	<i>Cyperus rotundus</i>	14
4	<i>Justicia japonica</i>	9
5	<i>Amomum sps</i>	7

**(e) Herb 5 (1×1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.451 gm Dry Weight: 0.153gm % Cover: 85

Sl.No.	Species	No. of individuals
1	<i>Cyathula prostrata</i>	7
2	<i>Alloteropsis cimicina</i>	11
3	<i>Elephantopus scaber</i>	4
4	<i>Commelina benghalensis</i>	4
5	<i>Ageratum conyzoides</i>	3

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs + Branches (gm)		Leaves (gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
<b>NE</b>	0.126	0.110	0.610	0.488	0.180	0.125	0.916	0.723
<b>NW</b>	0.118	0.103	0.598	0.477	0.172	0.121	0.888	0.701
<b>SW</b>	0.110	0.096	0.587	0.469	0.174	0.123	0.871	0.688
<b>SE</b>	0.128	0.111	0.591	0.474	0.168	0.117	0.887	0.702
<b>Center</b>	0.114	0.099	0.582	0.470	0.164	0.113	0.860	0.682

**Plot 6: Vattikkal-2 (Malappuram)**

**National Vegetation Carbon Pool Assessment (NCP IGBP)**

**PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS**

**CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Malappuram** Plot GPS Point Name = **Vattikkal -2**  
 Forest division: **Nilambur South Range: Karulai**  
 Site Centre GPS co-ordinates: **Lati. 11° 17' 27.4" Longi. 76° 21' 47.1"**  
 Sample Site-/Plot No.: **04/02 NW** Date: **03/06/ 2010** Time: **9.30 am**  
 G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 11° 17' 31.1" Longi 76° 21' 46.3"**  
 Observer: **Deepu Divakaran** Altitude: Site/Plot: **70 m/ 70 m**  
 Marking on image: (Google/1:25,000 or larger)  
 (Tonal characteristics on FCC)  
 Slope (°): **0.01°** Photograph Number:  
 Aspect : **SW** Topography General Observations): **Almost flat**

**CATEGORY 2: FOREST AND SOIL- GENERAL:**

**Forest Type: Moist Deciduous**  
 Number of storeys and description: **03**  
 Top canopy species (Leaves): ***Terminalia elliptica, Terminalia paniculata***  
 First storey species (Leaves): ***Dillenia pentagyna, Stereospermum colais var. colais, Careya arborea***  
 Second storey species (Leaves): ***Ziziphus oenoplia, Holarrhena pubescens***  
 Regeneration – only **tree species** (in general - very good, good and poor): **Poor**  
 Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.): Nil  
 Wildlife evidence (Sighting/pug marks/droppings/horns/sound/burrows): **Dung (Elephant & Gaur)**  
 Grass Cover (%): **99** Ground Cover (overall % including grasses): **99.5**  
 Stoniness (pebbles/boulders %): **0** Rock Out-crop (%): **0**  
 Soil Type: **Loamy** Soil Colour: **Dark brown** Soil Texture: **Medium**  
 Litter thickness: **3-5 cm** Humus Colour: **Pale brown** Humus thickness: **1 cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0217	7.1120	1463043
0.30-0.60	0.0140	5.8800	
0.60-1.00	0.0064	1.6384	



**CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: 40 Hits: 12 (Canopy/Sky)  
NW-SE: Steps: 40 Hits: 30 (Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: 30+ 33+28 +25 = 29  
at base of ultimate branch forking 1<sup>st</sup> : 18+ 20+13.5+12 = 15.88

**Size of Quadrat for Trees (31.62×31.62 m i.e. 0.1 ha)/ Scrub (10×10 m –pl. take more plots)**

(a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –gbh up to mm level.

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	<i>Terminalia paniculata</i>	100.20	3.5	11.00	L
2	<i>Terminalia elliptica</i>	315.10	6.5	30.00	L
3	<i>Dillenia pentagyna</i>	94.30	12.0	18.00	L
4	<i>Dillenia pentagyna</i>	106.10	12.5	20.00	L
5	<i>Terminalia elliptica</i>	190.40	9.0	20.00	L
6	<i>Cassia fistula</i>	48.90	10.0	11.00	L
7	<i>Stereospermum colais var. colais</i>	11.00	1.5	3.25	L
8	<i>Strychnos nux-vomica</i>	21.60	6.0	7.00	L
9	<i>Strychnos nux-vomica</i>	28.10	5.5	7.00	L
10	<i>Strychnos nux-vomica</i>	13.20	–	5.50	L
11	<i>Strychnos nux-vomica</i>	14.30	–	5.00	L
12	<i>Ziziphus oenoplia</i>	14.10	–	5.00	L
13	<i>Ziziphus oenoplia</i>	38.20	5.0	7.20	L
14	<i>Ziziphus oenoplia</i>	44.10	6.0	7.50	L
15	<i>Ziziphus oenoplia</i>	31.10	5.5	7.00	L
16	<i>Ziziphus oenoplia</i>	51.20	2.3	6.00	L
17	<i>Ziziphus oenoplia</i>	53.40	–	6.50	L
18	<i>Terminalia paniculata</i>	16.30	1.7	3.00	L
19	<i>Terminalia paniculata</i>	10.00	–	2.50	L
20	<i>Dillenia pentagyna</i>	110.60	10.0	13.50	L
21	<i>Terminalia paniculata</i>	14.00	1.8	3.00	L
22	<i>Careya arborea</i>	121.70	8.5	12.00	L
23	<i>Buchanania lanzan</i>	116.30	15.0	19.50	L
24	<i>Terminalia elliptica</i>	152.40	13.5	25.50	L
25	<i>Hydnocarpus pentandra</i>	11.00	2.0	2.50	L
26	<i>Terminalia elliptica</i>	170.90	20.0	28.00	L
27	<i>Pterocarpus marsupium</i>	327.80	11.0	33.00	L

(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base) (Please bring representative stem of all shrub species either entire stem or pieces of 15 cm long from base, middle and top of the tiller) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Allophylus serratus</i>	21	6	Thick	1			2.5			1.15			0.110			0.045		
			Medium		1			2.2			1.12			0.065			0.021	
	0.05%	0.1%	Thin			1			2.0			0.95			0.064			0.025
<i>Urena lobata</i> ssp. <i>lobata</i>	29	7	Thick	1			1.4			0.38			0.006			0.002		
			Medium		1			0.9			0.45			0.004			0.001	
	0.08%	0.1%	Thin			1			0.7			0.30			0.003			0.001
<i>Chromolaena odorata</i>	88	21	Thick	3			2.5			1.50			0.195			0.065		
			Medium		3			1.5			0.78			0.036			0.006	
	0.005%	5%	Thin			2			0.9			0.40			0.010			0.002

(2) Shrubs (South-West) Size = 5× 5 m (girth at 30 cm above base)

Species/bush	No. of bushes and % cover		No. of tillers in 3 bushes of each species			Girth/Diam.(cm)			Height (m)			Fresh Wt.(gm)			Dry Wt.(gm)			
	0.1 ha	5 x 5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Sida acuta</i>	18	2	Thick	1			1.0			0.75			0.023			0.008		
			Medium		1			0.5			0.40			0.014			0.004	
	0.02%	0.01%	Thin															
<i>Chromolaena odorata</i>	88	8	Thick	1			2.6			1.35			0.115			0.046		
			Medium		1			2.5			1.26			0.075			0.024	
	0.005%	2%	Thin			1			1.7			0.85			0.057			0.023
<i>Urena lobata</i> ssp. <i>lobata</i>	29	8	Thick	1			1.4			0.59			0.013			0.004		
			Medium		1			0.9			0.51			0.007			0.002	
	0.08%	0.1%	Thin			1			0.6			0.48			0.003			0.001

(a) **Tree Saplings (North-East)** 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.

Sl.No	Species	Number	Girth/Diameter (cm)				Height (m)			
1	<i>Dillenia pentagyna</i>	1	3.7				0.24			
2	<i>Persea macrantha</i>	2	6.5	4.3			2.82	1.43		
3	<i>Briedelia retusa</i>	1	3.3				1.30			
4	<i>Schleichera oleosa</i>	1	3.4				0.68			

(b) **Tree Saplings (South-West)** Size: 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm)

Sl.No	Species	Number	Girth/Diameter (cm)				Height (m)			
1	<i>Tectona grandis</i>	1	3.9				0.69			
2	<i>Persea macrantha</i>	2	6.7	4.8			2.85	1.45		
3	<i>Schleichera oleosa</i>	1	3.2				0.44			
4	<i>Hydnocarpus pentandra</i>	2	3.8	4.4			0.70	0.74		

(a) **Tree Seedling (North-East)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

Sl.No.	Species	Number	Diameter (cm)				Height (m)			
1	<i>Schleichera oleosa</i>	2	0.7	0.8			0.28	0.32		
2	<i>Hydnocarpus pentandra</i>	1	1.5				0.40			
3	<i>Persea macrantha</i>	2	1.4	1.8			0.43	0.49		

(b) **Tree Seedling (South-West)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

Sl.No.	Species	Number	Diameter (cm)				Height (m)			
1	<i>Holarrhena pubescens</i>	1	1.6				0.47			
2	<i>Persea macrantha</i>	3	2.4	2.1	1.8		0.61	0.62	0.43	
3	<i>Schleichera oleosa</i>	2	2.5	1.9			0.76	0.56		

(a) **Herb 1 (1× 1 m)** (record epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous.

In 1×1 m: Fresh weight: 0.209 gm Dry Weight: 0.064gm % Cover: 83

Sl.No.	Species	No. of individuals
1	<i>Chamaesyce hirta</i>	3
2	<i>Alloteropsis cimicina</i>	98
3	<i>Curculigo orchioides</i>	38
4	<i>Hemidesmus indicus var. indicus</i>	2
5	<i>Dolichos trilobus</i>	1

**(b) Herb 2 (1× 1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.218 gm Dry Weight: 0.069gm % Cover: 85

Sl.No.	Species	No. of individuals
1	<i>Curculigo orchioides</i>	28
2	<i>Cyperus rotundus</i>	17
3	<i>Alloteropsis cimicina</i>	53
4	<i>Cyathula prostrata</i>	6
5	<i>Axonopus compressus</i>	6

**(c) Herb 3 (1× 1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.184 gm Dry Weight: 0.059gm % Cover: 79

Sl.No.	Species	No. of individuals
1	<i>Amomum</i> sps	8
2	<i>Elephantopus scaber</i>	3
3	<i>Cyathula prostrata</i>	16
4	<i>Alloteropsis cimicina</i>	21
5	<i>Cyperus rotundus</i>	13

**(d) Herb 4 (1× 1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.159gm Dry Weight: 0.049gm % Cover: 73

Sl.No.	Species	No. of individuals
1	<i>Cyperus rotundus</i>	16
2	<i>Curculigo orchioides</i>	8
3	<i>Elephantopus scaber</i>	3
4	<i>Brachiaria remota</i>	38
5	<i>Cyathula prostrata</i>	14

**(e) Herb 5 (1× 1 m) (recorded epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: 0.146 gm Dry Weight: 0.044gm % Cover: 71

Sl.No.	Species	No. of individuals
1	<i>Cyathula prostrata</i>	18
2	<i>Synedrella nodiflora</i>	4
3	<i>Alloteropsis cimicina</i>	19
4	<i>Ageratum conyzoides</i>	6
5	<i>Brachiaria remota</i>	28

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs + Branches (gm)		Leaves (gm)		Humus (gm)		Total	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
<b>NE</b>	0.202	0.166	0.156	0.130	0.111	0.089	0.469	0.385
<b>NW</b>	0.198	0.165	0.142	0.118	0.102	0.083	0.442	0.366
<b>SW</b>	0.176	0.145	0.139	0.115	0.095	0.078	0.410	0.338
<b>SE</b>	0.184	0.153	0.146	0.121	0.106	0.086	0.436	0.361
<b>Center</b>	0.165	0.136	0.130	0.109	0.089	0.073	0.384	0.317

## Plot 7: Vattikkal -3

### National Vegetation Carbon Pool Assessment (NCP IGBP)

#### PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS

##### CATEGORY 1: SITE AND OBSERVER

State: **Kerala** District: **Malappuram** Plot GPS Point Name = **Vattikkal- 3**

Forest division: **Nilambur South Range: Karulai**

Site Centre GPS co-ordinates: **Lati. 11° 17' 27.4" Longi. 76° 21' 47.1"**

Sample Site-/Plot No.: **04/03 NW** Date: **04/06/ 2010** Time: **9.00 am**

G.P.S. Reading (HHDD: MM:SS and WGS 84): Lati °' " Longi °' "

Observer: **Deepu Divakaran** Altitude: Site/Plot: **90 m**

Marking on image: (Google/1:25,000 or larger)

(Tonal characteristics on FCC)

Slope (°): **0.01°**

Photograph Number:

Aspect : **NW**

Topography General Observations): **Almost flat**

##### CATEGORY 2: FOREST AND SOIL- GENERAL:

**Forest Type: Moist Deciduous**

Number of storeys and description: **03**

Top canopy species (Leaves): ***Terminalia elliptica, Terminalia paniculata***

First storey species (Leaves): ***Careya arborea, Strychnos nux-vomica***

Second storey species (Leaves/No leaves): ***Ziziphus oenoplia, Chromolaena odorata***

Regeneration – only **tree species** (in general - very good, good and poor): **Poor**

Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.):

Lopping

Wildlife evidence (Sighting/pugmarks/droppings/horns/sound/burrows): **Dung**

**(Elephant)**

Grass Cover (%): **99** Ground Cover (overall % including grasses): **99.5**

Stoniness (pebbles/boulders %): **0** Rock Out-crop (%): **0**

Soil Type: **Loamy** Soil Colour: **Dark Brown** Soil Texture: **Medium**

Litter thickness: **2-4 cm** Humus Colour: **Pale Brown** Humus thickness: **0.5cm**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0225	7.2401	13.79933
0.30-0.60	0.0122	4.3920	
0.60-1.00	0.0043	2.1672	

### **CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals):

NE-SW: Steps: 40 Hits: 32 (Canopy/Sky) NW-SE: Steps: 40 Hits: 13 (Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy):

Top: 33+33.5+28.5+27 = 30.5 At base of ultimate branch forking 1<sup>st</sup>: 9 +9.5 +6.+7.5 = 8.13

**Size of Quadrat for Trees** (31.62×31.62 m i.e. 0.1 ha)/ **Scrub** (10×10 m –pl. take more plots)

- (a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –**gbh up to mm level.**

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	<i>Terminalia elliptica</i>	70.00	–	17.50	L
2	<i>Terminalia elliptica</i>	141.00	14.5	25.00	L
3	<i>Terminalia paniculata</i>	21.00	2.1	3.50	L
4	<i>Miliusa tomentosa</i>	10.20	–	2.00	L
5	<i>Miliusa tomentosa</i>	10.10	1.5	2.00	L
6	<i>Tamilnadia uliginosa</i>	10.50	–	2.50	L
7	<i>Pajanelia longifolia</i>	19.50	–	3.50	L
8	<i>Terminalia elliptica</i>	137.40	–	25.00	L
9	<i>Terminalia elliptica</i>	174.60	19.0	33.00	L
10	<i>Careya arborea</i>	14.10	–	3.50	L
11	<i>Terminalia elliptica</i>	190.80	15.5	33.50	L
12	<i>Terminalia elliptica</i>	84.20	17.0	21.00	L
13	<i>Careya arborea</i>	12.60	–	2.00	L
14	<i>Terminalia paniculata</i>	11.80	1.5	2.50	L
15	<i>Strychnos nux-vomica</i>	20.10	–	7.50	L
16	<i>Strychnos nux-vomica</i>	20.80	–	6.00	L
17	<i>Strychnos nux-vomica</i>	22.10	–	6.50	L
18	<i>Strychnos nux-vomica</i>	73.70	6.2	15.50	L
19	<i>Pajanelia longifolia</i>	40.20	–	10.00	L
20	<i>Terminalia elliptica</i>	149.20	18.0	27.00	L

21	<i>Terminalia elliptica</i>	185.00	20.0	28.50	L
22	<i>Buchanania lanzan</i>	106.20	—	6.20	L
23	<i>Buchanania lanzan</i>	68.10	—	7.30	L
24	<i>Buchanania lanzan</i>	28.20	—	3.00	L
25	<i>Careya arborea</i>	96.80	2.1	9.50	L
26	<i>Careya arborea</i>	97.90	4.5	9.00	L
27	<i>Terminalia paniculata</i>	149.20	10.0	18.00	L
28	<i>Terminalia paniculata</i>	174.10	9.0	16.00	L
29	<i>Careya arborea</i>	124.60	1.7	6.50	L
30	<i>Terminalia elliptica</i>	175.30	14.5	23.00	L
31	<i>Terminalia elliptica</i>	145.30	12.0	22.00	L

**(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base)** (Please bring representative stem of all shrub species either **entire stem or pieces of 15 cm long from base, middle and top of the tiller**) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	

**(2) Shrubs (South-West) Size = 5× 5 m (girth at 30 cm above base)**

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	

**(a) Tree Saplings (North-East) 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)			
1			+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+



**(b) Tree Saplings (South-West)** Size: 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm)

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)
1			+ + + +	+ + + +
2			+ + + +	+ + + +
3			+ + + +	+ + + +

**(a) Tree Seedling (North-East)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)
1			+ + + +	+ + + +
2			+ + + +	+ + + +
3			+ + + +	+ + + +

**(b) Tree Seedling (South-West)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)
1			+ + + +	+ + + +
2			+ + + +	+ + + +
3			+ + + +	+ + + +

**Bamboo** (plot size 0.1 ha) (circumference to be taken about 30 cm above ground)

1	Number of rosettes in the plot	=	% Cover=
2	Rosettes circumference (m)	+ + + + + + + +	Avg.=
3	Number of culms in rosettes	+ + + + + + + +	Avg.=

Girth Class: e.g. thick (>20), medium (>10-≤20) and thin (≤10) cm. Please collect **three** samples of 30 cm long for each girth class of culms from base, middle and upper part of the same culms.

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)		Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	3	
1		Thick	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +		
		Medium	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +		
		Thin	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +		

**(a) Herb 1 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous. **Keep record.**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			3		
2			4		

**(b) Herb 2 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**(c) Herb 3 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**(d) Herb 4 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**(e) Herb 5 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**Number of dead/dry, stumps of trees /cut but live (0.1 ha plot)**

S. No.	Species	Dead			Stumps		
		Nos.	Girth (Cm)	Height (m)	Nos.	Girth (cm)	Height (m)
1			+ + +	+ + +		+ + +	+ + +
2			+ + +	+ + +		+ + +	+ + +
3			+ + +	+ + +		+ + +	+ + +

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	<b>Twigs+ Branches (gm)</b>		<b>Leaves (gm)</b>		<b>Humus (gm)</b>		<b>Total</b>
	Fresh	Dry	Fresh	Dry	Fresh	Dry	
(a) NE							
(b) NW							
(c) SW							
(d) SE							
(e) Center							

## Plot 8: Vattikkal -4 (Malappuram)

### National Vegetation Carbon Pool Assessment (NCP IGBP)

#### PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS

##### CATEGORY 1: SITE AND OBSERVER

State: **Kerala** District: **Malappuram** Plot GPS Point Name = **Vattikkal - 4**

Forest division: **Nilambur South Range: Karulai**

Site Centre GPS co-ordinates: **Lati. 11° 17' 27.4" Longi. 76° 21' 47.1"**

Sample Site-/Plot No.: **04/04 NE** Date: 05/06/ 2010 Time: **8.30 am**

G.P.S. Reading (HHDD: MM:SS and WGS 84): **Lati 11° 17' 22.9" Longi 76° 21' 46"**

**Observer: Deepu Divakaran** Altitude: Site/Plot: **80 m**

Marking on image: (Google/1:25,000 or larger)

(Tonal characteristics on FCC)

Slope (°): **0.02°**

Photograph Number:

Aspect : **NE**

Topography General Observations): **Almost flat**

##### CATEGORY 2: FOREST AND SOIL- GENERAL:

**Forest Type: Moist Deciduous**

Number of storeys and description: **03**

Top canopy species (Leaves): ***Lagerstroemia microcarpa, Persea macrantha, Tectona grandis***

First storey species (Leaves): ***Hydnocarpus pentandra, Schleicheria oleosa***

Second storey species (Leaves): ***Glycosmis pentaphylla, Allophylus serratus***

Regeneration – only **tree species** (in general - very good, good and poor): **Poor**

Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.): **Cattle**

Wildlife evidence (Sighting/pug marks/droppings/horns/sound/burrows): **Dung**

**(Elephant)**

Grass Cover (%): **40** Ground Cover (overall % including grasses): **99**

Stoniness (pebbles/boulders %): **0** Rock Out-crop (%): **0**

Soil Type: **Loamy** Soil Colour: **Dark Brown** Soil Texture: **Medium:**

Litter thickness: **7-10 cm** Humus Colour: **Pale Brown** Humus thickness: **1.5**

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0260	8.3460	14.68920
0.30-0.60	0.0134	4.6632	
0.60-1.00	0.0035	1.6800	

### **CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: 40 Hits: 33 (Canopy/Sky) NW-SE: Steps: 40 Hits: 35 (Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: 32+34+30+34 = 32.5 At base of ultimate branch forking 1<sup>st</sup> : 13+17+12+17 = 14.75

**Size of Quadrat for Trees** (31.62×31.62 m i.e. 0.1 ha)/ **Scrub** (10×10 m) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) – **gbh up to mm level.**

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	<i>Schleichera oleosa</i>	85.20	12.0	23.00	L
2	<i>Schleichera oleosa</i>	57.50	14.0	20.00	L
3	<i>Persea macrantha</i>	159.60	17.0	28.00	L
4	<i>Tectona grandis</i>	204.80	11.0	29.00	L
5	<i>Hydnocarpus pentandra</i>	40.80	5.0	10.50	L
6	<i>Hydnocarpus pentandra</i>	35.60	—	13.00	L
7	<i>Hydnocarpus pentandra</i>	70.40	10.0	17.00	L
8	<i>Hydnocarpus pentandra</i>	32.10	7.0	9.00	L
9	<i>Hydnocarpus pentandra</i>	15.40	4.0	4.50	L
10	<i>Terminalia paniculata</i>	140.70	16.0	28.00	L
11	<i>Lagerstroemia microcarpa</i>	253.20	17.0	32.00	L
12	<i>stereospermum colais var. colais</i>	162.80	4.0	34.00	L
13	<i>Hydnocarpus pentandra</i>	98.40	6.5	17.00	L
14	<i>Hydnocarpus pentandra</i>	49.20	5.5	12.00	L
15	<i>Hydnocarpus pentandra</i>	42.60	3.0	7.00	L
16	<i>Hydnocarpus pentandra</i>	213.80	11.0	24.00	L
17	<i>Tectona grandis</i>	130.10	9.0	23.00	L
18	<i>Schleichera oleosa</i>	83.40	8.5	15.50	L
19	<i>Tectona grandis</i>	224.80	7.0	30.00	L
20	<i>Schleichera oleosa</i>	146.10	6.0	24.00	L
21	<i>Tectona grandis</i>	216.80	24.0	34.00	L

22	<i>Tectona grandis</i>	76.10	—	9.00	L
23	<i>Tectona grandis</i>	121.40	13.5	20.00	L
24	<i>Schleichera oleosa</i>	127.60	9.5	17.00	L
25	<i>Schleichera oleosa</i>	38.40	—	13.00	L
26	<i>Tectona grandis</i>	120.40	—	20.00	L
27	<i>Schleichera oleosa</i>	62.40	10.0	18.00	L
28	<i>Schleichera oleosa</i>	12.80	—	1.80	L
29	<i>Tectona grandis</i>	158.40	13.0	19.50	L

**(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base)** (Please bring representative stem of all shrub species either **entire stem or pieces of 15 cm long from base, middle and top of the tiller**) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	

**(2) Shrubs (South-West) Size = 5× 5 m (girth at 30 cm above base)**

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	

**(a) Tree Saplings (North-East) 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)			
1			+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+

**(b) Tree Saplings (South-West)** Size: 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm)

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)
1			+ + + +	+ + + +
2			+ + + +	+ + + +
3			+ + + +	+ + + +
8			+ + + +	+ + + +

**(a) Tree Seedling (North-East)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)
1			+ + + +	+ + + +
2			+ + + +	+ + + +
3			+ + + +	+ + + +

**(b) Tree Seedling (South-West)** Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)
1			+ + + +	+ + + +
2			+ + + +	+ + + +
3			+ + + +	+ + + +

**Bamboo** (plot size 0.1 ha) (circumference to be taken about 30 cm above ground)

1	Number of rosettes in the plot	=	% Cover=
2	Rosettes circumference (m)	+ + + + + + + +	Avg.=
3	Number of culms in rosettes	+ + + + + + + +	Avg.=

Girth Class: e.g. thick (>20), medium (>10-≤20) and thin (≤10) cm. **Three** samples of 30 cm long for each girth class of culms from base, middle and upper part of the same culms.

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)		Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3	1	2	3	
1		Thick	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
		Medium	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
		Thin	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
2		Thick	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
		Medium	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	
		Thin	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	

**(a) Herb 1 (1×1 m)** (recorded epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous.

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**(b) Herb 2 (1× 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**(c) Herb 3 (1× 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**(d) Herb 4 (1× 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		

**(e) Herb 5 (1× 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			4		
2			5		
3			6		



**Number of dead/dry, stumps of trees /cut but live (0.1 ha plot)**

S. No.	Species	Dead			Stumps		
		Nos.	Girth (Cm)	Height (m)	Nos.	Girth (cm)	Height (m)
1			+ + +	+ + +		+ + +	+ + +
2			+ + +	+ + +		+ + +	+ + +
3			+ + +	+ + +		+ + +	+ + +

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs+ Branches (gm)		Leaves (gm)		Humus (gm)		Total
	Fresh	Dry	Fresh	Dry	Fresh	Dry	
(a) NE							
(b) NW							
(c) SW							
(d) SE							
(e) Center							

## Plot 9: Punjavayal-1 (Wayanad)

### National Vegetation Carbon Pool Assessment (NCP IGBP)

#### PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS

##### **CATEGORY 1: SITE AND OBSERVER**

State: **Kerala** District: **Wayanad** Plot GPS Point Name = **Punchavayal -1**

Location/Forest division/Range/Compartment or any landmark: Near Punchavayal thodu tributary of kabana (Forest area MD)

Site Centre GPS co-ordinates: Lati. **10° 51.'42.23"** Longi. **76°2'14.820"**

Sample Site-/Plot No.: S1 /NE/NW/SW/SE Date: 3/11/ 2009 Time: 9.30am

G.P.S. Reading (HHDD: MM:SS and WGS 84): Lati °....'...."Longi ...°.....'....."

Observer: Deepu Divakaran Altitude: Site/Plot: ... m/ .... m

Marking on image: (Google/1:25,000 or larger)  
(Tonal characteristics on FCC)

Slope (°): Photograph Number:

Aspect : N/E/S/W/NE/SE/SW/NW Topography General observations):

##### **CATEGORY 2: FOREST AND SOIL- GENERAL:**

**Forest Type: MD**

Number of storeys and description: **3**

Top canopy species (Leaves/No leaves): **Stereospermum colais, Lagerstromea macrocarpa**

First storey species (Leaves/No leaves): **Cassia, Helicteres, Zyziphus**

Second storey species (Leaves/No leaves): **Chromolena, Lantana**

Regeneration – only tree species (in general - very good, good and poor):

Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.):

Wildlife evidence (Sighting/pug marks/droppings/horns/sound/burrows):

Grass Cover (%): **99** Ground Cover (overall % including grasses): **99.9**

Stoniness (pebbles/boulders %): Rock Out-crop (%):

Soil Type: Soil Colour: Soil Texture:

Litter thickness: Humus Colour: Humus thickness:

Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (Kg%)	Carbon mass (kg/m <sup>2</sup> )
0.00-0.30	0.0137	4.8498	10.9626
0.30-0.60	0.0116	4.3848	
0.60-1.00	0.0032	1.728	

### **CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: Hits: 20 (Canopy/Sky) 53 NW-SE: Steps: Hits: (/Sky)27

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: 19 + + + = At base of ultimate branch forkin 1<sup>st</sup>: + + + =

**Size of Quadrat for Trees** (31.62×31.62 m i.e. 0.1 ha)/ **Scrub** (10×10m) (a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –**gbh up to mm level.**

Tree id.	Species	Gbh (≥ 10 cm) all plants	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	Cassia fistula	24.2		3.4	
2	Cassia fistula	17.8	1.8	3.4	
3	Lagerstroemia microcarpa	159.5	2.5	12	
4	Helictus isora	17.2	1.45	3.5	
5	Cassia fistula	12.2	2.2	4.2	
6	Helictus isora	22.3	1.75	2.5	
7	Steriospermum colais	318	8.5	24	
8	Helictus isora	12.8		1.5	
9	Lagerstroemia microcarpa	154		14	
10	Lagerstroemia microcarpa	41.2	1.5	4	
11	Cassia fistula	36.9	1.45	5.8	
12	Helictus isora	19.7	1.5	4	
13	Cassia fistula	11.2	1.5	4	
14	Helictus isora	22.1	2.1	3.5	
15	Cassia fistula	21.1	2	5	
16	Cassia fistula	21	2	5	
17	Ziziphus mauritiana	15	2	5.5	
18	Cassia fistula	13	2	5	
19	Cassia fistula	14	2	5	
20	Cassia fistula	11	1.95	4.5	

21	Cassia fistula	12	13.1	5.2	
22	Cassia fistula	12.2	13.7	5	
23	Cassia fistula	16.6	3	5	
24	Cassia fistula	21	2	4.2	
25	Cassia fistula	16	3	5	
26	Lagerstroemia microcarpa	131.2	5.5	14	
27	Lagerstroemia microcarpa	243.6	2.75	19	

**(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base)** (Please bring representative stem of all shrub species either **entire stem or pieces of 15 cm long from base, middle and top of the tiller**) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Chromo lena odorata			Thick	3+	3	+2+4+3	5+	4.9	+6.9+5+4	1.5+	2.5	+ .3+2.1+1.8	+	+		+	+	
			Medium	3+		+	2.6+		+	+	+		1.8+		+	+		+
			Thin	1+		2	+1+2						+	+		+	+	
Solanu m torvum			Thick	1+		1	+	2.6+		+	.95+		+	+		+	+	
			Medium	1+	1	+		+	+	+	+		+	+		+	+	
			Thin	1+1		+		.9+		12+	10	+	+	+		+	+	
Urena labata			Thick	+		+		+	+	+	+		+	+		+	+	
			Medium	1+	1	+		1.6+		+.35+		+	+.44		+	+		+
			Thin	1+1		+		1.3+		.45+	.50	+		+	+		+	+
Lantana camara			Thick	4+	3	+		5.3+		+	+		+	+		+	+	
			Medium	5+6+2				5.2+4.9+5.1+5.2		+	+		+	+		+	+	
			Thin	2+	4	+		2.3+		+	+		+	+		+	+	
Glycos mis pentaph ylla			Thick	1+	1	+		3.4+	3.7	+	+	+	5+	5.4	+	+	+	
			Medium	1+		+		2.4+		+	+		4.1+		+	+	+	
			Thin	+		+		+	+		+	+	+	+		+	+	

**(2) Shrubs (South-West) Size = 5× 5 m (girth at 30 cm above base)**

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)			
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
Lantana camara			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	1+	+		2.3+	+		.65+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
Solanu m torvum			Thick	+	+		+	+		45+	30	+	+	+		+	+	
			Medium	2.1+	+		+	+		+	+		+	+		+	+	
			Thin	+	+		+	+		+	+		+	+		+	+	
Sida cordata			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	1+	+		+	+		+	+		+	+		+	+	
			Thin	1+	1	+	1			+	+		+	+		+	+	
Catunar egam spinosa			Thick	+	+		+	+		+	+		+	+		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+	
			Thin	1+	+		+	+		+	+		4+	+		+	+	

**(a) Tree Saplings (North-East) 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.**

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)					
1	Helicteres isora		+	+	+	+	+	+	+
2			+	+	+	+	+	+	+
3			+	+	+	+	+	+	+

**(b) Tree Saplings (South-West) Size: 5× 5 m plot (>10 cm tall and/or girth 3 to <10 cm)**

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)					
1	Helicteres isora		+	+	+	+	+	+	+
2	Bauhinia sps		+	+	+	+	+	+	+
3	Diospiros montana		+	+	+	+	+	+	+

**(a) Tree Seedling (North-East) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)					
1			+	+	+	+	+	+	+
2			+	+	+	+	+	+	+
3			+	+	+	+	+	+	+

**(b) Tree Seedling (South-West) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)	Height (m)					
1			+	+	+	+	+	+	+
2			+	+	+	+	+	+	+

**Bamboo** (plot size 0.1 ha) (circumference to be taken about 30 cm above ground)

1	Number of rosettes in the plot	=								% Cover=
2	Rosettes circumference (m)		+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes		+	+	+	+	+	+	+	Avg.=

Girth Class: e.g. thick (>20), medium (>10-≤20) and thin (≤10) cm. Please collect **three** samples of 30 cm long for each girth class of culms from base, middle and upper part of the same culms.

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)	Dry Weight (gm)	
			1	2	3	1	2	3	1	2	3		1	2
1		Thick	+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+	
2		Thick	+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+	
3		Thick	+	+		+	+		+	+		+	+	
		Medium	+	+		+	+		+	+		+	+	
		Thin	+	+		+	+		+	+		+	+	

(a) **Herb 1 (1×1 m)** (recorded epiphytes/lithophytes/climbers etc. also).

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	Cyathula prostrate		6	Justicia	3
2	Mimosa pudica	62	7	Scoparia duls	3
3	Cyperus	8	8		
4	Cinderalla	8	9		
5	Fern sp.	9	10		

(b) **Herb 2 (1×1 m)** (recorded epiphytes/lithophytes/climbers etc. also)

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	Mimosa	3	7	Justicia	
2	Cyperus	10	8		
3	Ammomum	12	9		
4	Senna tora	5	10		
5	Cyathula	20	11		
6	Cinderella	6	12		

**(c) Herb 3 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			5		
2			6		
3			7		
4			8		

**(d) Herb 4 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			5		
2			6		
3			7		
4			8		

**(e) Herb 5 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1			5		
2			6		
3			7		
4			8		

**Number of dead/dry, stumps of trees /cut but live (0.1 ha plot)**

S. No.	Species	Dead			Stumps		
		Nos.	Girth (Cm)	Height (m)	Nos.	Girth (cm)	Height (m)
1			+ + +	+ + +		+ + +	+ + +
2			+ + +	+ + +		+ + +	+ + +
3			+ + +	+ + +		+ + +	+ + +

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs+ Branches (gm)		Leaves (gm)		Humus (gm)		Total
	Fresh	Dry	Fresh	Dry	Fresh	Dry	
(a) NE							
(b) NW							
(c) SW							
(d) SE							
(e) Center							

## Plot 10: Punjavayal - 2 (Wayanad)

### National Vegetation Carbon Pool Assessment (NCP IGBP)

#### PROFORMA FOR FIELD DATA COLLECTION FOREST ECOSYSTEMS

##### CATEGORY 1: SITE AND OBSERVER

State: **Kerala** District: **Wayanad** Plot GPS Point Name = **Punjavayal -2**

Location/Forest division/Range/Compartment or any landmark: **Wayanad WLS**

Site Centre GPS co-ordinates: Lati. **10° 52'35.40"** Longi. **76°6'12.19"**

Sample Site-/Plot No.: **S1P2** /NE/NW/SW/SE Date: **27/07/ 2010** Time: 10 am

G.P.S. Reading (HHDD: MM:SS and WGS 84): Lati **10° 52'37.42"** Longi **76°6'10.04"**

Observer: **Deepu Divakaran** Altitude: Site/Plot: **750 m/ 760 m**

Marking on image: (Google/1:25,000 or larger)

(Tonal characteristics on FCC)

Slope (°):

Photograph Number:

Aspect : **N/E/S/W/NE/SE/SW/NW**

Topography General observations): **Hill**

##### CATEGORY 2: FOREST AND SOIL- GENERAL:

**Forest Type: MD**

Number of storeys and description: **3**

Top canopy species (Leaves/No leaves): **Lagerstroemia micarocarpa, Termiinalaia bellirica, Schleschera oleosa**

First storey species (Leaves/No leaves): **Cassia fistula, Melina arborea, Canthium**

Second storey species (Leaves/No leaves): **Helicteres, Lantana, Chromalena**

Regeneration – only tree species (in general - very good, good and poor): **Poor**

Disturbance evidence (Lopping/cutting/cattle sighting/hoof marks/dung/fire/ etc.): **Nil**

Wildlife evidence (Sighting/ /droppings/horns/sound/burrows): **Pug marks. Dropping**

Grass Cover (%):**80** Ground Cover (overall % including grasses): **85**

Stoniness (pebbles/boulders %): Rock Out-crop (%):

Soil Type: Soil Colour: **Dark Brown** Soil Texture: **Fine**

Litter thickness: **5** Humus Colour: **Pale Brown** Humus thickness: **<5cm**



Depth (m)	Bulk Density (kg/m <sup>3</sup> )	Organic carbon (%)	Carbon mass (Kkg/m <sup>2</sup> )
0.00-0.30	0.021	7.308	14.6204
0.30-0.60	0.0125	4.65	
0.60-1.00	0.0052	2.6624	

### **CATEGORY 3: QUANTITATIVE MEASUREMENTS**

Crown Density (%) (make a small hole in leaf/paper and count sky or crown cover hits and steps, count which is ever is less in count across both diagonals): NE-SW: Steps: Hits: (Canopy/Sky) NW-SE: Steps: Hits: (Canopy/Sky)

Stand height (m) (average from 4 trees of top and 4 of 1<sup>st</sup> canopy): Top: + + + =  
At base of ultimate branch forkin 1<sup>st</sup>: + + + =

**Size of Quadrat for Trees** (31.62×31.62 m i.e. 0.1 ha)/ **Scrub** (10×10 m) (a) Pl. use steel measuring tape; (b) for gbh at 1.37m from ground make sticks of 1.37 m to fix the height; in plains from any direction but on slopes from upper side; (c) fix the metallic tag at the base of the tree preferably concealed and hide with stones) –**gbh up to mm level.**

Tree id.	Species	Gbh (≥ 10 cm all plants)	Height (m) 1 <sup>st</sup> forking	Height (m) at ultimate forking	Leaf (L)/ No-leaf (NL)
1	Lagerstroemia microcarpa	75.8		35	
2	Schleschera oleosa	191.1	8	38	
3	Lagerstroemia microcarpa	145.2	7	31	
4	Cassia fistula	31.2	2	3.8	
5	Cassia fistula	26.7		9.5	
6	Cassia fistula	27		5.5	
7	Bauhinia sps	101.3	1.6	4.5	
8	Bauhinia sps	89.2	3.4	6	
9	Bauhinia sps	68.5	5	9.5	
10	Bauhinia sps	24.8	2.3	4.5	
11	Bauhinia sps	27.1	2	4	
12	Canthium travancoricum	10.1	1.5	2.5	
13	Melina arborea	35.3	5.5	14	
14	Melina arborea	41.1	2.9	5.3	
15	Cassia fistula	26.5		3	
16	Terminalia bellirica	228.4	2	35	
17	Lagerstroemia microcarpa	33.8	2.2	5.5	
18	Schlechera oleosa	46.3	5	8.5	
19	Schlechera oleosa	49.8	5.2	9	
20	Stereospermum colais	131.6	13.5	29	
21	Canthium travancoricum	24.5	2.5	3.4	
22	Canthium travancoricum	13.1	2.2	3.2	

23	Canthium travancoricum	12.1	2.2	3	
24	Lanea coromandelica	188	10	28	
25	Lagerstroemia microcarpa	223.5	8	36	
26	Melina arborea	53.8	4.5	6.5	
27	Terminalia bellirica	280.3	2.4	32	
28	Cassia fistula	24.2		8	
29	canthium	32.1	1.75	5.5	
30	canthium	19.4	1.5	4.5	
31	canthium	15.2	4	4	
32	canthium	13	2	4	
33	canthium	20	2	4.5	
34	canthium	22.1	3	4	
35	canthium	24.6	1.45	7	

**(1) Shrubs (North-East) Size: 5 × 5 m (girth at 30 cm above base)** (Please bring representative stem of all shrub species either **entire stem or pieces of 15 cm long from base, middle and top of the tiller**) Girth class e.g.: Thick ≥15 cm, Medium 7-<15 cm and Thin <7 cm, it will vary with species and site-to-site.

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)				
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
Chromo lena odorata	214	28	Thick	19+	+		3.1+	+		+	+	1.8	.13+	+		+	+		
			Medium	28+	+		+	+	2.4	+	1.35	+		.06+	+		+	+	
			Thin	+	+	50	+	+	1.8	+	+	.36		+	+	.006	+	+	
Lantana camara	38	3	Thick	3+	+		2.4+	+		1.6+	+		.083+	+		+	+		
			Medium	+	2+		+	1.3	+		+	.7	+	+	.013	+	+	+	
			Thin	+	+	1	+	+	1	+	+	.43		+	+	.002	+	+	
Helicter es isora	21	4	Thick	3+	+		3.1+	+		+	+	3.84	+	+		+	+		
			Medium	2+	+		+	2.82	+		+	.73	+	+	.037	+	+	+	
			Thin	+	+	3	+	+	1.2	+	+	.28		+	+	.002	+	+	

**(2) Shrubs (South-West) Size = 5 × 5 m (girth at 30 cm above base)**

Species/ bush	No. of bushes and % cover		Number of tillers in 3 bushes of each species			Girth/Diam. (cm)			Height (m)			Fresh Weight (gm)			Dry Weight (gm)				
	0.1ha	5×5m	Bush No.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
canthium	214	34	Thick	6+	+		3.2+	+		1.85+	+		+	+			+	+	
			Medium	+	4	+		+	+	2.3	+	2.3	+		+	+		+	+
			Thin	+	+			+	1.9	+		+	.38	+		+	+		+
lantana			Thick	3+	+		2.2+	+		2.5+	+		+	.008	+		+	+	
			Medium	1+	+		1.4+	+		.8+	+		.015+	+		+	+		
			Thin	+	+		+	+		+	+		+	+		+	+		
Glycos mis pentapb ylla	47	4	Thick	1+	+		3.3+	+		+	+	.190	+	.191	+		+	+	
			Medium	+	+		2.+	+	4	+	0.58	+		+	+		+	+	
			Thin	1+	+		+	+	1.7	+	+	+	.43	+	+		+	+	
capsicu m	1	1	Thick	1+	+		3.1+	+		+	+	.93	+	+	.068		+	+	
			Medium	+	+		+	+		+	+		+	+		+	+		
			Thin	+	+		+	+		+	+		+	+		+	+		

**(a) Tree Saplings (North-East) 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm) use of calliper is advised.**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)				
1			+	+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+	+

**(b) Tree Saplings (South-West) Size: 5 × 5 m plot (>10 cm tall and/or girth 3 to <10 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)				
1			+	+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+	+

**(a) Tree Seedling (North-East) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)				
1	Schlechera oleosa	2	2.8+	2.6	+	+	+	.63+	+	+	+
								.61			
2	Wrightia tinctoria	1	2.1+	+	+	+	.57+	+	+	+	

**(b) Tree Seedling (South-West) Size: 5 × 5 m (up to 10 cm long and/or girth < 3 cm)**

S.n.	Species	Number	Girth/Diameter (cm)				Height (m)			
1			+	+	+	+	+	+	+	+
2			+	+	+	+	+	+	+	+
3			+	+	+	+	+	+	+	+

**Bamboo** (plot size 0.1 ha) (circumference to be taken about 30 cm above ground)

1	Number of rosettes in the plot	=								% Cover=
2	Rosettes circumference (m)		+	+	+	+	+	+	+	Avg.=
3	Number of culms in rosettes		+	+	+	+	+	+	+	Avg.=

Girth Class: e.g. thick (>20), medium (>10-≤20) and thin (≤10) cm. Please collect **three** samples of 30 cm long for each girth class of culms from base, middle and upper part of the same culms.

S. No	Species / Rosettes	Girth class	No. of culms in rosettes			Girth of Culms (cm)			Height (m)			Fresh Weight (gm)		Dry Weight (gm)		
			1	2	3	1	2	3	1	2	3			1	2	3
1		Thick	+	+		+	+		+	+		+	+		+	+
		Medium	+	+		+	+		+	+		+	+		+	+
		Thin	+	+		+	+		+	+		+	+		+	+
2		Thick	+	+		+	+		+	+		+	+		+	+
		Medium	+	+		+	+		+	+		+	+		+	+
		Thin	+	+		+	+		+	+		+	+		+	+
3		Thick	+	+		+	+		+	+		+	+		+	+
		Medium	+	+		+	+		+	+		+	+		+	+
		Thin	+	+		+	+		+	+		+	+		+	+

**(a) Herb 1 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also). Take fresh observations and weight of all, and for dry weight bring one sample if homogeneous or 2 if heterogeneous. **Keep record.**

In 1×1 m: Fresh weight: 0.6gm Dry Weight: .....gm % Cover: 72

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	Curcuma sps	6	5		
2	Curculago orchioides	4	6		
3	Cyathula prostrata	28	7		
4	Justicia sps	6	8		

**(b) Herb 2 (1 × 1 m)** (record epiphytes/lithophytes/climbers etc. also)

In 1×1 m: Fresh weight: .623 gm Dry Weight: 73gm % Cover: .....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	Curcilago orchiooidies	80	7		
2	grass	120	8		
3	cyathula	21	9		
4	Acharanthes aspera	3	10		
5	ammomum	7	11		
6	Leportea intrepta	2	12		

**(c) Herb 3 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: .589 gm Dry Weight: .....gm % Cover: 72

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	ageratum		7		
2	Curculago orchioides	5	8		
3	grass	98	9		
4	Ammomum sps	5	10		
5	Cyathula prostrata	16	11		
6	justicia	3	12		

**(d) Herb 4 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: ..... gm Dry Weight: .....gm % Cover:

.....

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	Cyperus rotundus	26	7		
2	curcilago	8	8		
3	grass	117	9		
4	ammomum	9	10		
5	Asparagus	2	11		
6			12		

**(e) Herb 5 (1× 1 m) (record epiphytes/lithophytes/climbers etc. also)**

In 1×1 m: Fresh weight: .498 gm Dry Weight: .....gm % Cover: 60

S.No.	Species	No. of individuals	S.No.	Species	No. of individuals
1	ammomum	11	4		
2	curculago	4	5		
3	leportea	2	6		

**Number of dead/dry, stumps of trees /cut but live (0.1 ha plot)**

S. No.	Species	Dead			Stumps		
		Nos.	Girth (Cm)	Height (m)	Nos.	Girth (cm)	Height (m)
1	Lagerstroemia		45+ + +	12+ + +		+ + +	+ + +
2	Melia arborea		45+ + +	4.25+ + +		+ + +	+ + +

**Litter and humus:** 5 plots of 1×1 m (Litter is fresh and hard leaves/ twigs/branches/fruits & humus is soft beneath litter) Please take fresh weight of all, and for dry weight bring one sample from each plot if homogeneous or 2 if heterogeneous strata.

Plots	Twigs+ Branches (gm)		Leaves (gm)		Humus (gm)		Total
	Fresh	Dry	Fresh	Dry	Fresh	Dry	
(a) NE	.448	.295	.216				
(b) NW	.421	.274	.202				
(c) SW	.453	.289	.211				
(d) SE	.392	.251	.194				
(e) Center	.392	.260	.189				

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## Plates



Fig1.Study site at Wayanad – Sampling locations



Fig.2. Study plots





Fig.3 Tree enumeration



Fig.4. Ground vegetation studies



Fig. 5. Shrubs and herbs



Fig.6. Litter accumulation





Fig.7. Bamboo area



Fig.8. Tree numbering



Fig.9. Elephants in the plot



Fig.10. Elephant trenches