



FIELD INSTRUCTIONS
FOR THE
BANGLADESH FOREST INVENTORY

17-11-2016

The Forest Department of Bangladesh leads actions to improve forest management and conservation, adopting forward thinking, innovative approaches in its management of approximately 1.55 million hectares of land across the country.

In 2015, the Forest Department began a process to establish a National Forest Inventory and Satellite Land Monitoring System for improved forest and natural resource management. The process supports national objectives related to climate change mitigation providing information that will form the basis of the country's Reducing Emissions from Deforestation and Forest Degradation (REDD+) efforts. The process also addresses domestic information needs and supports national policy processes related to forests and the multitude of interconnected human and environmental systems that forests support.

The activities implemented under the Bangladesh Forest Inventory are collaboration between several national and international institutions and stakeholders. National partners from government departments and agencies assist in providing a coordinated approach to land management. International partners, including the United States Agency for International Development (USAID), the Food and Agriculture Organization of the United Nations (FAO) and SilvaCarbon are supporting financial and technical elements of the process to assist in institutionalising the Bangladesh Forest Inventory as permanent tool for forest monitoring in Bangladesh.

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Disclaimer

This document outlines activities related to the Bangladesh Forest Inventory process. The information herein does not reflect the official position of the supporting international agencies including USAID, FAO or SilvaCarbon. Should readers find any errors in the document or would like to provide comments for improving its quality they are encouraged to contact the BFI Unit of the Forest Department.

FOREWORD

Efforts in forest management and conservation over the past decades have focused on reducing deforestation, expanding social forestry and introduction of co-management, and the development of targeted forest management plans. These efforts have stimulated practical changes in forest policy and legislation related to forest management in Bangladesh.

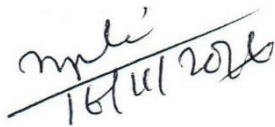
Participation of local populations in forest management and conservation is increasing. Innovative approaches to better manage forests are becoming widely accepted and implemented. Integrated strategies for sustainable natural resource management are becoming more important and, decision makers need more than at any time reliable data on the status of tree and forests to take appropriate decisions.

The Bangladesh Forest Inventory (BFI), under the leadership of the Forest Department aims to provide information on the status of trees and forest resources. Through the BFI, the Bangladesh Forest Department will provide improved estimates of tree and forest resources for cross-sectoral policies and measures, national and local actions.

This manual is the result of an extensive consultative process during which national and international experts from universities, national entities and international organizations have contributed to ensure the full adoptability and maximize the performance of the field data collection process.

It is anticipated that current efforts to improve the assessment of tree and forest resources will benefit a wide range of national agencies and stakeholders that can help recognize and valorisation of the role of trees in our everyday life and guide the process towards better understanding, management and conservation of trees and forests in Bangladesh.

Md. Yunus Ali

A handwritten signature in black ink, appearing to read 'md ali', with the date '16/11/2016' written below it.

Chief Conservator of Forests

Forest Department

Dhaka, November 2016

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LIST OF ACRONYMS

Acronyms	Description
AF	Acquired Forests
BFI	Bangladesh Forest Inventory
CF	Chief Conservator
CHT	Chittagong Hill Tracts
CWD	Coarse Wood Debris
DBH	Diameter at Breast Height
DGPS	Differential GPS
DL	Daily Labour
DTL	Deputy Team Leader
DWM	Down Woody Material
FAO	Food and Agricultural Organization of the United Nations
FD	Forest Department
FWD	Fine Wood Debris
GHG	Green House Inventory
GPS	Global Positioning System
HD	Horizontal Distance
HT	Height
INC	Inclination
LCCS	Land Cover Classification System
LF	Land Feature
LGED	Local Government Engineering Department
m	meter
MRV	Measurement, Reporting and Verification
NFI	National Forest Inventory
NFMS	National Forest Monitoring System
OFC	Open Foris Collect
OTH	Other
PA	Protected Areas
PC	Plot center
PF	Protected Forest
QA/QC	Quality Assurance/Quality Control
REDD+	Reducing Emission from Deforestation and Forest Degradation
RF	Reserved Forest
RP	Reference Point
R-PP	Readiness-Preparedness Proposal
SD	Slope Distance
SLMS	Satellite Land Monitoring System
SP	Skilled Person
SPOT	Satellite for observation of Earth
TE	Technical Expert
TL	Team Leader
UNFCCC	The United Nations Framework Convention on Climate Change
UNK	Unknown
UN-REDD	The United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
USF	Un-classed State Forest
VD	Vertical Distance
VF	Vested Forests
WO	Witness object

1 INTRODUCTION

The Bangladesh Forest Inventory (BFI) is a process under the leadership and supervision of the Forest Department which draws on broad, cross-disciplinary collaboration from affiliated government agencies, academic institutions, non-government organisations, private industry and development partners. The BFI seeks to increase knowledge related to forests, their management and the factors that influence land use and land cover change. This is achieved through the integration of field inventory, remote sensing and socio-economic data and pursued through the following objectives:

- Provide information on current status of forest and tree resources to assist long-term monitoring of natural resources;
- Assist national scale management planning, policy decisions and international reporting requirements including REDD+;
- Identify links between forest resource use and forest status to assist the valuation of ecosystem services;
- Support management objectives within sub-national forest types.

The BFI follows a stratified systematic random sample design (Iqbal, Kuegler et al., 2016) considering five district zones of Bangladesh based on their climatic and geophysical properties (Akhter, Jalal et al., 2016) (see Figure 1). Identification of the variables has been carried out with broad stakeholder engagement through several consultations and workshops (Rahman, 2016a; SilvaCarbon & FD, 2015) to ensure the process reflects national priorities. The overall design process has drawn on lessons learned from past inventory experience in Bangladesh (Costello, Sola et al., 2016).

The methodology outlined in this document has undergone a comprehensive field testing process in the hill, coastal and mangrove zones facilitated by the Forest Department in consultation with Khulna University, University of Chittagong and Shahjalal University of Science and Technology. The contribution from the universities has helped to make the process of forest inventory as efficient as possible.

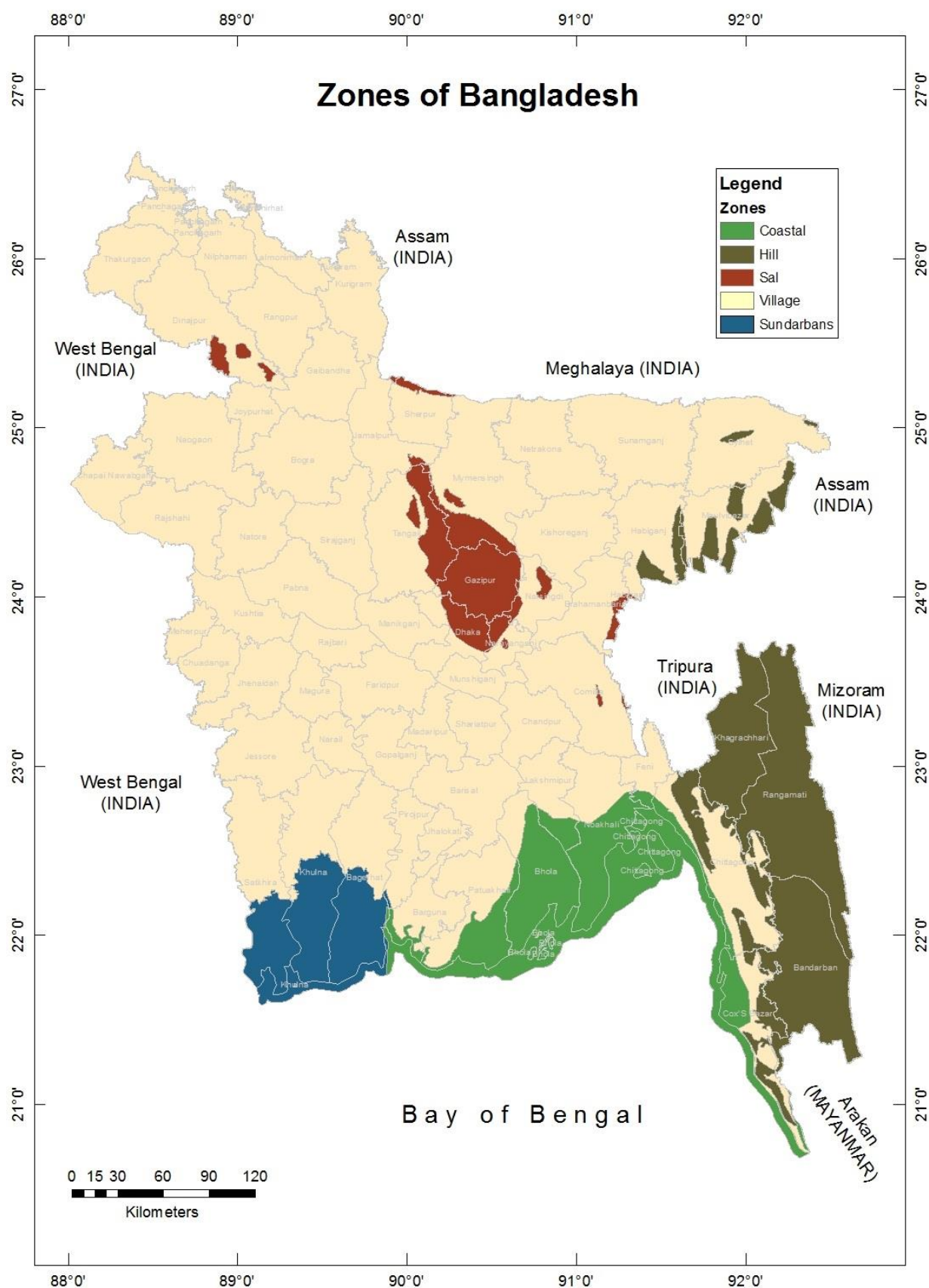
The chapters in this manual are structured in chronological order. In this way, the contents page can be referred as a checklist to assist the sequencing of activities. It is acknowledged that these processes may be improved over time where more efficient methods are identified. In consequence, this manual will serve as a living document whereby any constructive ideas or comments to assist its improvement are highly appreciated.

1.1 PURPOSE AND SCOPE OF THIS MANUAL

This manual has been developed to support the process of biophysical data collection by field crews during BFI and verification of data by Quality Assurance and Quality Control (QA/QC) teams. It includes procedures to locate and establish field plots, measure and record information related to trees and other vegetation, soil, litter and land cover, and provides the codes assigned to each data collection variable. The variables collected relate to:

- | | |
|----------------------------|---------------------------------------|
| • <u>Plot data</u> | • <u>Down woody material</u> |
| • <u>Land feature data</u> | • <u>Soil and litter measurements</u> |
| • <u>Subplot data</u> | • <u>Tree and sapling details</u> |
| • <u>Seedling details</u> | • <u>Bamboo details</u> |

This manual draws much of its content from other manuals developed to support national forest and natural resource monitoring objectives, including the use of GPS (Costello & Sultana, 2015), the description of land use/cover features (BSGI, 2016) and soil measurement (SRDI, Dhaka University et al., 2016) and others.



Source: Akhter, M., Jalal, R., Costello, L., Rahman, L., & Tasnuva, U. (2016). Zoning for Tree and Forest Assessment in Bangladesh. Retrieved from Dhaka

Figure 1: Zones used for stratification of the Bangladesh Forest Inventory

1.2 ORGANIZATION OF THIS MANUAL

Procedures in this manual are ordered to coincide as much as possible with the order in which field data variables are recorded in the field. Information that is infrequently used or that is included only for documentation purposes is provided in the appendix.

Each section of the field guide begins with a general overview of the data elements collected to provide the background necessary to prepare field crews for data collection. Descriptions of data elements follow the format provided below:

ITEM NUMBER; DATA ITEM NAME:

[table_column_name]

When collected	Specific criteria for when variable is recorded
Field width	Number of digits available to enter in the data sheet
Tolerance	Acceptable range of measurement
Values	Actual values/codes of variables

Tolerances may be stated in +/- terms or number of classes for ordered categorical data elements (e.g., +/- 2 classes); in absolute terms for some continuous variables (e.g., +/- 1 cm); or in terms of percent of the value of the data element (e.g., +/- 10 percent of the value). For some data elements, no errors are tolerated (e.g., PLOT NUMBER).

1.3 UNITS OF MEASURE

This field guide will use METRIC units as the measurement system. Compass bearings use magnetic north. Other measurements are described below:

- Length and height in meter (m)
- Tree DBH in centimeter (cm)
- Leaf cover in percentage (%)
- Bearing in degree (°)
- Slope in percentage (%)
- Geographical coordinates in degree decimal

1.4 PLOT DESIGN

1.4.1 PLOT DESIGN

The plot design differs in the Sundarbans zone to the rest of the country; however, the subplot design is consistent for both plot types (see Figure 2).

Plot - refers to the entire cluster of five nested subplots in the Sal, Village, Hill and Coastal zones and three nested subplots in Sundarbans zone.

Subplot—consists of Large, Medium and Small plots, referred as L, M and S plots respectively.

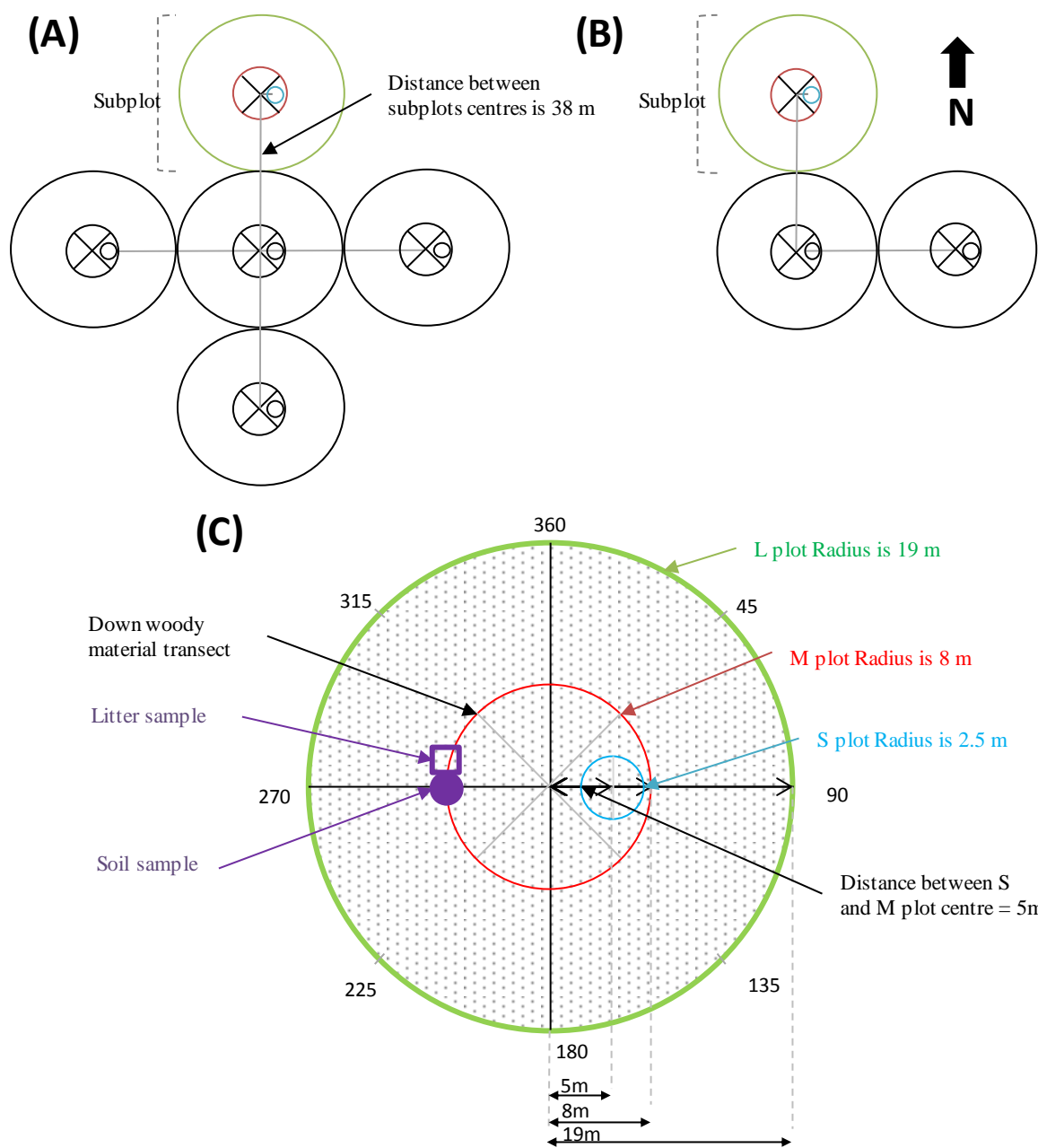


Figure 2: Plot Diagram (A) for Sal, Hill, Coastal and Village zones, (B) Sundarbans zones and (C) Subplot structure

Table 1: Dimension and number of S, M and L plots within each plot (or sampling unit) in the different zones

Zones	L plot (19 m radius)	M plot (8 m radius)	S plot (2.5 m radius)
No. subplots: Sundarbans	3	3	3
No. subplots: Other zones	5	5	5

1.4.2 RULES FOR RECORDING TREES/SAPLINGS/SEEDLINGS

The data collection parameters for each tree or sapling (hereafter collectively referred to as ‘trees’) are listed below. Their collection depends on the tree’s size and relative position in the plot.

- Tree ID
- Status
- Species
- Bearing (trees of DBH ≥ 10.0 cm from subplot centre, sapling of DBH ≥ 2.0 cm to < 10 cm from S plot center)
- Horizontal distance (trees of DBH ≥ 10.0 cm from subplot centre, sapling of DBH ≥ 2.0 cm to < 10 cm from S plot center)
- DBH / DBH measurement height
- Tree length
- Bole length (1/5)
- Damage / severity
- Decay class

All plants, regardless of their perceived form (tree/sapling) that respect the physical dimensions shown in Figure 3 should be recorded.

The physical dimensions of seedlings are not recorded, however the number of seedlings of each tree species are counted in the S plot. The collar diameter of Goran (*Ceriops decandra*) are also recorded in the S plot.

Rules for determining trees, saplings and seedlings		
Tree: DBH ≥ 10.0 cm	Sapling: DBH ≥ 2.0 cm to < 10 cm	Seedling: Height ≥ 10.0 cm and DBH < 2.0 cm

Figure 3: Rules for measuring the different vegetation components within L, M and S plots

Trees on the subplot are recorded according to the following rules (Table 2). If a tree is located in an area that does not meet the criteria below, it is not recorded.

Table 2: Where to record trees, stumps, saplings and seedlings

NESTED PLOT DIMENSIONS	MEASUREMENT THRESHOLDS	WHERE TO MEASURE
L PLOT (19-meter radius)	All live and dead standing trees ≥ 30.0 cm DBH. Stumps (live or dead) ≥ 30.0 cm diameter	Measure horizontal distance and bearing of live and dead trees (DBH ≥ 30 cm) from subplot center
M PLOT (8-meter radius)	All live and dead standing trees ≥ 10.0 cm DBH Bamboo clumps Stumps (live or dead) ≥ 10.0 cm diameter	Measure horizontal distance and bearing of live and dead trees (DBH ≥ 10.0 cm) from subplot center
S PLOT (2.5-meter radius)	All live and dead saplings DBH ≥ 2 cm to < 10 cm Nypa and Goran (<i>Ceriops decandra</i>) Stumps (live or dead) ≥ 2 cm to < 10 cm diameter	Measure horizontal distance and bearing of live and dead trees (DBH ≥ 2 cm to < 10 cm) from ‘S’ plot center

1.4.3 PLOT AREA CRITERIA

Trees and saplings are selected for measurement when they are within the dimensions of the subplot. Therefore, the HORIZONTAL DISTANCE from the subplot center to the bole center at the ground should be less than or equal to the radius of that subplot.

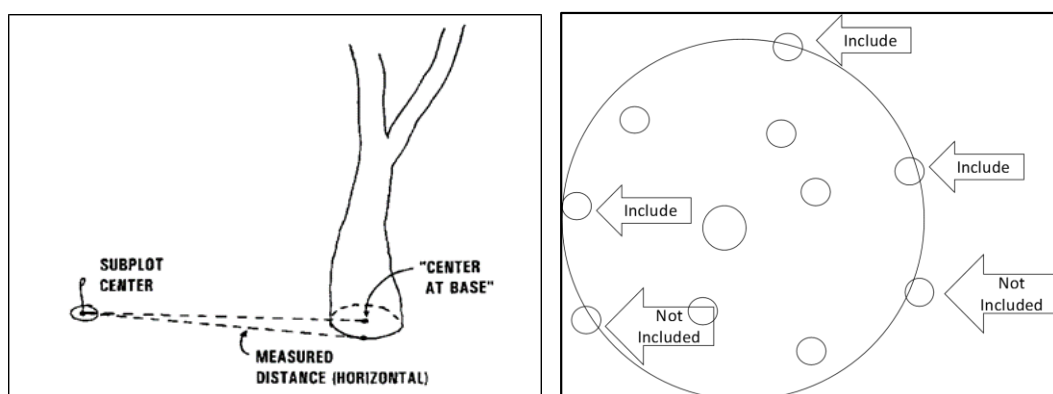


Figure 4: Criteria for trees inside the plot boundary

Special care should be taken for boundary trees. This may involve using a measuring tape stretched from plot center to exactly the mid-point of the tree. If 50% of the base of the trunk is within the boundary of the plot, the tree should be recorded. If more than 50% of the base of the trunk is outside the subplot boundary, it should not be measured.

1.5 FIELD WORK ORGANIZATION

The BFI Unit facilitates the provision and maintenance of equipment and provides support to field teams. The BFI Unit coordinates the data collection, processing and the validation of field data. The role, functions and institutionalization of the BFI Unit are explained in the document prepared by (Rahman, 2016b). The BFI Unit includes the functional teams, namely, field teams, Quality Assurance/Quality Control (QA/QC) teams and Supervisors.

Field team consists of 7 members as follows: 1 Team Leader (TL), 1 Deputy Team Leader (DTL), 2 Technical Experts (TE), 1 Skilled Person (SP) and 2 Labourers (DL). Local people will be engaged as much as possible in the composition of the field team.

The QA/QC team consists of four members (Rahman & Hayden, 2016) as follows: 1 Team Leader (QA TL), 1 Deputy Team Leader (QA DTL), 1 Skilled Person (QA SP) and 1 Labourer (QA DL). Measurement quality and consistency are assessed using two methods: hot checks and cold checks (Rahman et al., 2016). The specific objectives of QA/QC process are:

1. To obtain uniform and consistent interpretation and application of field instruments among all field crews.
2. To minimize technical errors in field measurement and data collection processes.
3. To monitor the performance of each individual crew member and provide feedback to facilitate improvement.
4. To reveal limitations prevailing in the training program.
5. To assess and document the quality of field data in relation to accuracy, precision, completeness and consistency.

Supervision of the BFI will be provided by the designated Conservator of Forests from the respective Forest Circle of which there are nine in the country¹. They will supervise 3% of the plots inventoried (hot checks) and quality control 7% of plots (cold checks) in their respective jurisdiction (see Rahman et al. (2016).

¹All Conservator of Forests except CF Wildlife and Nature Conservation Circle

2 TRAVEL PLANNING AND LOCATING THE PLOT

2.1 PLANNING

The BFI Unit will ensure the necessary field forms are available to each team leader (for both field and QA/QC team). Field data will be completed using the mobile application open foris collect² however some paper forms are required to sketch the properties of the plot location. Paper forms are also available for all variables in case technical issues with the tablets arise. Example forms are provided in APPENDIX 5, however each team will carry multiple copies to every plot. The crew leader is responsible for organizing the data collection forms and preparing the field equipment for each day. For the Sundarban and coastal zones, the team should check the tidal range to ensure access and determine appropriate times to collect the soil and litter samples which are impeded during inundation.

2.2 CONTACTS

2.2.1 PERMISSION

Written or verbal permission from the landowner must be obtained before a plot is visited. This responsibility lies with the Team Leaders of the field and QA/QC teams.

In addition, information should be gathered from nearby communities regarding possible poor conditions. At this stage the team should provide information related to the objectives of the inventory to avoid misguided assumptions of the work.

2.2.2 RECORDING CONVERSATIONS WITH LANDOWNERS/CONTACTS

Conversations with landowners should be recorded in the LANDOWNER CONTACT form (F3) (see APPENDIX 5). This information will document that permission was obtained.

2.2.3 LIST OF CONTACTS

The contacts of local forest officials are provided to all field staff involved in the BFI implementation (see APPENDIX 11). The list of contacts including the location and phone number will be regularly updated by the BFI Unit.

2.3 EQUIPMENT MAINTENANCE

All equipment should be cleaned with fresh water and dried with a cloth after every day use in the field. This is especially important in mangrove ecosystems and coastal areas where salty water and soil and high humidity can rapidly cause corrosion to the equipment if it is not regularly cleaned. Particular attention should be paid to steel equipment with screw-on threads and all metallic tools should be coated with lubricant after cleaning and drying.

2.3.1 INSPECTION AND PREPARATION OF EQUIPMENT

Each piece of equipment is assigned to a specific team so it can be tracked. Periodic checks of equipment will be undertaken to ensure maintenance is being carried out effectively. It is the Crew Leader's responsibility to ensure the equipment is appropriately maintained.

It is the responsibility of the Inventory Crew to inspect the equipment and calibrate as required before going to the field. If any faults are discovered they must be fixed and/or reported to the BFI Unit for replacement as soon as the issue is noticed. Electronic equipment (rechargeable batteries, tablets and powerbank) **should be charged every night before going to the field.**

Final inspection of equipment should be undertaken every morning before departure to the field to ensure the equipment is in working condition.

²<http://www.openforis.org/>

2.4 SAFETY

Personnel working in the field are subject to many safety hazards. These can be minimized by considering the following:

Wear protective clothing provided: Long-sleeved shirts, hats, long pants, and boots protect you from contact cuts, abrasions and stinging/biting insects.

First Aid Kit: Any item used from the kit should be replaced as soon as possible. The BFI Unit should be contacted when replacement items are needed.

Take shelter in bad weather: Severe weather such as high winds, lightning or extreme heat should be avoided when conducting field work.

Protect from hot and humid condition. Hydration should be maintained by drinking plenty of water and ensuring the drink bottles provided are full prior to departing for the field.

2.5 LOCATING THE PLOT ON THE GROUND

Before going to each plot, the team leader should inform the supervisor and verify that all the necessary arrangements, tools materials and transportation plans have been finalized. The supervisor and the BFI Unit should be informed for any problem related to the accessibility to the plot.

2.5.1 INFORMING BEFORE GOING TO THE FIELD

As a general routine, Crew Leaders should keep good liaison with the local FD staff and inform them before going to the field. For plots on private land, access permission should be requested via local FD officials in advance to ensure measurements can be taken.

2.5.2 LOCATING PLOTS ON AVAILABLE MAPS, AERIAL AND SATELLITE IMAGES

Topographic maps will be provided to assist in locating the sample plots. The plot locations will be superimposed on satellite images³ and should be reviewed prior to departure to assist in determining accessibility and to assist the preliminary assessment of potential land features (Figure 5). In addition, the GPS coordinates of plot locations will be uploaded to each team's GPS and administrative information included in the OpenForis forms under the ADMINISTRATIVE LOCATION section.

Crews should review available maps to plan the most direct route to the plot. Advice from local informants (eg. local FD staff) should be consulted for information on local conditions.

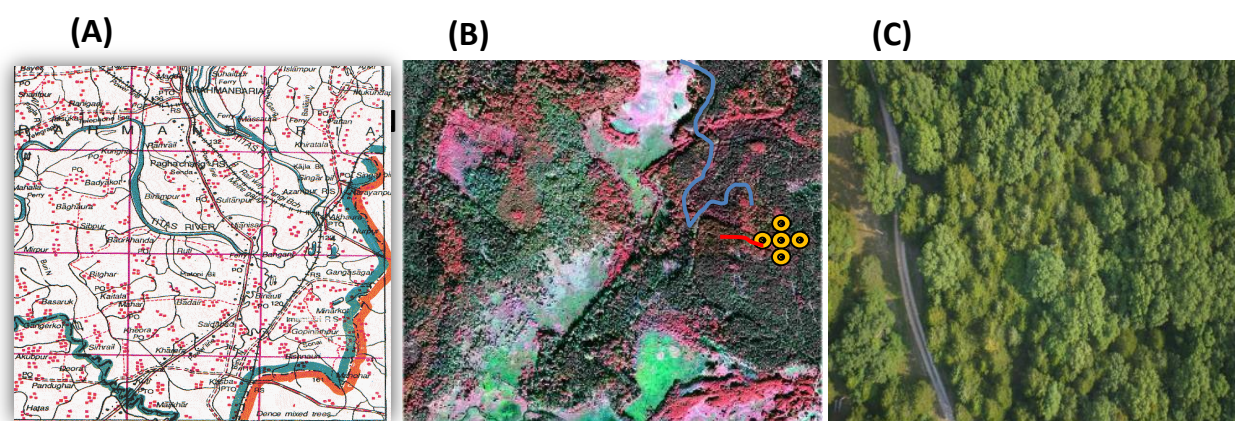


Figure 5: Use of different maps, pictures and images to guide the location of plot (A) topographic map, (B) high resolution satellite images and (C) aerial photo

2.5.3 ROUTE TO THE FIELD PLOT

³ Satellite images used are 2015 SPOT the most recent Google Earth and aerial images are from 2014.

An enlarged section of the map corresponding to the surrounding plot area will be prepared (photocopy or printed copy) and used to draw the access itinerary to the first plot. The team members will use the maps and GPS to navigate to predetermined coordinates using a GPS.

Reference objects (roads, rivers, houses) that contribute to the better orientation for the crew in the field should be identified during the planning phase. The way to reach the plot should be described by the field team using the symbols provided in (Figure 6) and documented on form F2 provided in APPENDIX 5.

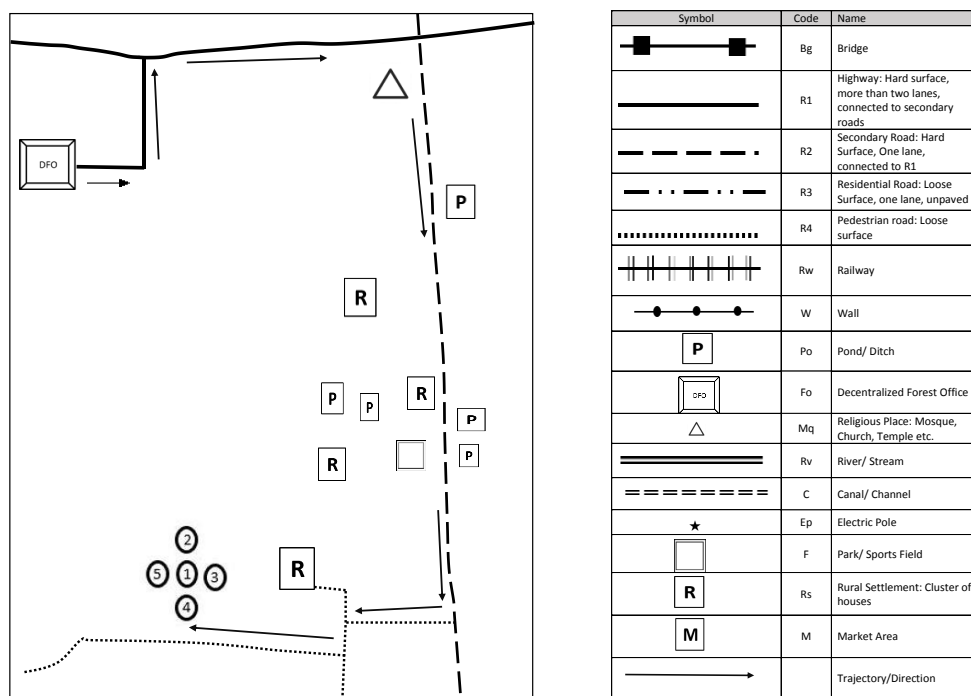


Figure 6: Description of the route to access a field plot and codes for description

2.5.4 INTRODUCTION TO THE LOCAL PEOPLE

On arrival to the site the crew must **establish contact** with the village representative, land owner or relevant contacted persons. The local people involved in the field measurement activities (in particular the field labourers and the Technical Expert for the Hill and Sal zones) should facilitate the communication with local people.

An **introductory meeting** should be organized to explain the aim of the visit to avoid misunderstandings.

It should be explained that the data is for monitoring purposes only and that information being collected is NOT part of any development/infrastructure projects. An information flyer will be made available for distribution to local land owners or curious individuals.

Some key points about the project introduction are mentioned below:

- This assessment is part of a larger programme of forest monitoring at national level.
- The information will be used to address issues related to the use of natural resources
- The field information will be use by the country and the international community to assist sustainable natural resource management decisions.
- The data will not be used to control land ownership on the plot location.

3 PLOT LAYOUT AND REFERENCING

Plot referencing (or monumentation) is a process aimed to ensure plots can be relocated in future. This is of critical importance to allow future remeasurement and also to assist the QA/QC process. Two types of monumentation are recorded:

Reference Point (RP): One RP is recorded for each plot. This is the primary identification feature of the plot. GPS point and physical markings are recorded for each RP. Horizontal distance and bearing are taken from the RP to the plot centre.

Witness Objects (WO): Three WOs are identified for each subplot (L) (where ever possible). The slope distance and bearing from the plot center to the WOs is recorded.

3.1 STEPWISE PROCESS OF ESTABLISHING A PLOT

3.1.1 BEFORE GOING TO THE FIELD

STEP 1: The field team receives the instruction from the BFI Unit about which plot to visit.

STEP 2: Maps and aerial images are reviewed to assist the location of the plot, undertake a preliminary assessment of land feature types and determine any accessibility issues.

STEP 3: Contact the local authority/people to get an overall idea about site conditions. In the case of Sundarbans or Coastal area, it is necessary to pre-determine water level fluctuation and the most appropriate time to go to the field.

3.1.2 ARRIVING AT THE PLOT

STEP 4: Navigate to the plot centre (subplot 1) coordinates using the GPS. Note that the GPS will never provide 100% accuracy as it only provides +/- 3 m accuracy.

Once reached, install a red /white pole at Plot Center. If plot centre (subplot 1) is not accessible, the pole is erected at one of the other four subplots and noted accordingly in section 6.4.1. The GPS coordinated for the subplots are not provided. Rather, the location of the subplot is determined by locating a point that is 38 m in a north, east, south or west direction. The distance and bearing function in the GPS can be used to determine the location.

Location of the plot center should be as accurate as possible. When taking the measurement, ensure that four or more satellites are recording positions. It may take up to five minutes for the GPS unit to establish contact with the satellites. For instructions on GPS use see section 5.3 and Costello et al. (2015).

STEP 5: Make a drawing of the access route from the road to the plot (using Form F2 found in the appendix 5). Use the descriptive codes as shown in Figure 6. Determine the level of access to the plot (as outlined in 6.3.4). If all or part of the plot is inaccessible note the reason based on the list described in 6.3.5.

3.1.3 ESTABLISH A REFERENCE POINT (RP) FOR THE PLOT CENTRE

STEP 6: Identify a suitable Reference Point (RP).

Ideally the RP should be a prominent object that is likely to remain *in situ* for the next 10 years. It should be easily located on the ground and the aerial images, **wherever possible**. Suitable reference points may be a house, power pole, rock or tree. If the RP is a tree the species and DBH are recorded.

In situations where there are no large or prominent trees or features in the immediate vicinity (for example in shrubland), the most significant tree, shrub or feature should be used. This is at the determination of the field team.

Detailed description of the RP should be provided in the notes. Information may include the land owners name, address, phone number (if willingly provided) as well as any description to relocate the RP. One or more photos of the RP should be taken.

STEP 7: Record the GPS coordinates of the RP and measure the horizontal distance and the bearing **from** the RP **to** the Plot Centre.

STEP 8: Mark the RP with spray paint and a metal tag at 2 m to maximize visibility and longevity. if the RP is a house it may not be appropriate to use paint and/or tag. In such cases detailed description should be provided in the notes.

STEP 9: Install a pointed metal rod(pin) at the plot center at least 30 cm below the surface. In case the metallic rod cannot be installed at the plot center, explanations should be provided in the RP note.

3.1.4 ESTABLISH WITNESS OBJECTS (WO) FOR THE SUBPLOT CENTRES

STEP 10: Install a red and white pole (ranging rod) at subplot centre.

STEP 11: Identify three (3) witness objects (WO) as close as possible to the subplot centre.

STEP 12: Measure the slope distance and the bearing **from** the subplot Centre **to** the WO.

STEP 13: Make a spray paint mark at the point the slope distance is measured. Nail a metal tag on the side facing plot centre.

The WOs are identified to triangulate the plot location (Figure 7) and assist the process of relocation required in follow up inventories. While all efforts should be made to make WOs visible for remeasurement, it is also important to minimize the evidence of the plot location that may encourage activities that result in degradation and subsequent bias. Therefor markings left of WOs should be subtle yet permanent.

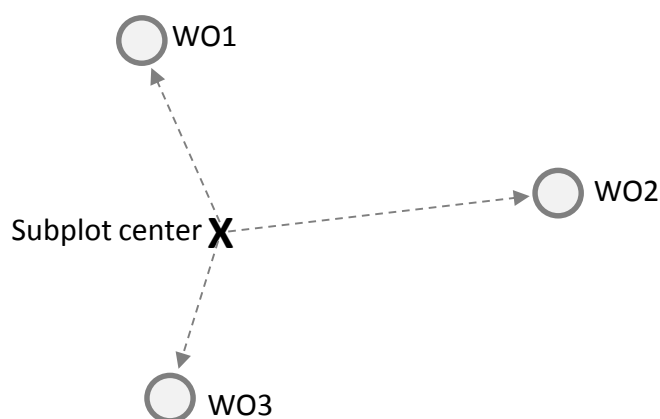


Figure 7: Ideal distribution of thee witness objects (WO) around plot center so that they can be used to triangulate plot center (PC).

3.1.5 ADDITIONAL INFORMATION TO REFERENCE PLOT AND SUBPLOT CENTRES

STEP 14: In "Plot Notes" record any information that may assist the relocation of the plot. Describe any prominent features present in the plot area that are unlikely to change in the next ten years; examples include details such as slope, aspect, topographic position, recognizable physiographic features (i.e. streams, ponds), human-made features (i.e. roads, houses, field boundary), and unusual or large trees.

Descriptions may include statement such as:

- The RP is the South-east corner of the tin house. The address of the house is House 5, Road 7. Mr. Rahman is the land owner. His contact number is 0179 XXX XXX.
- The RP is a large Rain Tree over 15 meters tall. It has a large, low hanging branch descending in a northerly direction.

Further plot monumentation will be undertaken on a later date by a team specifically designated to record the geographic location using a DGPS accurate to +/- 2 cm.

3.2 LAYING OUT THE PLOT

Each subplot is made up of an S Plot (2.5 m radius), M Plot (8 m radius), and L Plot (19 m radius) as illustrated in Figure 2. A plot comprises five subplots in all zones except the Sundarbans. Plots in the Sundarbans have only three subplots as shown in Figure 8B.

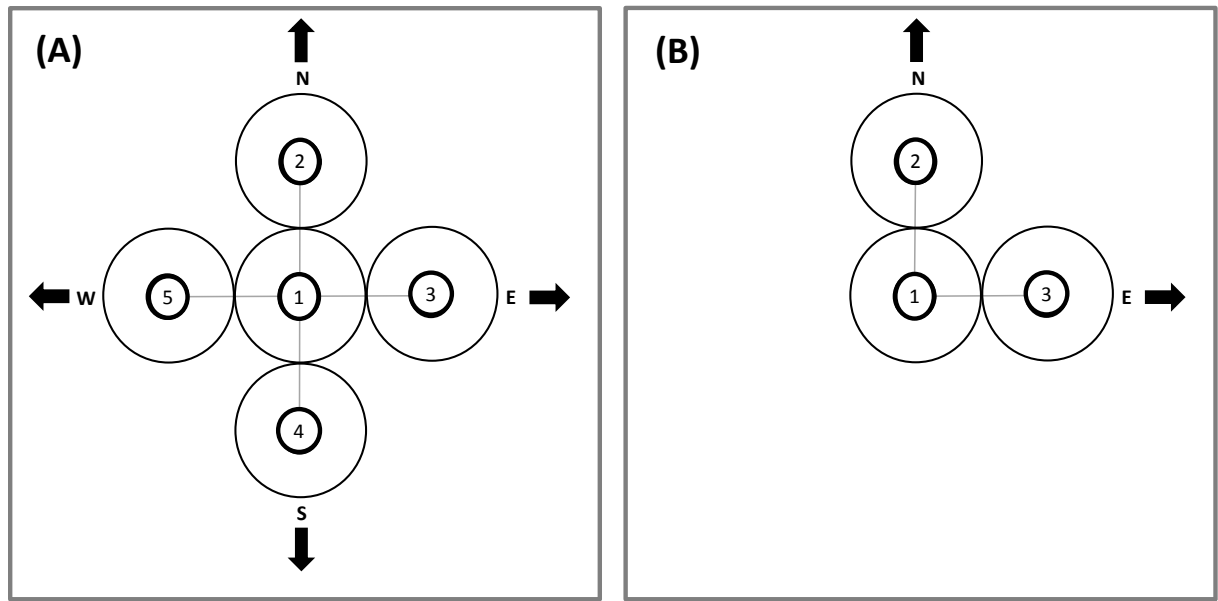


Figure 8: Subplot numbers (A) in Hill, Sal, Coastal and Village zones, (B) in Sundarbans.

4 RECOGNITION OF LAND FEATURES TYPES

One of the core objectives of the BFI is to estimate and account for changes in land types over time. Traditionally, this process has relied on a system of land classes (such as forest land, cropland, grassland etc.) that are assigned in the field. However, these descriptions are often vague or lacking appropriate definitions to allow their comparability with classification systems used in different maps. Moreover, class names and definitions often change over time to meet different priorities which in turn limits their comparability at different points in time. To avoid this problem, the BFI methodology does not rely on pre-defined land cover class names to determine land use/cover; instead a detailed description of the physical attributes identified within homogeneous land feature are recorded. Land feature class attributes include information about landform, ownership, environmental problems, vegetation type, crown cover, growth form, management type, cropping system, water supply and disturbance with details provided for each.

When this information is collated it allows managers to develop an understanding of the different land types across the country and the management practices used under different tenure arrangements. With this information we can create broader classifications of land types and examine the effects of disturbance common among each and how this may be influencing land cover change over time. This method allows the development of different classifications depending on specific needs.

4.1 WHEN DESCRIBING THE LAND FEATURE

Land Feature data records information about the physical features (objects) of an area (land feature) that is observed in the field at the time of data collection. The combination of objects within a homogeneous area of land constitutes a land feature. Attributes are assigned to objects to provide further meaning to the descriptions. One or more land features may be present in one plot/subplot.

At least one land feature will be described for every visited plot regardless of the presence of trees. In practice, there may be more than one homogeneous land feature that falls across the plot (see Figure 9) In such cases, each homogeneous land feature needs to be described separately. The land features are assigned a unique numeric identifier. Each tree recoded in the inventory is then assigned the identifier that corresponds to the land feature in which they reside.

The attributes for each land feature present within the plot will serve to link the field inventory data with broader, or grouped, land feature classes e.g. post-flooded paddy field, homegarden, young *Acacia mangium* plantation, etc.(BSGI, 2016).

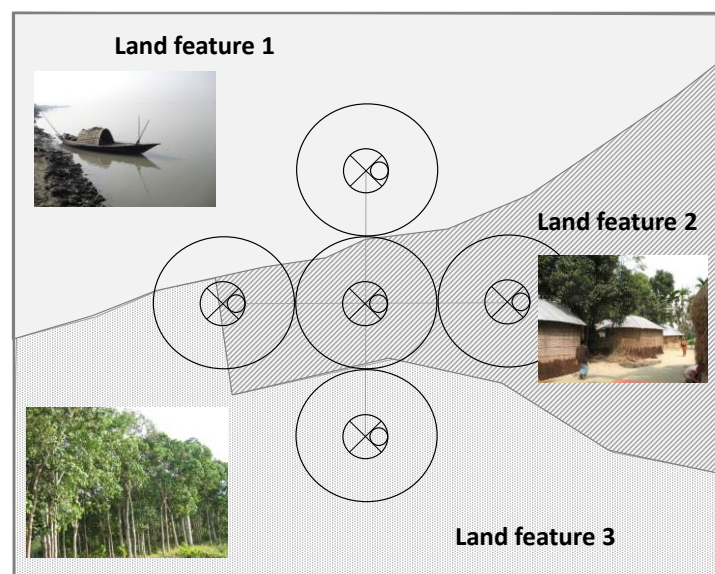


Figure 9: A plot may straddle more than one land feature class (in this case three different land features are present in one plot)

4.2 HIERARCHICAL LEVELS CONSIDERED FOR THE DESCRIPTION OF LAND FEATURES

Objects within a Land Feature are categorized into three broad classes: Vegetated, Non-vegetated and Water. Under these classes, additional attributes may be added to provide more detail at different hierarchical levels (an example is provided in Table 3). The information obtained from the description of the land feature(s) will be used to identify in which land class trees, seedlings and dead wood are located. For example, in the case of Table 3, all trees recorded within Land Feature 2 will be directly linked to the attributes of that land feature. As much detail as possible should be provided. This process needs to be repeated for each homogeneous land feature that falls within a plot.

Table 3: Land features are described at different hierarchical levels.

Land feature description process	Land Feature 1	Land Feature 2	Land Feature 3
LAND FEATURE DETAILS Land Feature ID, Size of Land Feature Area, Owner Group, Issues, Leaf Cover, CrownCover, photos and other general descriptions	Size> 5ha, management: unmanaged, linear form, water, pollution	Size<5ha, Owners Group: Individuals, Leaf Cover, Canopy cover: 20-30%	Size>5ha, Owner group: Community, Canopy cover, 80-100%, Leaf cover: 70%
OBJECT TYPE Vegetated, Non-vegetated and Water	Water	Vegetated and Non-vegetated	Vegetated
OBJECT ATTRIBUTES Vegetated: Trees, shrubs, grasses/herbs Non-vegetated: Linear, Nonlinear, bare ground, dump site etc. Water: river, canal, stream, lake, pond	River	Vegetated: Trees Non-vegetated: Building/structure	Trees
ARTIFICIALITY (OBJECT ATTRIBUTES)	Natural/ Semi-natural	Cultivated	Cultivated
ATTRIBUTE DETAILS Trees: Artificiality, Growth Form/Age, Management, Rotation Shrubs: Management Grasses/herbs: Crop, cropping pattern, management Non-vegetated: Comments required River: Salinity Lake: Salinity Pond: Salinity	Fresh	Trees: Cultivated and managed Non-vegetated: Private houses	Trees: Cultivated and managed Management: Plantation, Treatment: Selective felling, Rotation: 10-15 years

4.3 IDENTIFYING THE GEOGRAPHIC REFERENCE POINT FOR LAND FEATURE(S)

Each landfeature is assigned to a subplot that best represents the area. This is used as a reference to link satellite imagery to the Land Feature type.

Two potential cases can occur, depending on the presence of one or more land feature within a plot.

1. **Only one land feature is present in the plot:** the plot centre is used as the default location (Figure 10A);
2. **Multiple land features are present in the plot:** indicate the selected subplot centre (1 to 5) that best represents the land feature (Figure 10B).

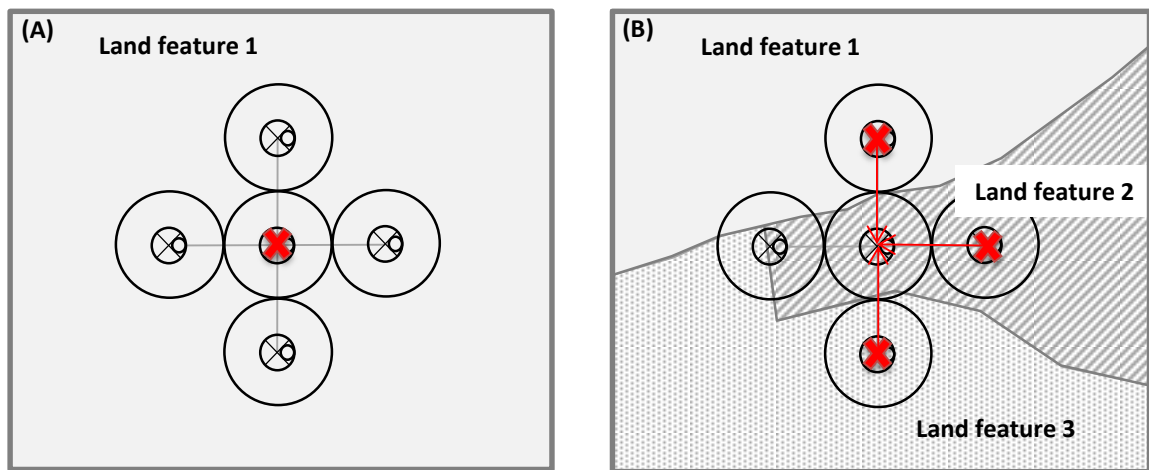


Figure 10: Assigning geographic locations to land features:(A) the plot is found in one land feature (the description is performed at the center of the plot), (B) the land features are described at the center of three subplots.

5 USE OF EQUIPMENT FOR FIELD MEASUREMENTS

This section provides information on how to operate equipment used in the BFI. A full list of equipment is provided in APPENDIX 4.

Field data is collected on mobile tablet devices using the Android application Open Foris Collect (OFC). OFC can be downloaded via Google Play store. Information about OpenForis is available at www.openforis.org.

In the event that the tablets are not functional or available, data can be recoded using the field forms provided in the APPENDIX 5. Additional field forms should be carried by field teams at all times.

5.1 DATA ENTRY USING ANDROID TABLETS

Field data is collected using Open Foris Collect Mobile: a mobile data collection application that can be used on any Android device. The devices used for the BFI are the Panasonic fz-B2 toughpads. The tablets can handle harsh conditions such as rain and dust however should be kept clean and dry as much as possible.


5.1.1 BASIC OPERATION

- The on button is used to put the device to sleep. Press the on button for approximately one second to deactivate the screen. This should be done as much as possible to save battery life.
- The screen rotation can be locked by pressing middle button on the top of the device.

BATTERY LIFE

- Operate the tablet in AIRPLANE MODE throughout the day. This function turns off all connectivity such as Wi-Fi and Bluetooth and will significantly save battery life.
 - Only turn AIRPLANE MODE off when connecting to Wi-Fi to submit the data (as explained 5.2).
 - To turn AIRPLANE MODE on or off, display the setting menu by swiping down on the top right of the screen and selecting or deselecting the Airplane Mode icon.
- The tablet should be recharged the night before going to the field

5.1.2 USING THE OPEN FORIS DATA COLLECTION APPLICATION

On the home screen of the device Press the icon  to launch the application.

Navigating the questions

The OFC data collection form is made up of different section. To open a section to begin data collection, press the green + symbol. The pages of the application can be navigated by swiping right or left with you finger. Alternatively, you can use the arrows at the top of the screen. The >> icon takes you to the next attribute. The >>| icon takes you to the next attribute that needs to be entered; it differs from the previous as it skips any field that does not require input.

Many fields are 'required' meaning that if a value is not entered there will be errors. Errors are shown by a red dot. ***All fields with red dots should be completed in full.***

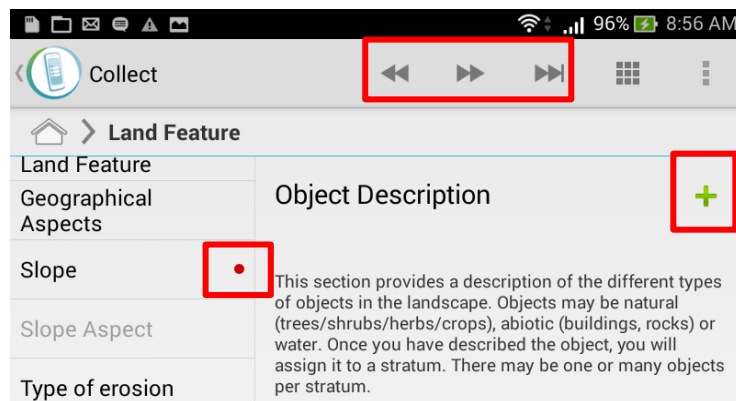


Figure 11: Navigating controls on the OFC application. Red dots show errors that must be corrected.

Data is collected in different ways: directly input as text or numbers, or as a list. Lists can facilitate either individual selections or multiple selections. Individual selection is shown with a circle and multiple selection are shown as a square.

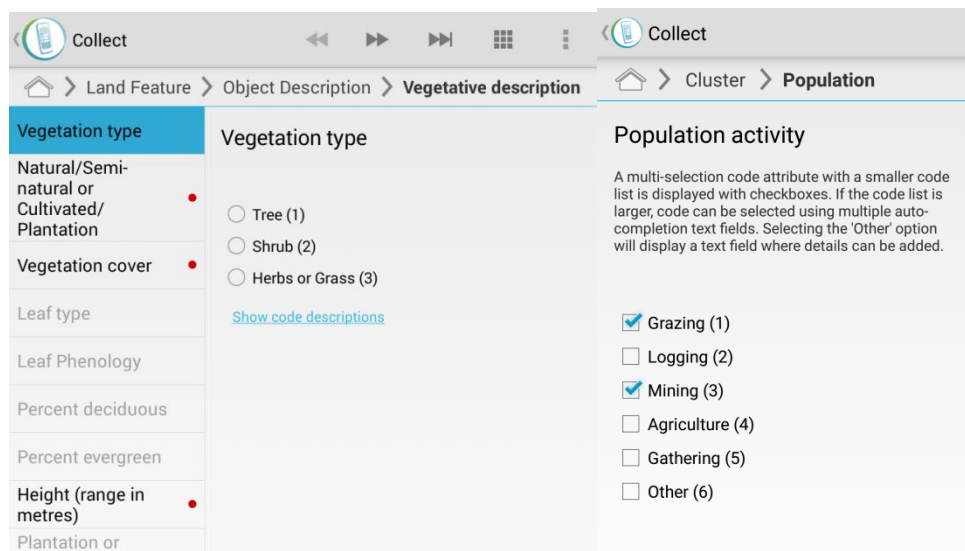


Figure 12: 'Select One' variables displayed with circles (left). Multi-select fields displayed with squares (right).

5.2 DATA SUBMISSION

Data is submitted using the export function in the OpenForis application. The data is submitted when it is

uploaded to Dropbox . To submit the data, follow the steps below:

1. Connect the device to Wi-Fi
2. Selecting the **Export** button accessed via the menu button described in Figure 13.
3. A pop-up window appears. Select **Export** and Leave the two check boxes blank.
4. Select the Dropbox icon (as shown in Figure 13).
5. Press **ADD**.

If exporting a large file (with many photos) the export process may take some time in which case the device should be allowed to process for one or two minutes.

Data should be exported at the end of each day. If Wi-Fi access cannot be obtained, data should be backed up to a secondary device using the methodology outlined below in section 5.2.1.

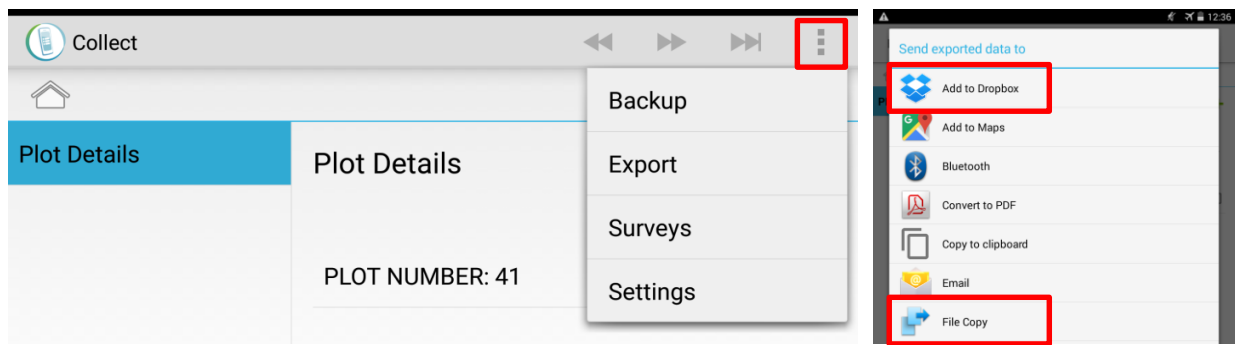




Figure 13: Setting are accessed via the icon displayed as **three dots** (left). Data is added to **Dropbox** (top right) or transfered to USB via the **File Copy** function (bottom right).

5.2.1 BACKUP DATA TO SECONDARY DEVICE

Data should be backed up to a secondary device every time field crews finish a plot or as often as necessary. A back up should be taken before deleting any data.

1. Selecting the **Export** button accessed via the menu button described in Figure 13.
2. In the pop-up window, select the “Save data in Download directory” box, then press **Export**. The pop-up window will disappear within one or two minutes indicating the file has been transferred.
3. Close the Open Foris application
4. Insert USB pen drive into the device.
5. Open the “OI File Manager” manager and navigate to the “Downloads” folder which is located at the path Storage > Emulated > Legacy > Download (as shown in Figure 14). The most recent export will be at the bottom of the list. The file has a .collect-data file extension.
6. Press and hold the file until the options appear at the top of the screen. Press Copy Icon .
7. Navigate to the USB folder located at Storage >USB 1.
8. Press the paste icon .

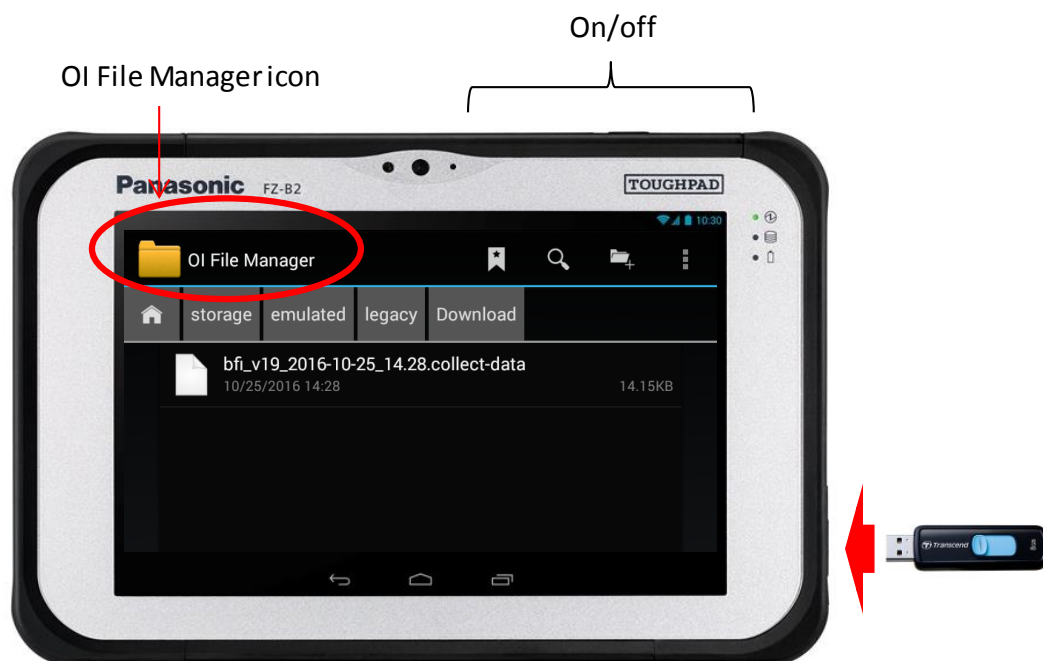


Figure 14: Data is transferred to USB using OI File Manager.

5.3 RECORDING GEOGRAPHIC COORDINATES WITH GPS

GPS coordinates are recorded for reference points to assist in plot monumentation. Coordinates are recorded in decimal degrees. All GPS coordinates should be recorded with the Garmin GPS receiver. The tablet device **should not** be used to record coordinates as this is less accurate.

5.3.1 BASIC OPERATIONS

The GPS unit is used to navigate to the plot location and also to record reference points coordinates. The main operations involve navigating to a waypoint (GPS position) and recording a waypoint. The main operating buttons are described in Figure 15.

FIND	Select to open the search menu.
MARK	Select to save your current location as a waypoint.
QUIT	Select to cancel or return to the previous menu or page.
ENTER	Select to select options and acknowledge messages.
MENU	Select to open the options menu for the page that is currently open. Select twice to open the main menu (from any page).
PAGE	Select to scroll through the main pages.
▲▼◀▶	Select ▲, ▼, ◀, or ▶ to select menu options and move the map cursor.
IN	Select to zoom in on the map.
OUT	Select to zoom out on the map.

Figure 15: Keys on the Garmin GPSMAP 64s (taken from Garmin Quick Start Manual).

5.3.2 ACQUIRING SATELLITES

The device must be communicating with at least four (4) satellites in order to record a position with suitable accuracy. The number of satellites can be checked via the satellites page which is access by scrolling through the main pages (use the **Page** button to scroll through the main functions).



Figure 16: Pressing the Page Function brings up the main functions of the device.

5.3.3 CREATE A WAYPOINT

Waypoints are created to record Reference Points(see section 0) that will assist in relocating plot locations. To create a waypoint:

1. Select **Mark**
2. The name of the waypoint can be edited using the arrow keys and pressing **Enter** on the appropriate field. *The coordinates are recorded in decimal degrees.*
3. All the waypoints will be downloaded from the devices at the end of the inventory. The naming convention for the RP is: "RP" followed by the Plot Number.

5.3.4 FINDING A WAYPOINT

Finding a waypoint is the process of navigating to a plot coordinate. To find a waypoint, go to the Waypoint Manager by scrolling through the **Pages**. Or select **Find> Waypoint**

1. Select **Waypoint** and scroll to find the specific waypoint
2. Select **Go**

5.3.5 FINDING A COORDINATE

If the waypoints are not preloaded on to the device, a location can be found by navigating to a coordinate. To navigate to a coordinate:

1. Select **Find**
2. Scroll to **Coordinates**
3. Enter the coordinate using the arrow keys and then select **Done**.

A comprehensive instruction manual by Costello et al. (2015) is available in Bangla via the BFI Unit.

5.4 MEASURING HORIZONTAL DISTANCES WITH THE DME

The DME has three components: the DME instrument, the transponder and the pole use to attach the transponder. The DME must be calibrated with the transponder before use:

1. Turn on the transponder: Hold the DME device next to the transponder (as shown in Figure 17) and press and hold the red button until two short beeps are heard.

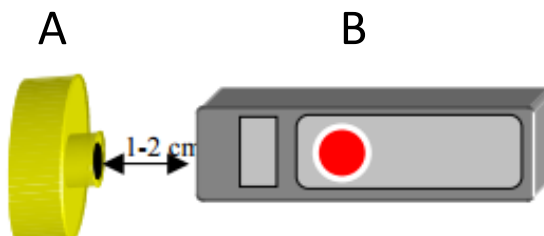


Figure 17: To turn on, hold the transponder (A) near the DME (B) and press the red button.


2. To calibrate:
 - a. Measure out 10 m with a tape measure.
 - b. Have one person hold the transponder at one end which the other holds the DME device at the other.
 - c. Give repeated short pressed to the red button until “F9” is shown
 - d. 10.00 should show indicating the device is calibrated.
3. Check the unit by giving repeated short pressed to the red button until “F5” is shown (see Figure 18).
 - a. 0.0 means feet and 0.00 means metres
 - b. Press the red button to change between the two.
4. Turn the device off after use
 - a. Hold the DME next to the transponder and press the red button for 10-15 seconds until the beep signal stops.

Functions of the DME measuring unit

Number/Pressures Function		Other Display Features	
[F1]	Distance measuring	[F7]	Temperature
[F2]	Will allow the DME to be used as a Prism based on a selected Prism Factor. <i>See F4 for prism factor selection.</i> The minimum diameter tree for the distance and prism factor will be displayed.	[F8]	No function, Space reserved
[F3]	Measuring unit reset to transponder function. For measuring with two measuring units	[F9]	Calibration
[F4]	Select prism factor. This will be the prism factor used when calculating the minimum diameter for the known distance, <i>see [F2]</i> English = 10, 20, 40, -- (means not used) Metric = 0.5, 1.0, 2.0, -- Make your selection by pressing the orange button.	[- - - -]	Working.
[F5]	Change unit, Meter or feet	[trP]	Measuring unit set as transponder
[F6]	Change transponder type [tYP1] or [tYP2] (only on newer models of DME) Otherwise no function		






Figure 18: Functions of the DME

5.5 MEASURING DISTANCES WITH THE TRUPULSE LASER RANGEFINDER

The TruPulse 200 Laser Range Finder is used for measuring distance, height and slope. To operate the device, look through the view finder and press the 'fire/on' button  on the top. The digital display shows an acronym for the function which can be changed by navigating the up and down arrows on the side of the device. It is recommended for the operator to prepare a wooden stick with the same height of his eyes to ensure adequate measurement of angles and distance.

5.5.1 CHANGING UNITS

It is critical to ensure all measurements are being collected in metres. The device allows you to choose between YARDS, METERS, and FEET for distance measurements. To change the units selection:

1. Press  for 4 seconds to access the System Setup Mode. "UnitS" will appear in the Main Display.
2. Press  to select the "Units" option.
3. Press  or  to display the previous or next distance unit option.
4. Press  to select the displayed distance unit and return to the operational Mode.

Each time the device is powered ON, it will return to the same unit setting that was last used.

5.5.2 THE BASIC STEPS FOR TAKING ANY DISTANCE MEASUREMENT:







1. Look through the eyepiece and use the crosshair to aim to the target.
2. Press-and-hold . The LASER status indicator is displayed while the laser is active. The laser will remain active for a maximum of 10 seconds while acquiring data about the target. If the target is not acquired in the 10 second period, release  and repeat this step.
3. Once the measurement is displayed, release . The measurement will flash one time indicating the measurement was downloaded. Then the measurement will be displayed steady until you press any button or the unit powers OFF.
4. In densely vegetated areas where vision is not clear, use the reflector and filter. One person should stand at the measurement point and hold the reflector. The person with the TruPulse attaches the filter and aims the laser (seestep 2). In this way only the reflector will be visible to the TruePulse.

Table 4: The various measurement functions can be changes by scrolling with the  or  arrows.

Code	Function	Description
SD	Slope Distance	Straight line distance between the TruPulse and the target.
VD	Vertical Distance	The distance between the target and the perpendicular to the path of the horizontal distance.
HD	Horizontal Distance	The level distance between the TruPulse and the plane of the target.
INC	Inclination	The angle of inclination between the TruPulse at level and the target.
HT	Height	Three-step height routine. The final calculation represents the vertical distance between the points on the target represented by ANG1 and ANG2.



5.5.3 MEASURING HEIGHT WITH TRUEPULSE

Height Measurements involve a three step process. This includes one horizontal distance (HD) and two angle (INC) measurements – one to the top of the tree and one to the bottom. At each step prompts are provided through the eye piece. The device uses these results to calculate the height of the target.

It is important to stand at a suitable distance from the tree so the aim can be clearly made to the top of the tree (step 3) and not the outer branches. Figure 19 shows the three shots required for the height routine.

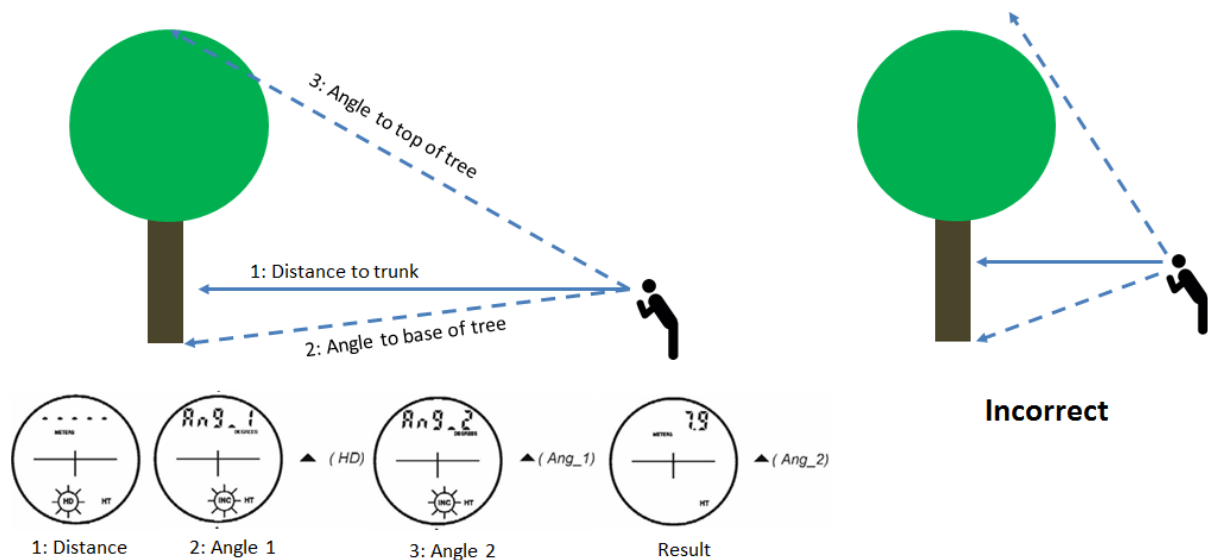


Figure 19: Correct method (left) of height measurement. The icons show the tree step prompts as viewed through the eye piece. Incorrect method (right) occurs if the person is standing too close to the tree.

5.5.4 MEASURING HEIGHT WITH THE SUUNTO

The Sunnto acts as both a compass and clinometer. The compass is used by looking through the device while it is flat. Slope distance is measured by looking through the device upright. You will know if you are holding the device correctly if the numbers appear the right way up.

- Step 1. Measure the horizontal distance between the base of the tree and the operator.
- Step 2. Looking through the peephole, line up the horizontal line with the top of the tree and read off the corresponding number from the percentage scale (ignore the sign), which is on the right hand side. The scale on the left is in degrees and should not be used!
- Step 3. Line up the horizontal line with the base of the tree and again read off the corresponding number from the percentage scale (ignore the sign).
- Step 4. If the base of the tree is level with you or below you (i.e. you're on the upward slope) then add the slope percentage value of Step 2 and Step 3 (Ignore the sign) to get the angle between tree top and base in percentage
- Step 5. If the base of the tree is above, you (i.e. you're on the downward slope) then subtract the slope percentage value of Step 3 from the slope percentage value of Step 2 (Ignore the sign) to get the angle between tree top and base in percentage
- Step 6. Calculate the tree height using the following equation

$$\text{Height} = (a \times d)/100$$

Where:

a = angle between tree top and base in percentage;
d = horizontal distance from the tree



Figure 20: Suunto compass and clinometer

Step 7. If the tree base is not visible on the level ground, calculate the tree height as follows

$$\text{Height} = (a1 \times d)/100 + E$$

Where:

$a1$ = angle between tree top and horizontal line in percentage;

d = horizontal measure the distance from the tree

E = Eye height of the operator

5.6 MEASURING SLOPE AND BEARING

Horizontal distance differs from *slope* distance. Horizontal distance is the measurement between two points at a constant angle. Slope distance considers angle and will therefore be longer. When the terrain is flat, distances can be measured directly. But on sloping terrain the horizontal distances differ from direct distances. A corrected distance is taken from a slope correction table in APPENDIX 3 and these distances are applied at all slopes longer or equal to 5 percent.

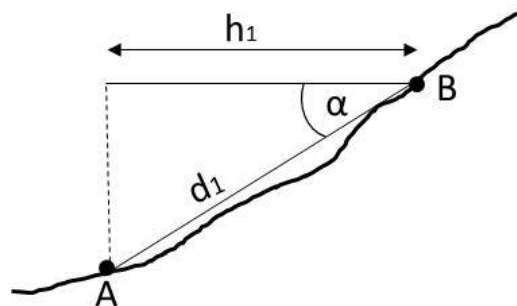


Figure 21. Distances on slope. h_1 Displays Horizontal distance. d_1 displays Slope Distance. Note: The distance between two points, measured along slope (d_1) is always longer than an equivalent horizontal distance (h_1). On slope terrain, the horizontal distance must be multiplied by a factor that corresponds to the inclination, in order to obtain a corrected distance.

The unit in this inventory is percentage. Where distances are measured using a measuring tape on sloping ground, slope distance will need to be corrected back to horizontal using the following equation:

$$\text{Horizontal distance} = \text{Slope distance} \times \cos(\alpha)$$

Where α = slope angle in degrees.

$$\text{Sloping distance} = \text{Horizontal distance} / \cos(\alpha)$$

Values of $\cos(\alpha)$ are provided in Appendix 4.

Note: The points recorded by the GPS will reflect horizontal distance. No corrections for distances on slope are required.

5.6.1 RECORDING SLOPE

Measure slope angle across the subplot to the nearest 1 percent using the Suunto. Looking through the view finder, the numbers on the left hand side are the degrees. The numbers of the right hand side are **percent**. Record the units in percentage.

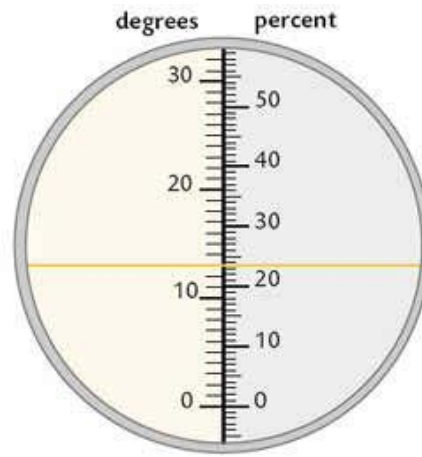


Figure 22: Slope measurement scale in the Suunto clinometer.

SUBPLOT SLOPE is determined by sighting the clinometer along a line parallel to the slope of each subplot. This angle is measured along the shortest pathway down slope before the drainage direction changes. To measure SUBPLOT SLOPE, Observer 1 should stand at the uphill edge of the subplot and sight Observer 2, who stands at the downhill edge of the subplot. Sight Observer 2 at the same height as the eye-level of Observer 1. Read the slope directly from the degrees scale of the clinometer:

- If slope changes gradually across the subplot, record an average slope.
- If slope changes across the subplot but the slope is predominantly of one direction, record the predominant slope percentage rather than the average.

5.6.2 SUBPLOT SLOPE DIRECTION

SUBPLOT SLOPE DIRECTION is measured with a hand compass along the same direction used to determine slope.

- If aspect changes gradually across the subplot, record an average aspect.
- If aspect changes across the subplot but the aspect is predominately of one direction, record the predominate direction rather than the average as bearing.

5.6.3 MEASURING BEARING USING SUNNTO

1. Look into the eye piece of compass side
2. Read the **top number** to determine bearing. The bottom number is the reverse angle of magnetic north.



Figure 23: Bearing measurement using Suunto clinometer

5.6.4 MEASURING BEARING USING COMPASS

1. Adjusting declination: The BFI uses magnetic north to record bearings. Therefore, before using the compass, make sure the declination is set to "0". If you are unsure or concerned about the accuracy of the declination, contact the BFI Unit.
2. Look into the eye piece of compass side
3. Look at the hair line and read the forward bearing with magnetic north of the targeted tree from the sub-plot center
4. Open the mirror and hold the compass at eye level so you can read the bezel (dial) from the reflection (Figure 24 (b)).
5. Align the tree with the sighting notch or hole, keeping the center line on the mirror in line with the center of the capsule
6. Hold the compass steady and turn the capsule until the orienting arrow and needle are aligned. The red needle needs align in the red arrow outline (Figure 24 (c))
7. Read the bearing from the bearing index

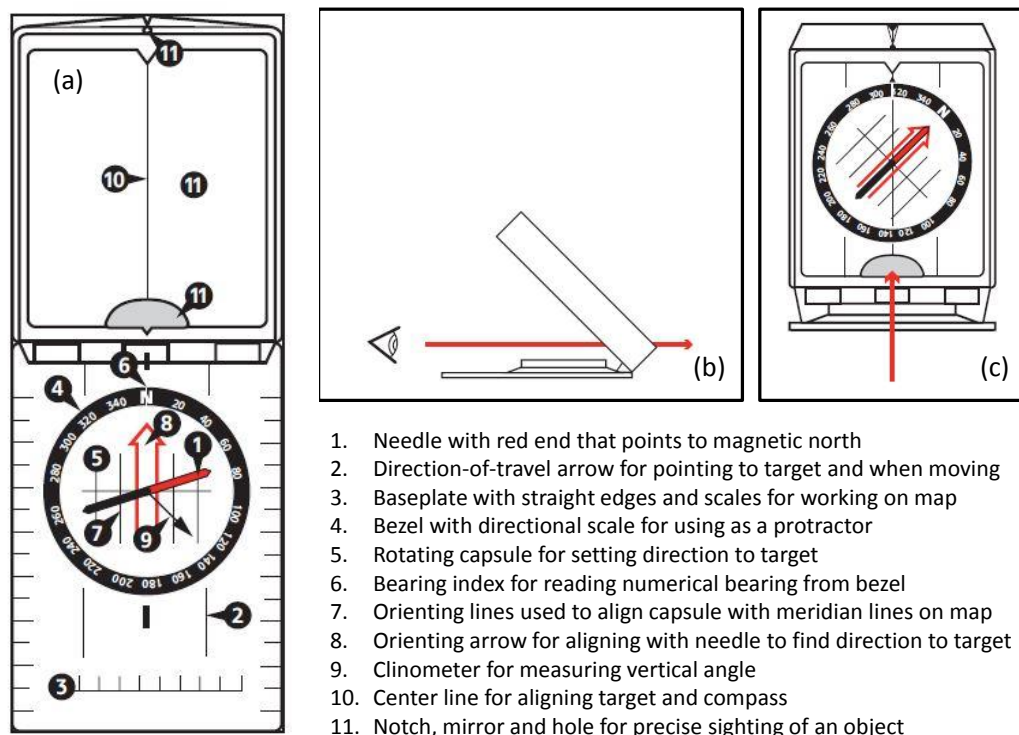


Figure 24: Features and operation of the mirror compass.

6 PLOT DATA COLLECTION

6.1 PLOT RECORD

6.1.1 PLOT NUMBER

[plot_id]

Record the identification number for each plot, unique within a district.

When collected:	All plots
Field width:	3 digits
Tolerance:	No errors
Values:	001 to 2500

6.1.2 INVENTORY DATE

[plot_date]

Record the date that the plot information was recorded. If the plot was visited over more than one day, record the first day.

When collected:	All plots
Field width:	List
Tolerance:	No errors
Values:	15/10/2016 to 31/5/2018

6.1.3 ARRIVING FROM

[arriving_from]

Record the location the crew is arriving from. If the crew is arriving from another plot (that has been measured/visited in the morning, select 2 and record the number of the previous plot visited in the “other” field.

When collected:	All plots	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	FD Field Office
	2	Another plot / Other – specify

6.1.4 DEPARTURE TIME

[time_dep]

Record the time the team departed the camp to travel to the plot.

When collected:	All plots
Field Width:	3 digits
Tolerance:	1 hour
Values:	00.00 to 24.00

6.1.5 FOREST OFFICE (FROM)

[plot_do_from]

Record the last decentralized office you have come from.

When collected:	arriving_from = 1
Field width:	List
Tolerance:	No errors
Values:	1 to 162

6.1.6 START TIME

[time_start]

Record the time when the team arrived at the plot.

When collected:	All plots
Field Width:	3 digits
Tolerance:	1 hour
Values:	0 to 99.5

6.2 PLOT LOCATION

This information is auto-calculated in OpenForis. It only needs to be entered if the OpenForis tablets are not operational and paper forms are being used, in which case the information can be entered before reaching the plot location.

Variable	6.2.1 DIVISION	6.2.2 DISTRICT	6.2.3 UPAZILA	6.2.4 UNION
Date Item Name:	[division]	[district]	[subdist]	[union]
When collected:	All plots			
Field width:	2 digits			
Tolerance:	No errors			
Values:	List provided by BBS	List provided by BBS	List provided by BBS	List provided by BBS

Variable	6.2.5 FOREST DIVISION	6.2.6 FOREST RANGE	6.2.7 FOREST BEAT
Date Item Name:	[forest_div]	[forest_rang]	[forest_beat]
When collected:	All plots		
Field width:	2 digits		
Tolerance:	No errors		
Values:	APPENDIX 8	APPENDIX 9	APPENDIX 10

6.2.8 ZONE

The zone refers to the areas used to stratify the inventory design.

[zone]

When collected:	All	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Coastal
	2	Hill

	3	Sal
	4	Sundarbans
	5	Village

6.2.9 PLOT COORDINATE

The plot coordinate refer to the central subplot (subplot 1) and are predefined and do not need to be record. The administrative location is defined automatically in open foris while it needs to be filled in the paper form.

[plot_coord]

Record the North-South and East-West GPS coordinates where the RP is located. The GPS coordinates are recorded in decimaldegree using the geographic coordinate system WGS84.

When collected:	All
Field Width:	14 digits
Tolerance:	+/- 10 m
Values:	20.700000 to 27.000000

6.3 PLOT DETAILS

6.3.1 TEAM NUMBER

[plot_teamnbr]

Record the crew number.

When collected:	All plots
Field width:	2 digits
Tolerance:	No errors
Values:	List

6.3.2 TEAMLEADER

[plot_leader]

Enter the name of the teamleader.

When collected:	All plots
Field width:	50
Tolerance:	No errors
Values:	Text

6.3.3 DEPUTY TEAMLEADER

[plot_dleader]

Enter the name of the deputy team leader.

When collected:	All plots
Field width:	50
Tolerance:	No errors
Values:	Text

6.3.4 PLOT STATUS

[plot_status]

Record the code that describes the sampling status of the plot. If the plot is inaccessible but the general areas can still be accessed the land feature descriptions should still be recorded and PLOT STATUS = 3 selected.

When collected:	All plots
Field Width:	1 digit

Tolerance:	No errors	
Values:	Code	Description
	1	Accessible - Sampled completely (5 subplots accessible and measured)
	2	Partially accessible - sampled (at least one subplot is measured)
	3	Inaccessible plot but Land Feature parameters measured from distance
	4	Not sampled – None of the parameter is measured

6.3.5 NONSAMPLED REASON

[plot_nonsample_reason]

For entire plots that cannot be sampled, record one of the following reasons.

When collected:	plot_status >1	
Field width:	1 digit	
Tolerance:	No errors	
Values:	Code	Definition
	1	Denied access – Access to the entire plot is denied by the legal owner, or by the owner of the only reasonable route to the plot. Because a denied-access plot can become accessible in the future, it remains in the sample and is re-examined at the next occasion to determine if access is available.
	2	Hazardous – Entire plot cannot be accessed because of a hazard or danger, for example cliffs, strip slopes, high water, security issues etc. Although most hazards will not change over time, a hazardous plot remains in the sample and is re-examined at the next occasion to determine if the hazard is still present.
	3	Restricted area – The plot cannot be accessible because it is located in a restricted area such as military areas, border areas.
	4	Water – The plot is inaccessible because it is located under water.
	96	Other – Entire plot not sampled due to a reason other than one of the specific reasons already listed. A field note is required to describe the situation.

6.3.6 PLOT ACCESS SKETCH

[plot_access_sketch]

Sketch the main access routes to the plot as described in Section 2.5.3 and using the form F2. Take a photo of the sketch in the OpenForis form. The hard copy should also be retained.

When collected:	All plots visited
Field width:	5 digits
Tolerance:	No errors
Values:	Jpeg image

6.4 REFERENCE POINT (RP)

Record the following items which describe the reference point (RP) and the course from the RP to the plot as described in section 3.1.3 ESTABLISH A REFERENCE POINT (RP) FOR THE PLOT CENTRE. These data items should match what is recorded on the plot card.

6.4.1 RP SUBPLOT

[rp_subplot]

Define which subplot centre the bearing and distance is measured to. Plot centrey (subplot 1) is default. However, if plot centre is not accessible, record the subplot which the RP is referenced to.

When collected:	Plot_status = 2
Field Width:	1 digit
Tolerance:	No errors

Values:	Code	Description
	1	Centre
	2	North
	3	East
	4	South
	5	West

6.4.2 RP TYPE

[rp_type]

Record the type of object chosen as the reference point (RP).

When collected:	All field visited plots, plot_status<4	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Tree
	2	Stump
	3	Electricity Pole
	4	House/structure
	96	Other - specify

6.4.3 RP SPECIES

[rp_spp]

If the RP is a tree or stump record the species code.

When collected:	rp_type=1
Field Width:	4 digits
Tolerance:	No errors
Values:	Tree Species List for species codes

6.4.4 RP DBH (CM)

[rp_dia]

If the RP is a tree, measure and record the DBH to the nearest centimeter. If the RP is a stump measure top diameter as explained in section 12.8 (RECORDING DIAMETER).

When collected:	rp_type=1
Field Width:	3 digits
Tolerance:	+/- 10 percent
Values:	001 to 999

6.4.5 RP BEARING (DEG)

[rp_bear]

Record, in degrees, the bearing **from** the RP **to** the plot center.

When collected:	plot_status < 3
Field Width:	3 digits
Tolerance:	+/- 4 degrees
Values:	001 to 360

6.4.6 RP HORIZONTAL DISTANCE (M)

[rp_dist]

Record, to the nearest meter, the horizontal distance from the RP to the plot center. If the RP is located out of line of clear sight due to vegetation density or it is just too far to use the laser, the horizontal distance can be collected using a GPS. If the GPS is used to measure distance, mention this information in the RP NOTES.

When collected:	plot_status < 3
Field Width:	4 digits
Tolerance:	+/- 5 percent
Values:	0001 to 1500 meters

6.4.7 RP GPS COORDINATES

[rp_gps]

Record the North-South and East-West GPS coordinates where the RP is located. The GPS coordinates are recorded in decimal using the geographic coordinate system WGS84.

When collected:	plot_status < 3
Field Width:	14 digits
Tolerance:	+/- 10 m
Values:	20.700000 to 27.000000 / 88.000000 to 93.000000

6.4.8 RP PICTURE

[rp_pic]

One picture of the RP is taken.

When collected:	All plots visited
Field width:	5 digits
Tolerance:	No errors
Values:	Jpeg image

6.4.9 RP NOTES

[rp_notes]

Record notes to explain any special RP situation that may need clarification for future plot visits. (e.g., shrub species, height/size of rock, RP not visited, RP BEARING and RP HORIZONTAL DISTANCE collected with a GPS, etc.). Required if RP TYPE = 4 - other.

When collected:	All field visited plots: as needed to describe special situation with the plot RP; required when RP TYPE = 4
Field Width:	2000 characters
Tolerance:	N/A
Values:	Single words or abbreviated sentences

7 LAND FEATURE DATA COLLECTION

Land Feature data is collected on all visited plots regardless of the presence of trees. Land Feature data are measured if the plot_status < 4. For example, if the plot is inaccessible due to inundation, the objects (water, sand deposits, floating vegetation) may be described. A description of the temporal variation may be attributed to the object "water" to describe its ephemeral nature. Further information on land feature data is provided in Section 4.

7.1 LAND FEATURE DETAILS

7.1.1 LAND FEATURE ID

[lf_id]

Auto generated unique identifier provided to all land features described in the field.

When collected:	plot_status <4
Field width:	4 digits
Tolerance:	No errors
Values:	001 to 6000

7.1.2 REPRESENTATIVE SUBPLOT

[If_status]

If only one land feature is identified, plot centre is assumed as the geographic point to represent the land feature. If more than one land features is present, select which subplot centre best represents the land feature (see page. 23)..

When collected:	plot_status<4		
Field Width:	1 digit		
Tolerance:	No errors		
Values:	Code	Description	
	1	Center subplot	Default location when there is only one land feature
	2	North subplot	Specified when more than one LF are present
	3	East subplot	Specified when more than one LF are present
	4	South subplot	Specified when more than one LF are present
	5	West subplot	Specified when more than one LF are present

7.1.3 SIZE OF LAND FEATURE

[If_size]

Provide a best estimate to the size of the land feature. The size of the land feature considered the broader landscape context, i.e., it is not confined to the plot. For reference, an area of 0.5ha is approximately 70 m x 70 m.

When collected:	All land features	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	< 0.5 ha
	2	>0.5ha

7.1.4 OWNER GROUP

[If_owner]

Record the OWNER GROUP code identifying the ownership (or the managing Agency for public lands) of the land in the land cover class.

When collected:	All land features	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Private - Owned by individuals or families
	2	Forest Department - Owned by Forest Department
	3	Government (other) - Owned by governments, or by government-owned institutions or corporations other than FD (e.g. Railways, Water Development Board, Roads & Highways)
	99	Unknown - No information available on the land ownership
	96	Other - To be specified in notes

7.1.5 LEGAL STATUS

[land_legal]

Record the LEGAL STATUS code as follow.

When collected:	land_own_group = 2	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	0	Not protected
	1	Reserved Forest (RF) - RFs are managed by FD under the provisions of the Forest Act, 1927. In many cases RF may not present a canopy cover in line with national definitions of forest.
	2	Protected Forest (PF) - PFs are also managed by FD under the provisions of the Forest Act, 1927.
	3	Vested Forests (VF) - Private forest lands, due to improper management whose management responsibility is taken by the Government under the Private Forests Ordinance, 1959. The area of "vested forest" area is relatively small and non-expanding.
	4	Acquired Forests (AF)- The government acquired the private forest lands under the State Acquisition and Tenancy Act (SAT), 1950 and responsibility of management was given to FD. This excludes AF that has been already declared as RF under the Forest Act, 1927.
	5	Un-classed State Forest (USF): The USF are located in the Chittagong Hill Tracts (CHT). The USF now have been placed under the control of the CHT District Councils where they are used mostly as jhum (slash and burn agriculture) by minor ethnic groups.
	6	Protected Areas (PAs): PAs are established mostly in RF or PF and include wildlife sanctuaries, national parks, safari parks, eco-parks, botanical gardens, and special biodiversity conservation area notified as such under the provisions of wildlife laws.
	7	Notified Area: The forest-land or waste-land or any land suitable for afforestation which is the property of Government, and for the purpose of reservation which has been notified under section 4 or section 6 of the Forest Act, 1927.

	8	Coastal Afforestation: Newly accreted land (char land) mostly in the coastal region which is suitable for afforestation and handed over to FD by the Government for a fixed term for afforestation.
	9	Social Forest (SF) - Plantation raised in marginal lands (embankment, railways etc.) belonging to different public agencies under government-led social forestry programmes where the participants have only usufructuary rights.
	99	Unknown

7.1.6 LAND FEATURE SERVICES

Select a maximum of three significant land feature services relevant to the land feature being described.

[If_serv]

When collected:	All land features	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	0	None observed
	1	Fruits, nuts, seeds, roots, berries, etc:
	2	Rattan: Active or potential harvesting
	3	Plant medicines: Medicinal plants (eg. leaves, bark, roots) used in traditional and/or for pharmaceutical companies
	4	Dying / tanning: Plant material and plant parts (especially leaves and fruits) harvested as colorants
	5	Wildlife: Provides habitat for wildlife
	6	Beekeeping activities:
	7	Windbreak: i.e. protection in coastal zone, from seasonal storm in hill zone
	8	Education and Research
	9	Recreation and tourism: Including ecotourism, hunting or fishing as leisure
	10	Cultural, spiritual value: Significant for cultural heritage, spiritual or religious reasons
	11	Merchantable timber
	96	Other: Specify in Remarks

7.1.7 CROWN COVER

CROWN COVER is different to the LEAF COVER as it measures the crown as a solid mass. The CROWN COVER is estimated visually as described below. The 'crown' is treated as a single area so the variability of leaf area/canopy density is not considered.

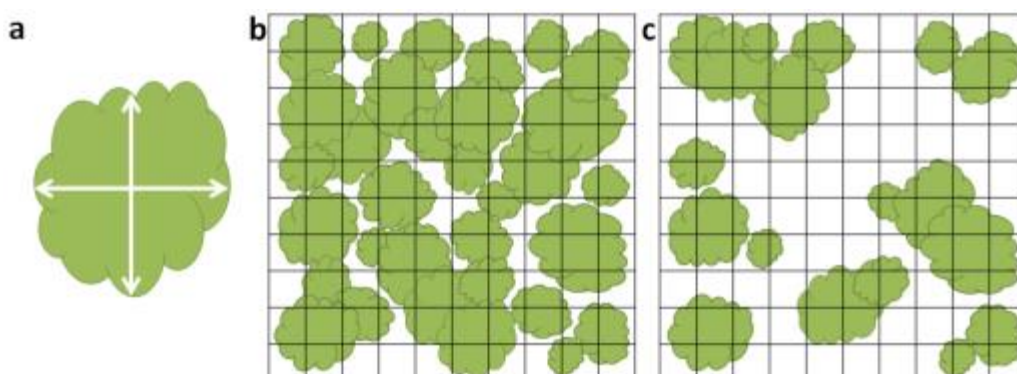


Figure 25: CROWN COVER

Crown cover considers the total area of crown where the crown is measured at its outer extremity (or drip line) (a). The CROWN COVER value should be representative of the entire land feature and is assigned based on a range over two fields: Min and Max. Sketching the CROWN COVER on a grid as shown above may assist in the process of estimation.

7.1.7.1.1 CROWN COVER %(MIN)

[cover_min]

When collected:	All land feature points
Field width:	3 digits
Tolerance:	No errors
Values:	000 to 100

7.1.7.2 CROWN COVER % (MAX)

[cover_max]

When collected:	All land feature points
Field width:	3 digits
Tolerance:	No errors
Values:	000 to 100

7.1.8 LAND FEATURE ISSUES

[lf_issues]

List the three (3) most prominent issues observed in the land at the time of assessment.

When collected:	All land features	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	0	None observed
	1	Over grazing: Signs that vegetation does not regenerate because of overgrazing.
	2	Water pollution: Aquatic surface presents signs of pollution
	3	Fire: Presence of fire (old or recent)
	4	Erosion: This includes weathering, dissolution, abrasion, corrosion, and transportation.
	5	Landslide: The sliding of a large mass of rock material, soil, etc., down the side of a mountain.
	6	Drought: Water shortage causing adverse impacts on vegetation.
	7	Waterlogging: Prolonged high water level caused by restricted drainage generally as a result of human activity and restricts activity such as agriculture.
	8	Flooding: Overflow of water that submerges land which is usually dry.
	9	Pests/Insect/Fungus: Pests, Insects and Fungus are present and can damage vegetation.
	10	Cyclone/tidal Surges: Presence of damages caused by cyclones or by coastal flood or tsunami-like phenomenon of rising water.
	11	Illicit felling: Unauthorised harvesting of timber and fuel wood
	12	Leaf collection: Collection of dry leaves from forest floor as fuel that hamper natural regeneration
	13	Storm damage: Presence of storm damages.

	14	Siltation: Accumulation of sediment/silt at tree base causing deoxygenation
	15	Invasive species: Invasive plant species affecting vigor of other vegetation
	96	Other: Provide details in notes

7.1.8.1 FIRE

[fire]

Describe the type of fire that is observed in the area.

When collected:	environmental_problem=3	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Recent fire: Evidence of fire during the current season/year
	2	Old fire: Evidence of fire during the previous years but not during current season

7.1.8.2 EROSION

[erosion]

Any type of erosion activity inside the observation unit must be recorded as per the following options:

When collected:	environmental_problem=4	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Erosion: General or type unknown
	2	Sheet: Uniform removal of soil in thin layers by the forces of raindrops and overland flow. Common on agricultural fields
	3	Rill: Removal of soil by concentrated water running through little streamlets or headcuts.
	4	Gully: Removal of soil along drainage lines by surface water runoff.
	5	River: Erosion noticed along river side and embankments caused by hydraulic forces of water

7.1.8.3 IMPACT

[impact]

Severity of impact caused by the issue described in 7.1.8.

When collected:	environmental_problem>=1	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Slightly disturbed: Exploitation of goods and services is carried out according to management plans
	2	Moderately disturbed: Many products collected without conforming to management plans and sustainability not respected
	3	Heavily disturbed: Heavily encroachment and obvious degradation of biodiversity and vegetation

7.1.9 LAND FEATURE PHOTO

[lf_photo]

Capture four (4) photos of the land feature wherever possible. All photos should be taken in landscape orientation to maximize their descriptive potential.

When collected:	All land feature points and PLOT_STATUS<4
Field width:	500 KB
Tolerance:	No errors
Values:	Jpeg

7.1.10 PHOTO POSITION

[lf_pic_pos]

Photos are taken from the subplot centre specified in. A minimum of two (2) and maximum of four (4) photos should be taken. The direction of the photo is recorded using the codes below.

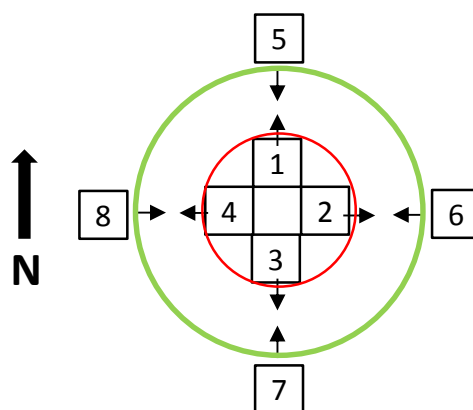


Figure 26: Indicate the photo position for each photo.

When collected:	Following each picture taken
Field width:	1 digit
Tolerance:	No errors
Values:	001 to 8

7.1.11 RECOMMENDED LAND CLASS NAME

[lf_class]

Select a land class description that best describes the land feature you are recording.

When collected:	All land feature points and plot_status<4
Field width:	5 digits
Tolerance:	No errors
Values:	APPENDIX 6

7.2 LAND FEATURE OBJECT DESCRIPTION

7.2.1 OBJECT ID

[object_id]

Sequential unique identifier provided to all land features objects described in the field.

When collected:	plot_status <4
Field width:	4 digits
Tolerance:	No errors
Values:	001 to 6000

7.2.2 OBJECT TYPE

[object]

Objects are the specific elements that together make up a land feature. At least one object must be recorded for each land feature. Three categories of object may be described.

When collected:	All land features	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Vegetated
	2	Non-vegetated (Abiotic)
	3	Water

7.2.3 VEGETATION TYPE

[veg_type]

Vegetation is classified in three categories: Trees, Shrubs and Grasses/Herbs. Bamboos and ferns greater than 5 m are classified as Trees if their height is less than 5 m.

When collected:	object = 1	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Tree: Woody vegetation greater than 5 m, generally with a single stem
	2	Shrub: Multi-stemmed herbaceous to woody plants between 0.5-5 m tall.
	3	Herbs or Grass: Graminoid/forbs/vegetable crops

7.2.4 ARTIFICIALITY

[artif]

Artificiality refers to the extent to which an area is cultivated or managed.

When collected:	veg_type < 3	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Natural or semi-natural: implies that the vegetation is not actively managed. It may be native or exotic plants. It may include a lesser proportion of planted species. Naturally occurring regrowth is likely to be present.
	2	Cultivated: may be an agricultural field, a timber plantation or other vegetation grown for its productive potential.

7.2.5 OBJECT PERCENTAGE OF COVER

[cover_perc]

This field defines the overall cover of the object you are describing. This differs from tree cover and pertains to shrubs and grasses

When collected:	object = 1 and veg_type >=2	
Field Width:	3 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	1-10%
	2	10-20%
	3	20-30%
	4	30-40%
	5	40-50%
	6	50-60%
	7	60-70%
	8	70-80%
	9	80-90%
	10	90-100%

7.2.6 GROWTH FORM / AGE

[maturity]

As a general rule plantation trees are considered even aged. Uneven age stands are defined by the presence of an understory, mid, and upper story canopy levels.

When collected:	veg_type=1	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Uneven agetural forest
	2	Uneven age semi-natural forest (plantation with natural regrowth)
	3	Uneven plantation (e.g. homestead, agroforestry)
	4	Even age planation: (block plantation, roadside plantation, ally cropping etc.)
	5	Even age young plantation
	6	Even age mature plantation

7.2.7 MANAGEMENT

[management]

Describe the predominant or obvious management activity observed for the vegetation being described.

When collected:	object=1	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	0	None observed
	1	Rubber plantation
	2	Tea garden
	2	Strip Plantation: Narrow timber plantation in marginal land (for example along road sides or river embankments)

3	Medicinal/otherplantation: includes palms and other plantations raised in an unplanned way for bark, aromatic or other timber quality, or other specific purpose.
4	NTFP plantation:(Murta, Golpata, Patipata, Silkworm plants for silk production, sporadic patches of village bamboo and cane etc.)
5	Woodlot plantation: Plantation under social forestry programmes for timber and fuelwood usually in small patches.
6	Coastal plantation: Plantation in coastal areas and newly accreted land with mangrove species and includes dyke and mound plantations
7	Plantation (general): Plantation for general purposes across large area
8	Agro-forestry system: land use management system in which trees or shrubs are grown around or among crops or pastureland.
9	Orchard: This category includes orchards which are plantation of trees normally devoted to the production of fruit and nuts and any other types of plantations such as sugarcane, banana and others.
10	Village Common Forests: community managed natural forests or Mouja Ban in the CHT
11	Jhum: Slash and burn or shifting cultivation common in CHT
12	Urban parkland: Urban recreational area
13	Bamboo groves: Bamboo plantation in patches
96	Other - specify

7.2.8 TREATMENT

[treatment]

Different types of treatments to stands.

When collected:	veg_type = 1	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	0	None observed
	1	Thinning: It is the reduction of trees in an immature stand for the purpose of improving the growth and form of the trees
	2	Weeding: It is a tending operation done in the seedling stage in a forest crop it involves the removal or cutting back of all weeds.
	3	Selective felling: the area is operated by selection felling
	4	Group felling: management practice to provide light and space for the benefit of the wider plantation.
	5	Strip felling: the area is operated by felling of trees in a linear way
	6	Clear felling: broad scale felling operation across large area
	7	Sanitary cutting: the area is operated on by removal of dead, diseased, deformed and moribund trees to maintain health of the other living trees.
	8	Prescribed burning:carried out to control fire by establishing distinct fire lines to prevent spread of fire in the surrounding area
	9	Natural Regeneration: the area is protected as such to enhance natural regeneration
	10	Assisted Natural Regeneration: include initiatives to protect natural tree seedlings in forested areas from competition of undergrowth and to encourage tree/forest establishment and regrowth.
	11	Artificial regeneration: forest crop is regenerating artificially by sowing, planting or other methods.

	12	Climber cutting: it is a tending operation done in the seedling and sapling stage in a forest crop which involving removal or cutting back of cluttering climbers that hinders normal growth of trees
	96	Other: please specify.

7.2.9 ROTATION

[rotation]

This information may come from the land owner. Assumptions can be based on the average rotation periods listed. Eucalypts and Acacias =10-15, Teak = 30-50. The value is entered as a range, i.e.: 15 – 20 years.

When collected:	artif = 2 and veg_type = 1 and management >0 and management < 6	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Less than 10 years
	2	10 to 20 years
	3	20 to 30 years
	4	Greater than 30 years
	99	Unknown

7.2.10 CROP DETAILS

7.2.10.1 CROP

[crop]

A list of common crops is provided. If the crop is not in the list choose other and provide details in the comments.

When collected:	veg_type=3 and artif = 2	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Rice
	2	Wheat
	3	Jute
	4	Mustard
	5	Lentil
	6	Potato
	7	Sugarcane
	8	Chili
	9	Maize
	10	Onion
	11	Winter vegetables
	96	Other: please specify
	99	Unknown

7.2.10.2 CULTIVATION STATE

[cultivation]

This field is relevant for crops and agricultural fields. Describe the state of land area at the time of the assessment in regards to its phase of cultivation.

When collected:	veg_type=3	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Fallow
	2	Conventional tilling: high soil disturbance
	3	Reduced tilling: low disturbance and more crop residues on soil surface
	4	No tilling: undisturbed productive field
	5	Recently harvested
	96	Other

7.2.10.3 WATER SUPPLY

[crop_watersup]

Describe the supply of water for the crop land. The option can be more than one depends on season.

When collected:	veg_type> 1	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	0	Not irrigated: if no active irrigation regime is in place
	1	Irrigated : Sprinklers or other irrigation infrastructure is present
	2	Post Flooding : Water is pooled and stored for irrigation
	3	Rain fed : Applies to crop field reliant on rain for irrigation
	4	Both Rain fed and Irrigated : Combination of options 3 and 4
	96	Other: Provide details in the comments.
	99	Unknown

7.2.11 NON-VEGETATED OBJECT TYPE

[non_veg]

Non-vegetated objects can be natural (rock, bare ground etc.) or artificial (dump site, salt flats).

When collected:	object=2	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	1	Soil, Sand Deposit: Unconsolidated, non-built up and natural surface. This class is defined by absence of the vegetated cover or water surface and have deposits placed on its surface. Sand deposit refers to a small ridges or hills of sand deposited over the soil or ground and usually found at the top of the beach above the usual maximum reach of the waves.
	2	Building / Structure: Built-Up Non-Linear surface such as houses, sheds or other artificial constructions that cover the land with an impervious surface.
	3	Roads / Rail / Linear surface Built-Up Linear surface such as roads, railways, linear walls or communication services such as power lines.
	4	Dump Sites/ Extraction Sites: Extraction site (or mine) is defined by the absence of the original rock or earthy materials are removed by human activity or machinery. Dump/Landfill site can also be a yard of waste disposal closed or open area.

	5	Salt Pans: Salt pans are flat expanses of ground covered with salt and other minerals and are found all around the coast in Bangladesh.
	6	Mud Flats: Mudflat is a flat area of very wet soil near the sea that is covered at high tide. Mudflats refer to a tract of low muddy land, especially near an estuary that is covered at high tide and exposed at low tide.
	7	Beach: Beaches are the pebbly or sandy shore, especially by the ocean between high- and low-water marks.
	8	River Banks: Land above the edge of a river, creek or stream.

7.2.12 NON-VEGETATED PERCENTAGE COVER

[non_veg_perc]

Estimate what proportion of the land feature is covered by the non-vegetated object you are describing.

When collected:	object=2	
Field width:	3 digits	
Tolerance:	+/-10%	
Values:	Code	Description
	1	1-10%
	2	10-20%
	3	20-30%
	4	30-40%
	5	40-50%
	6	50-60%
	7	60-70%
	8	70-80%
	9	80-90%
	10	90-100%

7.2.13 WATER BODY

[water]

Water bodies relevant to Bangladesh are provided in the list. It is not necessary to describe small ponds less than 3000 m² (or an area of approximately 55 m²).

When collected:	object=3	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	River: Naturally flowing freshwater.
	2	Pond: A pond is a human-constructed body of standing water with an area of variable size that is usually smaller than a lake.
	3	Baor / Oxbow Lake: A Baor is a natural water body and a dead section of a river where it has changed its course. It normally is a part of the floodplain of the river to which inlets and outlets connect it. The persistence of staying water ranges from 11 to 12 months. These water bodies are available mostly in the western and central-western (Faridpur, Kushtia, Jessore) parts of Bangladesh. Baors are known as oxbow lakes.
	4	Beels/Haors: Natural water reservoir, billabong or a lake-like wetland with static water. It becomes very extensive water body in the monsoon and dries up mostly in the post-monsoon period. So the persistence of staying water ranges from 5 to 9 months. In Bangladesh haors are found mainly in greater Sylhet and greater Mymensingh regions.

	5	Lake: Artificial/Natural standing water reservoir that is bigger than a pond
	6	Stream: Small linear water body, natural or man-made.
	7	Canal: Man-made channel established to control water flow
	96	Other

7.2.14 WATER SALINITY

[water_sal]

Salinity can measure by the smell or on advice from local people.

When collected:	object=3	
Field Width:	1 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Fresh: Non-salty water
	2	Saline: Salty water

7.2.15 WATER PERCENT OF COVER

[water_perc]

Each object described represents a proportional area of land feature. Mention the proportional area of this 'object' within the land feature as a percentage.

When collected:	object=3	
Field width:	2 digits	
Tolerance:	+/-10%	
Values:	Code	Description
	1	1-10%
	2	10-20%
	3	20-30%
	4	30-40%
	5	40-50%
	6	50-60%
	7	60-70%
	8	70-80%
	9	80-90%
	10	90-100%

7.2.16 LAND FEATURE NOTES

[lf_notes]

Provide any addition details related to the object described in the Land Feature section.

When collected:	As needed
Field Width:	255 characters
Tolerance:	N/A
Values:	Single words and abbreviated sentences

8 SUBPLOT DATA COLLECTION

8.1 SUBPLOT DETAILS

8.1.1 SUBPLOT NUMBER

[subp_id]

Record the code corresponding to the number of the subplot. See section 3.2 for the plot numbers for each plot in the different zones.

When collected:	plot_status <3	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Center subplot
	2	North subplot
	3	East subplot
	4	South subplot
	5	West subplot

8.1.2 SUBPLOT STATUS

[subp_status]

Indicate whether or not this subplot is sampled, inaccessible but the land features can be described, or non-sampled.

When collected:	All plots	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Sampled completely: All the components are measured
	2	Partially sampled: Partly inaccessible but the land features can be described
	3	Nonsampled – None of the parameter is measured

8.1.3 SUBPLOT SLOPE (%)

[subp_slope]

Record the average percent of slope present across the plot.

When collected:	subplot_status <= 2
Field Width:	3 digits
Tolerance:	+/- 10%
Values:	1 to 155

8.1.4 SUBPLOT SLOPE (BEARING)

[subp_slope]

Record the aspect across the subplot, to the nearest 1 degree. SUBPLOT SLOPE is determined along the direction of slope for land surfaces with at least 5 percent slope. If the slope direction is variable, record the predominant slope direction, for example, the direction water would run if poured onto the subplot.

When collected:	subplot_status <= 2
Field Width:	3 digits
Tolerance:	+/- 10 degrees
Values:	1 to 360

8.1.5 SUBPLOT LEAF COVER (COUNT)

[subp_leafco]

This field is only measured if vegetation greater than 2m in height is present on the subplot. LEAF COVER is the area occupied by leaves and branches. LEAF COVER is measured in along two 10 m transects using the GRS Densitometer.

To record LEAF COVER, look through densitometer and step out two 10 m transects in north-south and east west direction either side of the plot centre (see Figure 27). Record a value every 1m. At each 1 m interval, record a '1' for leaf cover and '0' for no-leaf cover/sky. The final result is the sum of all values divided by 20 to give a percentage.

Leaf cover is recorded as a '1' when more than 50% of the central ring in the densitometer is covered.



Figure 27: Using the GRS Densitometer to measure the leaf cover on two 10m transects in each subplot

When collected:	All transects
Field width:	2 digits
Tolerance:	+/- 5%
Values:	0 to 20

8.2 SUBPLOT LAND FEATURE PROPORTIONING

8.2.1 S PLOT CENTER LAND FEATURE CLASS

[subp_slf]

Record the most represented land feature class present in the S PLOT. If only one land feature is present at plot level, this field does not need to be entered.

When collected:	Number of (subplot_lf) >1 and subplot_status<3
Field Width:	1 digit
Tolerance:	No errors
Values:	1 to 9

8.2.2 PROPORTIONING LAND FEATURES WITHIN EACH SUBPLOT

If more than one land feature is present in the plot, the proportion of the L Plot land area covered by each land feature is measured using the diagram in Figure 28. There are approximately 256 squares in L Plot, and 44 squares in each M Plot. The measurements are recorded in Field Form F3.

- Draw the intersection of the land features on the LF Proportion diagram
- Count the number of squares and record on the paper plot form.
- Take a photo of the sketch on the tablet and record in section 14.1.

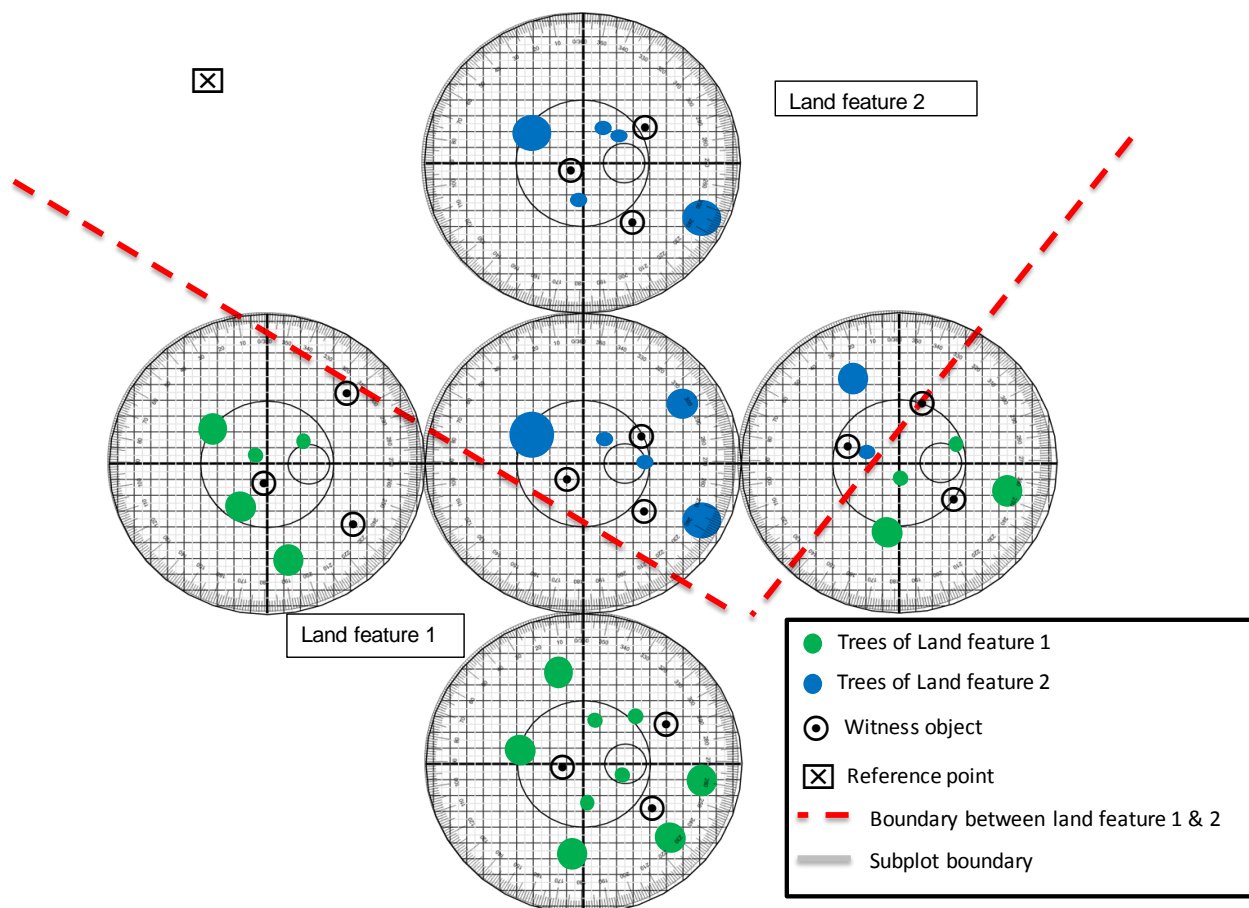


Figure 28: Each complete square is 2 m x 2 m (4 m²). Mark the squares are within each land feature, the boundary between land features, the intersections between the plot boundary and the land feature boundary.

8.2.3 LAND FEATURE NUMBER

[lf_subp_lfno]

Enter a Land Feature ID number to assign the proportion to

when collected:	plot_lf_n > 1 and subplot_status<3
field width:	2 digits
tolerance:	No error
values:	1 to 99

8.2.4 NUMBER OF SQUARES IN THE M PLOT

[lf_subp_mplot]

If more than one land feature is present in one subplot, complete the sketch as described in [Figure 28](#) and see Section 4 for details on land feature descriptions).

when collected:	plot_lf_n > 1 and subplot_status<3
field width:	2 digits
tolerance:	+/- 10%
values:	0 to 44

8.2.5 NUMBER OF SQUARES IN THE L PLOT

[lf_subp_lplot]

If more than one land feature is present in one subplot, complete the sketch as described in [Figure 28](#) and see Section 4 for details on land feature descriptions).

when collected:	plot_lf_n > 1 and subplot_status<3
field width:	2 digits
tolerance:	+/- 10%
values:	0 to 256

8.3 WITNESS OBJECT DETAILS

Wherever possible, three (3) witness objects should be recorded for each subplot. Bearing (from subplot centre to witness object), slope distance to the plot centre and a record note to describe the object are recorded for each witness objects. In the case the WO is a tree, additional information such as species, and diameter are recorded.

Record the following items which describe the witness objects (WO) and the course from the WO to the plot. These data items should match what is recorded on the plot card.

8.3.1 WO RECORD NUMBER

[wo_id]

Identifier for the WO. This is auto generated in the application.

When collected:	subplot_status <= 2
Field Width:	3 digits
Tolerance:	No errors
Values:	1-999

8.3.2 WITNESS OBJECT TYPE

[wo_type]

Record the type of object chosen as the WO.

When collected:	plot_status < 3	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Tree
	2	Electricity pole
	3	House/structure
	96	Other – specify

8.3.3 WO SPECIES

[wo_spp]

If the WO is a tree, shrub or stump record the species code.

When collected:	wo_type=1
Field Width:	4 digits
Tolerance:	No errors
Values:	Tree Species List for species codes

8.3.4 WO DBH (CM)

[wo_dia]

If the WO is a tree, shrub or stump, measure and record the DBH to the nearest centimeter.

When collected:	wo_type=1
Field Width:	3 digits
Tolerance:	+/- 0.5cm
Values:	001 to 999

8.3.5 WO BEARING (DEG)

[wo_bear]

Record the slope distance FROM the Subplot center to the WO; a WO should be within 20 meters of subplot center wherever possible.

When collected:	plot status < 3
Field Width:	3 digits
Tolerance:	+/- 4 degrees
Values:	001 to 360

8.3.6 WO SLOPE DISTANCE (M)

[wo_dist]

Record, to the nearest 0.1 meter, the slope distance from the plot center to the WO; a WO should be within 20 meters of subplot center.

When collected:	plot status < 3
Field Width:	4 digits
Tolerance:	+/- 0.1m
Values:	0001 to 1500 meters

8.3.7 TREE TAG NUMBER

[wo_tree_tag_no]

Affix an aluminum tree number tag and record a TREE TAG NUMBER for all witness trees and (where possible) objects.

Nail the tag at eye level facing subplot center and mark a spray paint mark at the base where the slope distance point is recorded to.

For live trees: Drive the nail in only as far as is necessary to firmly anchor it in the wood to allow for stem growth.

Standing dead trees: Pound the nail flush with the trunk on all standing dead trees.

Do not use a unique TREE TAG NUMBER more than once on a plot.

When collected:	plot_wo_type < 3 or plot_wo_type = 96
Field Width:	3 digits
Tolerance:	No errors
Values:	001 to 999

8.3.8 WO NOTES

[wo_notes]

Record notes to explain any special WO situation that may need clarification for future plot visits. (e.g., shrub species, height/size of rock, WO not visited.

When collected:	As needed to describe special situation when subplot_status = 1 or 2; required when wo_type = 3 or 4
Field Width:	2000 characters
Tolerance:	N/A
Values:	Single words or abbreviated sentences

8.4 SUBPLOT NOTES

[subplot_notes]

Record any notes needed to clarify or explain a special situation related to the subplot.

When collected:	All plots
Field Width:	2000 characters
Tolerance:	N/A
Values:	Words, phrases and numbers

9 SEEDLING AND SAPLING DETAILS

Seedlings and saplings are recorded in the S plot. Regeneration information are obtained by counting live tree seedlings within the 2.5 meter radius S Plot located 90 degrees and 5.0 meters from each subplot center within each of the five subplots. Seedlings height ≥ 10 cm and DBH < 2 cm will be counted.

Count all live seedlings that have their base inside the S Plot boundary regardless of vigor, damage, or closeness to other trees, but count only one seedling from a clump; a clump is 3 or more live stems that sprouted from a common root base (including stumps).

Nypa are recoded in the S plot as seedlings (recorded as a count) and all Goran (*Ceriops decandra*) with a collar diameter of less than 2 cm will also be counted as seedlings.

9.1 SEEDLING DETAILS

9.1.1 SEEDLING RECORD NUMBER

[seedling_id]

A sequential, unique identifier assigned automatically by the application.

When collected:	All seedlings
Field Width:	3 digits
Tolerance:	No errors
Values:	1-999

9.1.2 SEEDLING SPECIES

[seedling_spp]

Record the species name. If the species cannot be identified record it as an “unknown” or “Other” using the code UNK or OTH. Detail any descriptive features in the notes and collect a sample of foliage, flowers, bark, etc. for identification.

When collected:	All seedling count records
Field Width:	4 digits
Tolerance:	No errors for genus, no errors for species
Values:	Tree species list

9.1.3 SEEDLING COUNT

[seedling_count]

On each S Plot, record the number of live tree seedlings along with its species. Count live individuals by species: When seedlings are distributed evenly on an S Plot, a suggested method of estimating is to count the number of seedlings on one quarter of the S Plot and multiply by four (given that there is only one land feature on the S plot). Repeat for each species. Seedlings must be at least 10.0 cm in length and less than 2.0 cm at DBH to qualify for counting.

General seedling counting rules:

- Count all live seedlings with their bases inside the S Plot boundary regardless of vigor, damage, or closeness to other trees.
- Multiple “suckers” that originate from the same location, and stump sprouts are considered one seedling.
- Do not count any seedlings that sprout from a live tree.

When collected:	subplot_status=1
Field Width:	3 digits
Tolerance:	No errors for 5 or fewer per species; between 10- 25 per species +/- 10%; +/- 20% over a count of 25
Values:	001 to 999

9.2 SAPLING DETAILS

9.2.1 SAPLING ID

[sapling_id]

Sequential, unique identifier (assigned by the application automatically)

When collected:	All sapling records
Field Width:	3 digits
Tolerance:	No errors
Values:	1 to 999

9.2.2 SPECIES

[sapling_sp]

Record the SPECIES. Use code OTH for other or UNK for unknown live tree.

When collected:	All sapling records
Field Width:	4 digits
Tolerance:	No errors
Values:	Species list

9.2.2.1 SPECIES OTHER

Record information or comments if species is unknown

When collected:	Sapling_sp = OTH or UNK
Field Width:	255 characters
Tolerance:	No errors
Values:	Text

9.2.3 BEARING (DEG)

[sap_bearing]

Sight the BEARING from the center of the S plot to the base of the sapling.

When collected:	All live saplings > 2.0 and < 10.0 cm from S Plot centre
Field Width:	3 digits
Tolerance:	+/- 5 degrees;
Values:	001 to 360

9.2.4 HORIZONTALDISTANCE (M)

[sap_dist]

Record HORIZONTAL DISTANCE, to the nearest 0.1 meter, from the S plot centre to to the base of the sapling. for trees greater than or equal to 2.0 cm and less than 10.0 cm DBH.

When collected:	All live saplings 2.0 < 10.0 cm 2.5 m from S Plot centre
Field Width:	3 digits
Tolerance:	S Plot: +/- 0.1 meter
Values:	0.1 to 19.0

9.2.5 DIAMETER AT BREAST HEIGHT (CM)

[sap_dia]

Record sapling diameter as close to 1.3 m as possible.

When collected:	All live saplings 2.0 < 10.0 cm 2.5 m from S Plot centre
-----------------	--

Field Width:	3 digits
Tolerance:	S Plot: +/- 0.1 meter
Values:	0.1 to 19.0

9.2.6 HEIGHT TO MEASUREMENT POINT (M)

[sap_htdmp]

If the diameter is not measured at 1.3 meter, record the actual height of measurement for each recorded tree greater than 10 cm DBH.

When collected:	All live saplings 2.0 < 10.0 cm 2.5 m from S Plot centre
Field Width:	4 digits
Tolerance:	+/- 0.3 meter
Values:	00.1 – 3.0

9.2.7 SAPLING LENGTH (M)

[tree_total_lgt]

Measured from the uphill side of a tree on a slope) to the top most portion of the sapling still present and attached to the trunk.

When collected:	All live saplings 2.0 < 10.0 cm 2.5 m from S Plot centre
Field Width:	3 digits
Tolerance:	+/- 5 percent of true length for live trees < 20 meter
Values:	001 to 400

10 DOWN WOODY MATERIAL

Down Woody Material (DWM) is dead material on the ground in various stages of decay. DWM is considered in two categories:

- Coarse Wood Debris (CWD): ≥ 8 cm
- Fine Wood Debris (FWD): < 8 cm diameter

All DWM in the inventory is sampled using the line intersect sampling method.

In this method, transects are established, and individual pieces of Coarse Woody Debris (CWD) and Fine Woody Debris (FWD) are recorded if the central axis of the piece is intersected by the line of the transect.

LOCATING AND ESTABLISHING LINE TRANSECT

Four transects are established on each accessible subplot of all zones. Transects begin at the subplot (M) center and extend 8.0 meters to the edge of the subplot (M) (Figure 23). It is extremely important to lay out the transect in a straight line to avoid biasing the selection of pieces and to allow the remeasurement of transect lines and tally pieces for QA purposes.

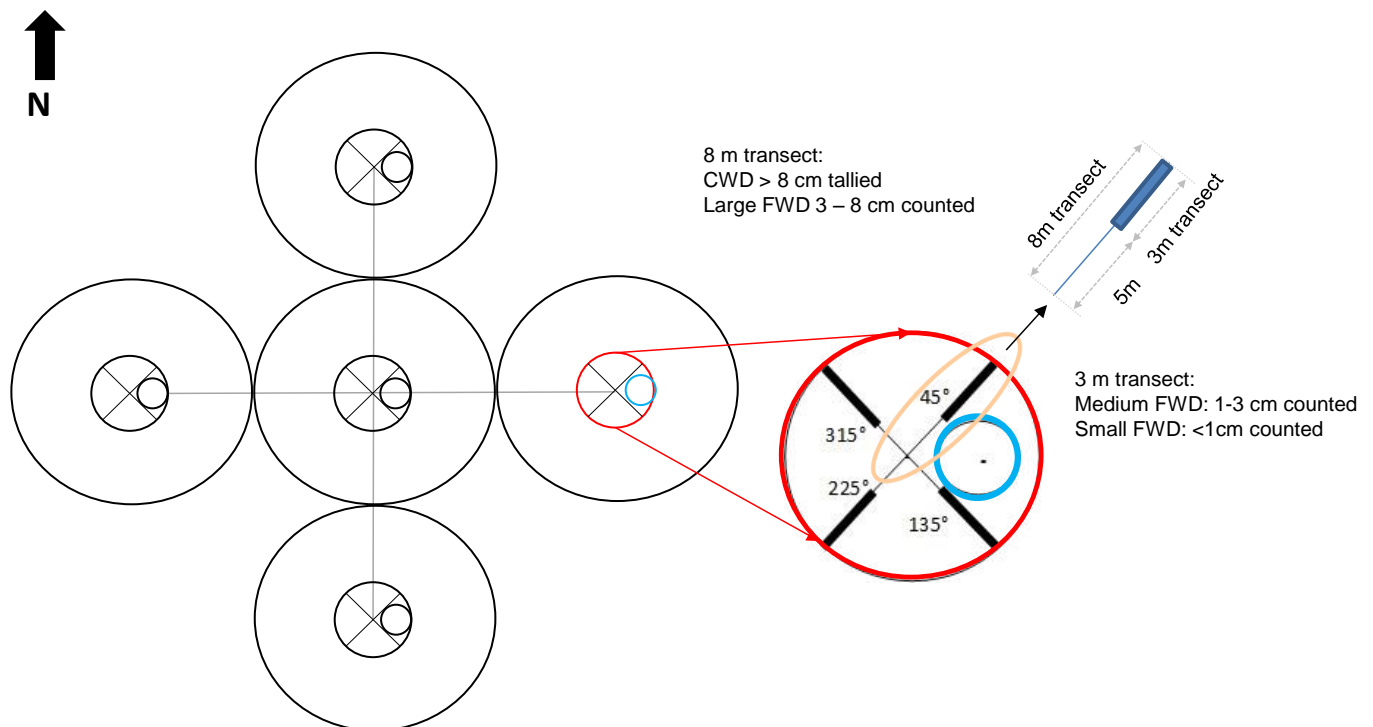


Figure 29: Plot Diagram and S and M plot/transect details

SAMPLING OF COARSE WOODY DEBRIS (CWD)

CWD includes dead trees and tall stumps that are leaning > 45 degrees from vertical. Most CWD will be lying on the ground. The minimum length for any piece is 15.0 cm. The counting and measurement of diameter of CWD at the point intersection will be done along the four 8 m transect as shown in Figure 29. For multi-stemmed sections see Figure 30 below.

Coarse woody debris (CWD) is recorded in all zones. Record CWD by starting at the subplot center and working towards the M plot boundary. Record a piece if it intersects the transect.

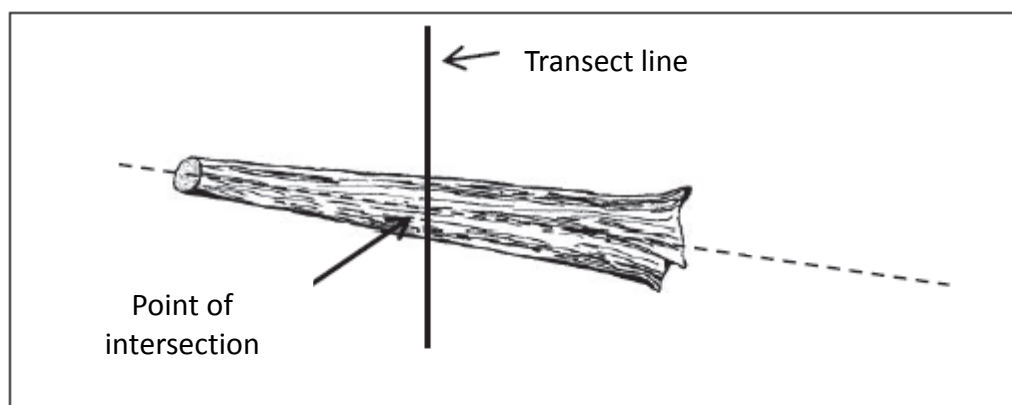


Figure 30: Rule for surveying CWD.

SAMPLING OF FINE WOODY DEBRIS (FWD)

FWD will be recorded within 3 size classes. Because FWD is generally present in high densities, a shorter transect is adequate. FWD will be counted at two different locations of each transect as follows considering the size classes as follows:

Category of FWD	Size Class	Diameter range	Transect length (horizontal distance)	Transect location (horizontal distance)
Small FWD	1	<1 cm	3 meter	5 to 8 meter
Medium FWD	2	1 – 3 cm	3 meter	5 to 8 meter
Large FWD	3	>3 – 8 cm	8 meter	0 to 8 meter

10.1 COARSE WOOD DEBRIS (CWD)

10.1.1 CWDID

[cwd_id]

A sequential, unique identifier assigned automatically by the application

When collected:	subplot_status <= 2
Field Width:	3 digits
Tolerance:	No errors
Values:	1-999

10.1.2 TRANSECT BEARING (DEG)

[cwd_tran]

The transect bearing is taken from the centre of the subplot. Record the transect bearing on which CWD is being recorded.

When collected:	subplot_status <= 2	
Field Width:	3 digits	
Tolerance:	+/- 2 degrees	
Values:	Transect direction (degrees) from center of subplot	
	0	No woody debris observed
	1	45
	2	135
	3	225

	4	315
--	---	-----

10.1.3 LAND FEATURENUMBER

[cwd_lfid]

Record the LAND FEATURE CLASS NUMBER in which each CWD is located.

When collected:	plot_lf_n > 1
Field Width:	1 digit
Tolerance:	No errors
Values:	1 to 9

10.1.4 CWD SLOPE DISTANCE (M)

[cwd_sdist]

Record the slope distance along the transect line to the point where the CWD piece first crosses the transect (the intersection point closest to the subplot centre). If two or more pieces have the same slope distances, record the top piece first. Measure and record to the nearest 0.1 meter. CWD SLOPE DISTANCE is used to locate the piece for QA purposes.

When collected:	All cwd pieces
Field Width:	4 digit
Tolerance:	+/- 0.1 meter
Values:	0.01 to 8.0

10.1.5 DIAMETER AT POINT OF INTERSECTION (CM)

[cwd_dia]

Record the piece's diameter at the point where the piece intersects the transect. Record the diameter to the nearest cm. If the diameter is close to 8 cm, measure the diameter to the nearest 0.1 cm to determine if the piece is actually >8 cm.

When collected:	All CWD
Field Width:	3 digits
Tolerance:	Pieces < 50.0 cm diameter: +/- 2 cm for decay class 1-4, +/- 5 cm for decay class 5 Pieces >50.0 cm diameter (decay classes 1-4): +/- 5 cm for each 50-cm increment Pieces >50.0 cm diameter (decay class 5): +/- 7 cm for each 50 cm increment above 50.0 cm
Values:	8.0 to 500.0

10.1.6 CWD DECAY CLASS

[cwd_dec]

Record a 1-digit code indicating the decay class of the piece. Record the decay class that predominates along the observed length of the piece. Use the guide below to determine CWD DECAY CLASS.

When collected:	All CWD	
Field Width:	1 digit	
Tolerance:	+/- class	
Values:	Code	Structural Integrity
	1	Fresh: Freshly fallen intact logs. Bark and fine twigs still attached.
	2	Low decay: Mostly sound, bark loosening, many fine twigs are gone.
	3	Moderate decay: Heartwood mostly sound, supports its own weight; and branch stubs remain firmly attached.
	4	High decay: Heartwood rotten, does not support its own weight, but maintains shape; extensive wood loss

		Branches/stubs break off.
	5	Rotten: piece no longer maintains shape, spreads on ground

10.2 FINE WOODY DEBRIS (FWD)

FWD is sampled in three size classes, along transect bearings described in Figure 29 above. Pieces in two FWD size classes (0.01 to 1 cm and 1 to 3 cm) are counted on a 3-m transect, from 5 m to 8 m horizontal distance. Pieces in the largest size class (3 to 8 cm) are counted on an 8 m transect, from 0 to 8 m. These transects overlap. Note: individual diameters are not recorded for FWD.

Count a piece of FWD if it intersects the transect. Be sure to count only woody material such as a twig, branch, wood fragment, or small shrub or tree stems. Do not count material that is actually litter, such as leaves. If there is no FWD on a transect, enter zeros for the count. If a transect is not measured, provide explanation in the notes.

10.2.1 FWD TRANSECT

[fwd_tran]

Record the bearing (degrees) of the transect on which FWD is sampled. The transect direction (degrees) is shown in degrees from the centre of the subplot.

When collected:	subplot_status <= 2	
Field Width:	3 digits	
Tolerance:	No errors	
Values:	Code	
	0	No woody debris observed
	1	45
	2	135
	3	225
	4	315

10.2.2 LAND FEATUREID

[fwd_lf]

Record the LAND FEATURE CLASS NUMBER in which each FWD is located.

When collected:	plot_lf_n > 1
Field Width:	1 digit
Tolerance:	No errors
Values:	1 to 9

10.2.3 SMALL FWD COUNT

[fwd_smallct]

Record the number of pieces counted in this size class (0.01 cm to 1cm diameter) along the transect 3 m segment. An accurate count should be conducted up to 50 pieces. If the count exceeds 50, the transect can be sub-sampled to estimate a total count for the transect length.

When collected:	subplot_status <= 2
Field Width:	3 digits
Tolerance:	0 to 50 = +/- 20% of the total count for the transect 51 to 100 = +/- 25% of the total count for the transect 100 + = +/- 50% of the total count for the transect
Values:	000 to 999 pieces

10.2.4 MEDIUM FWD COUNT

[fwd_medct]

Record the number of pieces counted in this size class (1 cm to 3cm diameter) along the 3 m transect segment. An accurate count should be conducted up to 50 pieces. If the count exceeds 50, the transect can be sub-sampled to estimate a total count for the transect length.

When collected:	subplot_status <= 2
Field Width:	3 digits
Tolerance:	+/- 20% of the total count for the transect
Values:	000 to 999 pieces

10.2.5 LARGE FWD COUNT

[fwd_lrgct]

Record the number of pieces counted in this size class (3 cm to 8cm diameter) along the 8 m transect segment. An accurate count should be conducted up to 20 pieces. If the count exceeds 20, the transect can be sub-sampled to estimate a total count for the transect length.

When collected:	subplot_status <= 2
Field Width:	3 digits
Tolerance:	+/- 20% of the total count for the transect
Values:	000 to 500 pieces

10.2.6 HIGH COUNT REASON

[fwd_highct]

Enter a code that applies to the situation encountered on the transect. Enter a code if any of the counts on the transect are greater than 100 pieces.

When collected:	dwm_fwd_smallct > 100 or dwm_fwd_medct > 100 or dwm_fwd_lrgct > 100	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	High count is due to an overall high density of FWD across the transect
	2	Animal nest
	3	Tree or shrub laying across transect
	96	Other reason

11 SOIL AND LITTER MEASUREMENTS

Soil samples are collected in three subplots (as described in Figure 31 below) and analysed to determine soil texture, bulk density and organic carbon. Strict processes must be followed to ensure methods of sample collection, storing, transporting and processing allow for accurate laboratory analysis.

Soil sample collection is not possible if the land is covered by water; therefore, the sequencing of soil sample collection in the mangroves is critical as the sampling window may last about 4 hours due to tides.

Soil samples can be collected by one or two members of the team while the rest of the team focusses on the other data collection components.

11.1 STEP-BY-STEP PROCESS FOR SOIL SAMPLE COLLECTION

- Step 1. Identify and record the LAND FEATURE ID that the soil sample was collected in (11.3.1)
- Step 2. Record the GENERAL SOIL CONDITION of the area (11.3.2).
- Step 3. Once the sampling point has been identified, push the auger into the ground to mark the spot. This way you will avoid standing on and compacting the sampling point.
- Step 4. Establish the litter collection frame directly north of the sampling point (11.4.1).
- Step 5. Now begin winding the auger in to the soil. If the GENERAL SOIL CONDITION is very hard, you may need to use a spade to collect the samples as described on page 70.
- Step 6. Once the auger is extracted and an intact core has been achieved, take a photo of the core next to a tape measure (see Figure 32)
- Step 7. Take the necessary samples from the auger and Label containers or bags with the naming convention: Plot/Subplot/Depth/Sample Type. For example for the top (0-15 cm) texture analysis in Plot 1, Subplot 2, label as:

P 1 / SP 2 / 0-15 / TEXTURE / Land Feature Number
- Step 8. Take the bulk density cores (11.3.6) and label appropriately as described above. This sample will also be used for Organic Carbon (OC) analysis.
- Step 9. If it will be more than one day till then Bulk Density/OC sample will be sent to the lab the samples should be exposed to sun and air so the soil can dry.
- Step 10. Collect the litter from within the litter frame and place in a plastic bag. Poke small holes in the bag to allow for drying and avoid condensation. Remember to open the bag and leave the litter to dry once back at the office.
- Step 11. Describe any relevant information about the sample in the SOIL AND LITTER NOTES (11.4.2).
- Step 12. Clean auger thoroughly after each use.
- Step 13. Place all soil samples into one plastic bag and label with the Plot Number and date.

11.2 EQUIPMENT USED FOR SOIL AND LITTER MEASUREMENTS

Large auger (Sundarbans) or small auger (other areas)	Dry and wet cloth
Soil Core Sampler	Stainless steel spoon
1 m x 1 m Litter frame	Permanent marker
Large and small shovels	Small stool
Plastic Jar (500 g)	Measuring tape
Plastic bag (Zip lock) small and medium size	Large Plastic sheet
Masking tape	Hammer
Cutter and knife	Plastic bags

11.3 SOIL AND LITTER SAMPLING AT SUBPLOT LEVEL

Soil samples are collected in three circular subplots oriented at subplot centre (1), north (2) and east (3) (see Figure 31). A soil sample should be representative of the area from which it is taken to ensure accurate results.

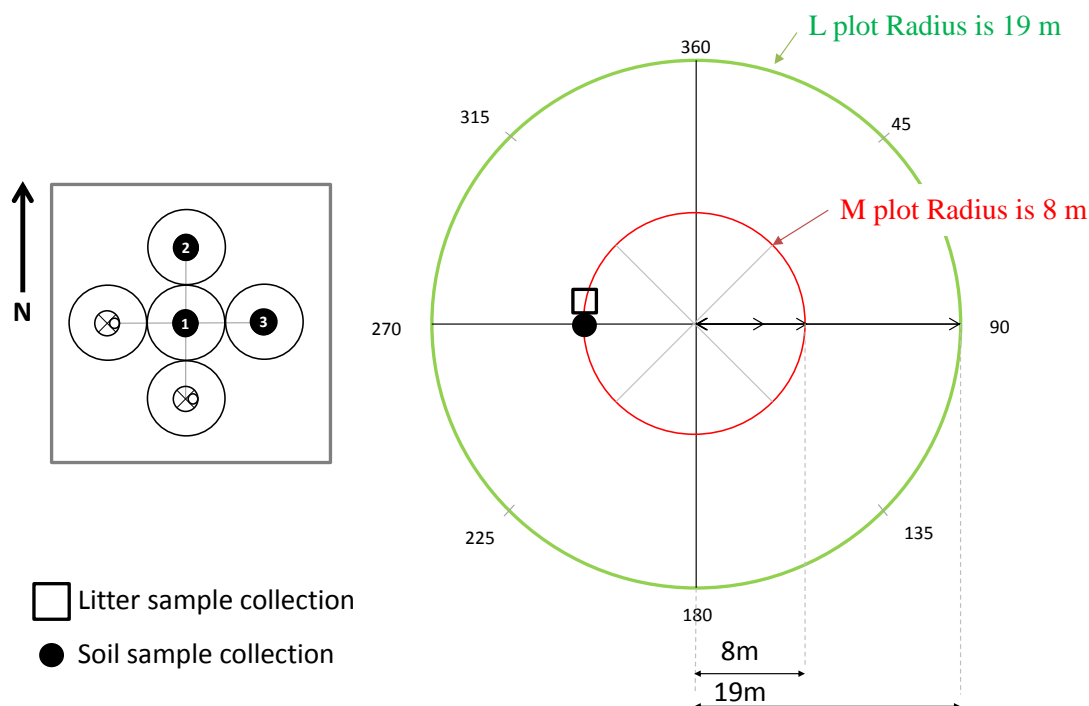


Figure 31: Soil and litter samples are collected in subplots 1-3 in all zones.

SOME CONSIDERATIONS WHEN TAKING SOIL SAMPLES:

- **Label:** Each sample must be labeled and stored to ensure its results are accurately documented and attributed to the correct location. The labeled code should contain three parts as follows
Plot number/sub-plot number/ sample collection depth / Sample Type / Land Feature Number
- **Documentation:** The appearance of the core must be documented to identify any unique properties in its appearance and to provide additional information to the analysis team about the sample. Additional comments are provided in the Notes section (See 11.4.2).
- **Sample preservation:** Samples should be securely packed and returned to the BFI Unit within one week of collection. To minimize decomposition of organic matter the organic carbon/bulk density sample should be air-dried by carefully leaving open to the air. Litter samples should be dried by leaving them in the sun to ensure they do not rot when left in the plastic bag. Sample must be relabeled when the label has been broken after the sample preservation.

11.3.1 LANDFEATURENUMBER

[fwd_lf]

Record the LAND FEATURE ID from which the soil sample was taken.

When collected:	plot_lf_n > 1
Field Width:	1 digit
Tolerance:	No errors
Values:	1 to 9

11.3.2 GENERAL SOIL CONDITION

Soil moisture of surface floor should be described under visual assessment for each sampled subplot.

[soil_cond]

When collected:	All	
Field width:	5 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Wet: Forms a ball easily, sticks to hands when touched leaving muddy marks.
	2	Moist: Forms a ball but may come apart/crack in large sections. Does not feel muddy to touch.
	3	Dry: Very crumbly. Does not form a ball
	4	Very dry: Significant cracks observed in ground of surrounding area. Difficult to dig/use core sampler.

11.3.3 SOIL DEPTH OF HUMUS (CM)

On each sampling plot, the organic litter covering the soil surface should first be carefully removed to expose the surface dark-coloured humus-rich mineral soil – sometimes referred to as the “duff” or “humus” layer. Then the depth of the dark coloured soil should be measured accurately with a ruler or tape on the vertical side of soil core for soil texture.

[soil_hdepth]

When collected:	All
Field Width:	3 digits
Tolerance:	+/- 2 cm
Values:	00.00 to 20.00

11.3.4 SOIL TEXTURE SAMPLE DEPTHS

List all sample depths taken. This is a multi-list so more than one option can be selected.

[soil_texture]

When collected:	All soil samples	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	0	Sample not taken
	1	5 cm - 10 cm
	2	20 cm-25 cm
	3	65 cm -70 cm
	96	Other depth - Specify

METHOD FOR COLLECTING SOIL TEXTURE SAMPLE IN THE FIELD (SMALL AUGER):

- Step 1. Scrape away the surface litter and weeds from the sampling spot with the help of a spade/belcha. This will assist to ensure samples are free from stubbles, grass, rubbish, plant roots, stems etc.
- Step 2. Insert the auger by rotating in one direction
- Step 3. Remove slowly once maximum depth has been reached.
- Step 4. Slice the core sample into two segments: 0–15 cm and 15–30 cm using the knife.
- Step 5. Put the samples in the plastic jar or zip lock bag and label as Plot/Subplot/Depth/Sample type/Land Feature ID. For example for the top section of the sample in Plot 1 Subplot 2, in land feature 1:

P 1/SP 2/0-15/TEXTURE/ LF-1



Insert the auger by rotating and pushing. Pull out slowly.



Place the auger in the big plastic sheet and collect the sample



Put the sample in plastic jar or bag if jar is not available.

METHOD FOR COLLECTING SOIL TEXTURE SAMPLE USING AUGER IN MANGROVES (LARGE AUGER)

- Step 1. Insert the open-faced auger vertically and twist till it reaches maximum depth.
- Step 2. Pour some water onto the soil so it will moisten the soil around the auger.
- Step 3. Slowly pull the auger out of soil rotating continuously (If the sample is disturbed or consists of coarse roots, clean the auger and collect a new core).
- Step 4. Slice the soil in three segments: 0–15 cm, 15–30 cm, and 30-100 cm and cut from the auger face.
- Step 5. Put the sample in the plastic bag or jar and label it as Plot / Subplot / Depth / Sample Type. For example for soil sample for texture for 0-15cm in plot 1, subplot 2, land feature 1:

P 1/ SP 2 / 0-15 /TEXTURE / LF-1

METHOD FOR SOIL COLLECTION IN HARD SOILS

In some cases the ground may be too hard to use an auger for soil sample collection. In this case pit may be dug with a shovel to the desired depths. It is very important not to ensure samples only have soil from the appropriate depth class. The below steps should be followed:

- Step 1. Use a shovel or belcha to remove surface grass and litter open a pit to 15 cm in depth.
- Step 2. Use a measuring tape to ensure an accurate depth. Ensure the side of the pit is vertical and flat
- Step 3. Remove all loose soil from the pit so the sample will not be contaminated.
- Step 4. Use a small shovel to scrape an even section from the side of the pit. Be sure the soil represents an even sample; i.e., there is not more soil from the top of the pit than the bottom.
- Step 5. Put the sample in the plastic bag or jar and label to the naming convention specified above.
- Step 6. Repeat for the 15-30cm sample.
- Step 7. The bulk density cores may be taken from the same pit.



Step 1: Dig a pit using a shovel



Step 2: Mark the depth of sample layer with a carpenters tape



Put the sample in plastic bag or jar and label appropriately.

11.3.5 SOIL AUGER PICTURE

Take a picture of the soil core (from auger) next to a measuring tape as shown in Figure 26.



Figure 32: Include the measuring tape when taking photos of soil samples (© Frida Sidik, FAO)

[wo_pic]

When collected:	plot status < 3
Field width:	5 digits
Tolerance:	No errors
Values:	Jpeg image

11.3.6 BULK DENSITY SAMPLE DEPTHS

Samples are taken from relatively undisturbed cores with minimal soil compaction. Samples should be taken at the points where there are not visible soil cracks (undisturbed). If a core is taken and it is loose, cracked or disturbed, another core should be taken near by the sample location. As the bulk density will be used to calculate the organic carbon content, we use the same samples taken for organic carbon analysis. Always clean the equipment after use to avoid contamination from previous sample collection. BD samples are labelled as Plot number/sub-plot number/ sample collection depth / Type / Land Feature Number

List all sample depths taken. This is a multi-list so more than one option can be selected.

[soil_texture]

When collected:	All soil samples	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	0	Sample not taken
	1	5c m - 10 cm
	2	20 cm - 25 cm
	3	65 cm - 70 cm
	96	Other depth - Specify

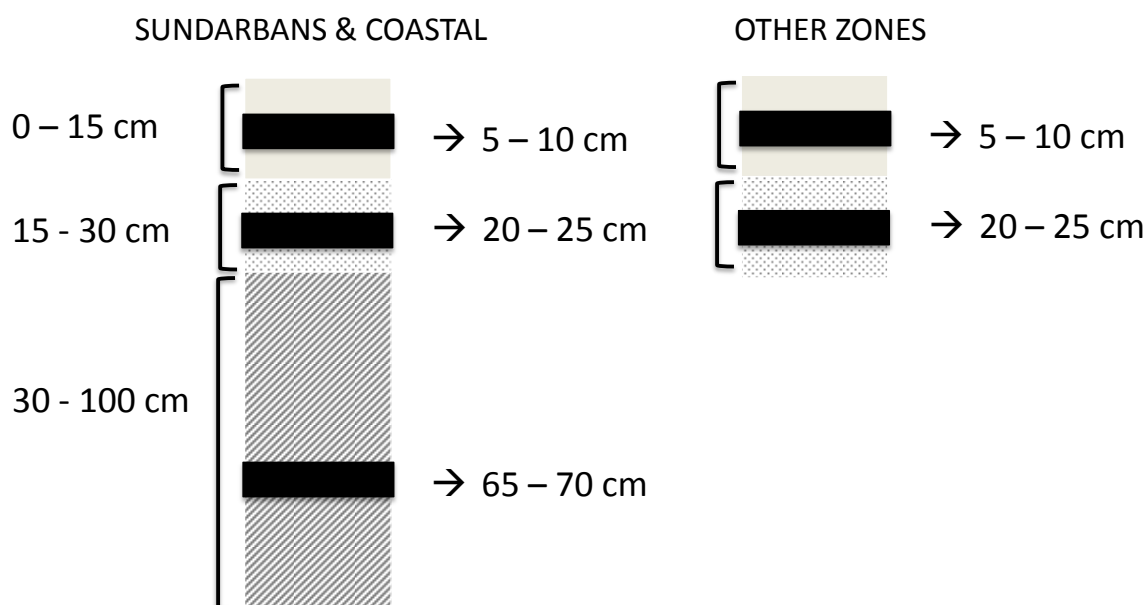


Figure 33: Collection of soil samples for bulk density measurement in different zones

METHOD FOR DENSE SOILS USING CORE SAMPLER

1. Remove the top 5 cm of soil with a shovel or knife.
2. Push the ring into the soil and hammer downward until it is completely submerged. If required, place an extra ring on top and hammer a little further so to ensure the core is completely filled.
3. Use a shovel or knife to dig the core out.
4. Use a knife to cut away any soil that is protruding from the ends. The core should be completely full and flat with soil at both ends. This sample represents the 0 – 15 cm interval.
5. Now use the shovel to dig to a depth of 20 cm and repeat steps 2 – 5. This sample represents the 15 - 30 cm interval written in the field form.
6. Label the cores as Plot/Subplot/Depth/BDC/LF (be as accurate as possible when in recording the depth) For example for the 0-15cm sample in Plot 1 Subplot 2, land feature 1, record:

P 1/S 2/5-10cm/BDC / LF 1



Push the core sampler into the soil



Extract the sample using a field knife or shovel



Level the surface of the soil sample on both sides and ensure that soil is completely level with edge of the core.

METHOD FOR MUDDY SOILS USING AUGER (MANGROVE FOREST ONLY)

1. Insert the open-faced auger vertically and twist the auger until it reaches the required depth.
2. Once the auger has reached the appropriate depth, pour some water (half cup) into the hole. This will help the soil core being removed intact.
3. Gently pull auger out of soil. If the sample is disturbed or consists of coarse roots, clean the auger and try to collect a new core.
4. Cutting the soil away from the auger face. Take the unused parts for soil texture (see the method above) and gently clean and flat the surface of soil core.
5. Take the measuring tape to control the depth of core and mark the depth where the subsample will be collected using blade. Subsample the soils at depth 0-15, 15-30, and 30-100 cm by taking a 5 cm sample with consistent depth interval midpoint of each subsample depth (Figure 5). For example, when sampling the 0-15 cm depth, the sample would ideally come from the 5-10 cm depth. Use the measuring tape and blade for measuring and marking the depth interval.
6. Put the sample in a jar or zip lock bag.
7. Label it with permanent marker as Plot / Subplot/Depth/BDC/Land Feature ID. For example for soil sample for Bulk density for the soil layer 30-100 cm in subplot 2 of plot 1, land feature 2 write:

P 1/ Sp 2/ 65-70 /BDC / LF2



Figure 34: Bulk density cores are extracted from the long auger in the Sundarbans. Use a tape measure to extract exactly 5cm length sections at intervals between 0-15, 15-30, and 30-100.

11.4 LITTER SAMPLING

11.4.1 LITTER SAMPLE

IN THE FIELD:

- Mark out a 1 m x 1 m square at each subplot, directly to the north of where the soil core is collected.
- Collect the dead leaves, flowers, fruits, seeds, and bark fragments (excluding woody particles).
- Put the samples in the plastic bag and label it with permanent marker as Plot/Subplot. For example for Plot 1 Subplot 2:

P 1/S 2

- Poke some small holes in the bag so the leaves wontrot. 'Make sure the holes are small enough that no leaves can fall out.
- Once back in the office, open up the bag and leave in the sun to dry out before sending back to the BFI Unit.



Figure 35: The litter frame is used to determine the 1m x 1m area for litter collection.

[litter]

When collected:	All soil samples	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Yes – Sample was taken and labelled correctly
	2	No – Sample was not taken. Please specify.

11.4.2 SOIL AND LITTER NOTES

Record notes to explain any information that may need clarification for soil analysis (e.g., presence of roots, etc.). In particular, provide any information related to sample extraction for the bulk density.

[soil_notes]

When collected:	All
Field Width:	2000 characters
Tolerance:	N/A
Values:	Single words or abbreviated sentences

12 TREE DETAILS

This chapter describes how and where to sample live trees and standing dead trees. Determining which measurements are required is based on tree size, tree status, and regional location.

Begin recording trees at abearing of 001 degrees from subplot center and continue clockwise around the subplot. Work outward from subplot center to subplot perimeter.

Note: trees, standing dead trees and palms (except *Nypa*) are referred to (and collected as) TREES

12.1 TREE ID

[tree_id]

Sequential, unique identifier (assigned by the application automatically) to permanently identify each tree on a given subplot.

When collected:	All tree records
Field Width:	3 digits
Tolerance:	No errors
Values:	1 to 999

12.2 LAND FEATURE NUMBER

[tree_lfid]

Record the LAND FEATURE CLASS NUMBER in which each tree is located.

When collected:	All recorded trees
Field Width:	1 digit
Tolerance:	No errors
Values:	1 to 9

12.3 TREE STATUS

[tree_status]

This field is used to track the status of sample trees over time: as they first appear, as ingrowth, as they survive, and when they die or are removed.

Stumps are recorded in this survey, provided they have a top diameter ≥ 10 cm—i.e., they would be large enough for the tree survey if not cut/broken. If a stump does not reach breast height, only record base diameter and height.

When collected:	All dead and live trees > 10.0 cm; all dead and live stumps > 10.0 cm	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Definition
	1	Live tree
	2	Dead standing tree: The tree is standing above a 45 degree angle; a tree is dead when none of its parts are alive (leaves, buds, cambium) at 1.3m or above.
	3	Stump (dead)
	5	Stump (alive)

Standing dead trees must be at least 10.0 cm in DBH, have a bole which has an unbroken LENGTH of at least 1.3 meter, and lean less than 45 degrees from vertical as measured from the top of the root collar to 1.3 meter. See figures below for examples.

“Unbroken” is defined as at least 50 percent attached to the original source of growth. The degree of lean on dead trees with partially separated (i.e., 1 to 50 percent) boles is measured from the top of the root collar to the top of the tree.

Portions of boles on dead trees that are separated greater than 50 percent (either above or below 1.3 meter), are considered severed and are included in Down Woody Material (DWM) if they otherwise meet DWM criteria.

Live and dead standing trees, and partially separated boles of dead trees, do not have to be self-supported. They may be supported by other trees, branches, or their crown.

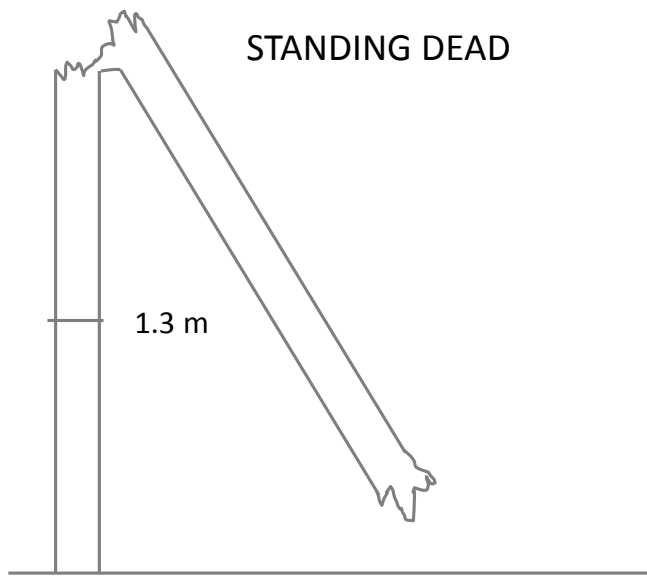


Figure 36: Example of an unbroken bole to 1.3 meter = STANDING DEAD

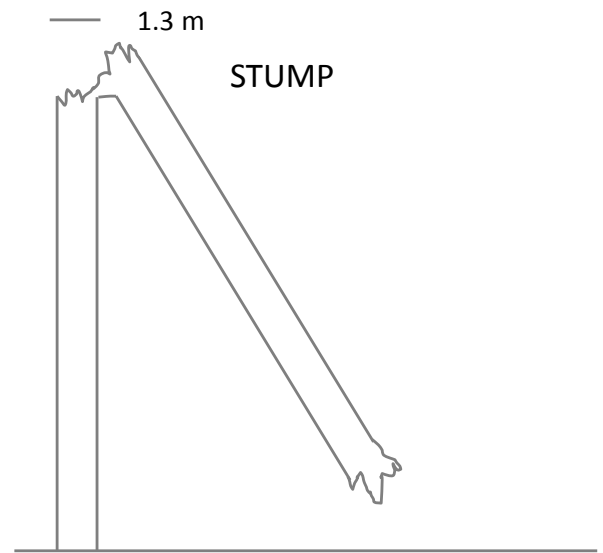


Figure 37: Example of a broken bole of less than 1.3 meter = STUMP

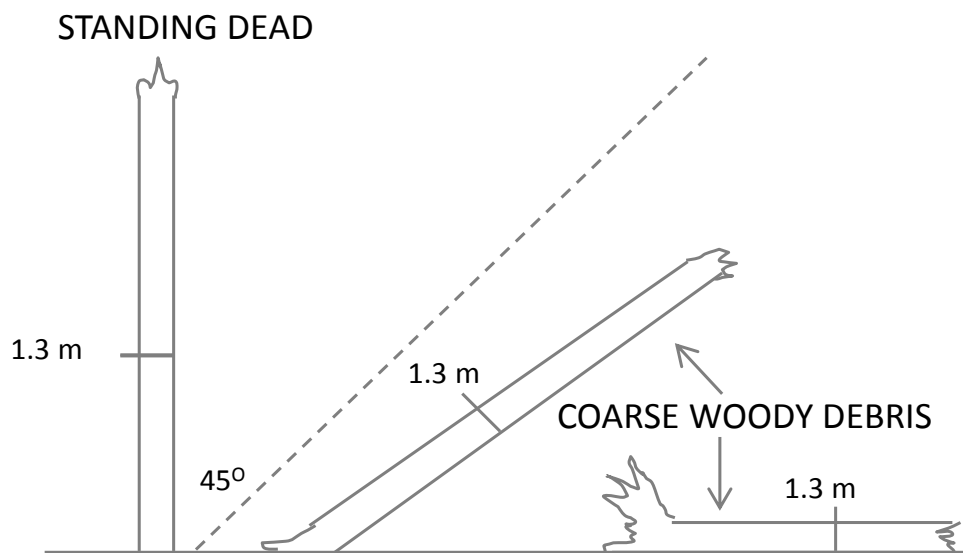


Figure 38: Other examples of dead trees

12.4 SPECIES

[tree_spp]

Record the species name. If a species is encountered that is not listed and it is not clear it should be recorded as Unknown and descriptions provided in the UNKNOWN SPECIES DESCRIPTION section (12.5). If the tree is known by another name or is not in the list, it is recorded as “Other” and details provided in the next field. All UNKNOWN or OTHER trees should be referred to the QA team. A sample should be taken and pressed where appropriate. If possible, collect samples outside the subplots from similar specimens and make a note to correct the SPECIES code later. Use code OTH for other or UNK for unknown live tree.

When collected:	All trees
Field Width:	4 digits
Tolerance:	No errors
Values:	Species list

12.5 UNKNOWN SPECIES DESCRIPTION

12.5.1 UNKNOWN - ALREADY DESCRIBED

[unk_like]

If this unknown tree has been described already, provide the tree ID number which contains the full description.

When collected:	unk_sppid> 1
Field Width:	3 digits
Tolerance:	No errors
Values:	1 to 999

12.5.2 DESCRIPTION

[tree_spp_other]

If a tree is unknown or not found in the SPECIES list, provide any descriptive details here and consult with the QA team. Be sure to take appropriate supporting photos of the tree.

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'
Field Width:	255
Tolerance:	No errors
Values:	Text

12.5.3 PHOTO 1: FORM / HABIT

[tree_unk_pic1]

If the tree is recorded as “Other” or “Unknown”, take a photo of the tree’s FORM or HABIT.

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'
Field Width:	500KB
Tolerance:	NA
Values:	Jpeg image

12.5.4 PHOTO 2: CUT BARK

[tree_unk_pic2]

If the tree is recorded as “Other” or “Unknown”, Cut the trunk and take a photo of the tree's bark and under bark to note if any sap or exudates appear.

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'
Field Width:	500KB
Tolerance:	NA
Values:	Jpeg image

12.5.5 PHOTO 3: FOLIAGE / FLOWERS

[tree_unk_pic3]

If the tree is recorded as “Other” or “Unknown”, take a photo of the foliage, flowers or leaf arrangement.

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'
Field Width:	500KB
Tolerance:	NA
Values:	Jpeg image

12.5.6 FORM

[unk_form]

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Tree
	2	Shrub
	3	Liana
	4	Palm
	96	Other

12.5.7 BARK

[unk_bark]

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Exfoliating
	2	Fissured
	3	Furrowed
	4	Plated
	5	Shredy
	6	Smooth
	7	Winged
	99	Unknown
	96	Other

12.5.8 RESIN OR LATEX

[unk_resin]

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Absent
	2	White
	3	Yellow
	4	Red
	5	Clear
	96	Other

12.5.9 LEAF TYPE

[unk_leaf]

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Long
	2	Round
	3	Palmate
	4	Lobed
	5	Opposite
	6	Alternate
	7	Pinnate
	8	Bipinnate
	9	Tripinnate
	96	Other
	99	Unknown

12.5.10 FLOWER COLOUR

[unk_flcolour]

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	White
	2	Green
	3	Red
	4	Yellow
	5	Pink
	6	Violet
	7	Blue
	8	Purple
	9	Orange
	99	Unknown
	96	Other

12.5.11 FRUIT LENGTH (CM)

[unk_frlength]

If the tree is recorded as "Other" or "Unknown", take a photo of the foliage, flowers or leaf arrangement.

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	1cm	
Values:	0 - 99	

12.5.12 FLOWER SHAPE

[unk_flshape]

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	Round

	2	Cylindric
	3	Flat
	4	Ovoid
	5	Obovoid
	96	Other
	99	Unknown

12.5.13 FRUIT COLOUR

[unk_frcolour]

When collected:	tree_spp = 'OTH' or tree_spp = 'UNK'	
Field Width:	2 digits	
Tolerance:	No errors	
Values:	Code	Description
	1	White
	2	Green
	3	Red
	4	Yellow
	5	Pink
	6	Violet
	7	Blue
	8	Purple
	9	Orange
	99	Unknown
	96	Other

12.6 BEARING (DEG)

[tree_bearing]

Sight the BEARING from the subplot center to the center of the base of the tree. For multi-stemmed species, sight to the center-point of the stems. Record BEARING to the nearest degree. Use 360 for north. Bearing for saplings is recorded from the centre of the S Plot.

When collected:	All live trees ≥ 10 cm DBH and standing dead tally trees ≥ 10 cm DBH and saplings $2.0 < 10.0$ cm from S Plot centre
Field Width:	3 digits
Tolerance:	+/- 5 degrees;
Values:	001 to 360

12.7 HORIZONTALDISTANCE (M)

[tree_dist]

Record HORIZONTAL DISTANCE, to the nearest 0.1 meter, from the subplot center (for trees greater than or equal to 10.0 cm DBH) to the pith of the tree at the top of the root collar.

When collected:	All live trees ≥ 10.0 cm DBH
Field Width:	3 digits
Tolerance:	M Plot: +/- 0.3 meter from 0.1 to 7.5 meter
	M Plot: +/- 0.1 meter from 7.5 to 8.0 meter
	L Plot: +/- 1.0 meter from 8.0 to 18.5 meter
	L Plot: +/- 0.3 meter from 18.5 to 19 meter
Values:	0.1 to 19.0

12.8 RECORDING DIAMETER

Diameter at Breast Height (DBH) is recorded at 1.3 m by default. If the diameter is measured at a different height, record the height the DBH was measured (in meters).

DIAMETER OF STUMPS

Diameter on stump less than 1.3 m in height: Use a diametertape or other measuring instrument to measure the longest and shortest axes across the top of the stump. Record diameter as the average of the two measurements.

Note: for live stumps which are re-shooting, the diameter of the shoots between 2 cm and 10 cm are measured in the S plot. If there are multiple shoots coming from the one stump/root system, only the one most dominant shoot is measured.

This means that live stumps with shoots between 2 cm and 10 cm are ostensibly collected twice: once as a stump and once as a seedling or sapling.

Stumps are measured at the same diameter thresholds as trees in the M (≥ 10 cm dia) and L (≥ 30 cm dia) plots.

SPECIAL DBH SITUATIONS:

1. **Forked tree:** In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less. Forks originate at the point on the bole where the piths intersect. Forked trees are handled differently depending on whether the fork originates below 0.3 meter, between 0.3 and 1.3 meter, or above 1.3 meter.
 - a. **Trees forked below 0.3 meter.** Trees forked are treated as distinctly separate trees. Distances and bearing are measured individually to the center of each stem where it splits from the stump, DBH is measured for each stem at 1.3 meter above the top of the root collar.
 - b. **Trees forked between 0.3 meter and 1.3 meter.** Trees forked between 0.3 meter and 1.3 meter are also counted as separate trees, but only one distance and bearing (to the central stump) is recorded for each stem. Although a single bearing and distance applies to all, multiple stems should be recorded as they occur in clockwise order (from front to back when one stem is directly in front of another). The DBH of each fork is measured at a point 1.3 meter above the pith intersection.
 - Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 1 meter above the common pith intersection.
 - Once a stem is recorded as a fork that originated from a pith intersection between 0.3 and 1.3 meter, do not recognize any additional forks that may occur on that stem.

Trees forked at or above 1.3 meter. Trees forked at or above 1.3 meters are considered one single tree (see Figure 40). If a fork occurs at or immediately above 1.3 meter, measure diameter below the fork just beneath any swelling that would inflate DBH.

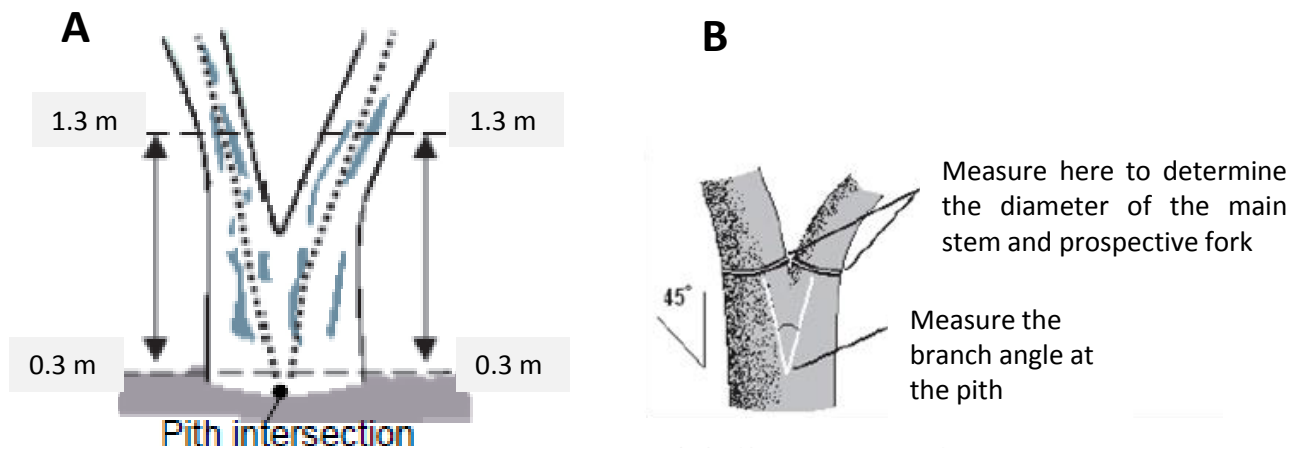


Figure 39: (A) Method for trees forked below 0.3 m; (B) Method for trees forked between 0.3 and 1.3 m.

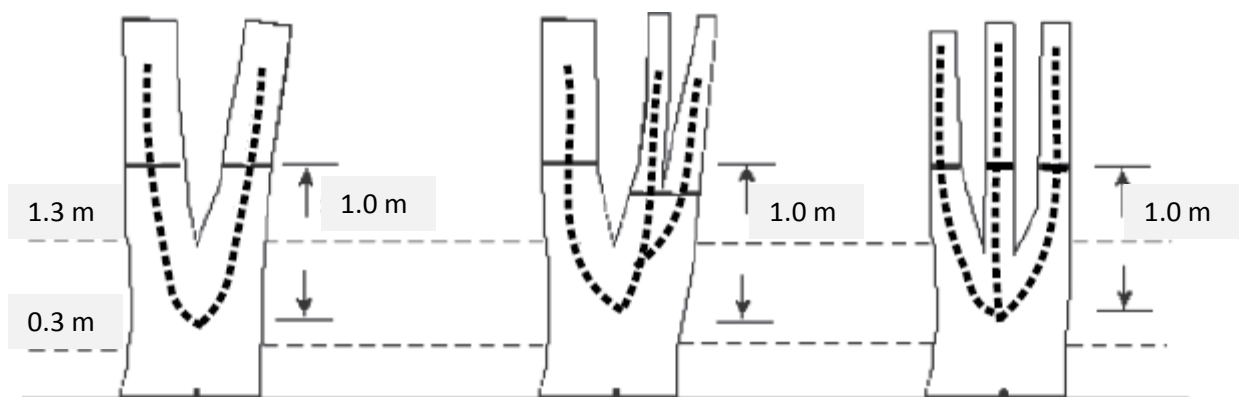


Figure 40: Method for trees forked above 0.3 m.

2. **Stump Sprouts.** Stump sprouts originate between ground level and 1.3 meter on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be 1/3 the diameter of the dead bole. Stump sprouts originating below 0.3 meter are measured at 1.3 meter from ground line. Stump sprouts originating between 0.3 meter and 1.3 meter are measured at 1.0 meter above their point of occurrence. As with forks, rules for measuring distance and bearing depend on whether the sprouts originate above or below 0.3m.
3. **Tree with butt-swell or bottleneck:** Measure these trees 0.5 meter above the end of the swell or bottleneck if the swell or bottleneck extends 1.0 meter or more above the ground.
4. **Tree with irregularities at DBH:** On trees with swellings, bumps, depressions, and branches at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form.
5. **Tree on slope:** Measure diameter at 1.3 meter from the top of the root collar along the bole on the uphill side of the tree.
6. **Leaning tree:** Measure diameter at 1.3 meters from the top of the root collar along the bole. The 1.3 meter distance is measured along the underside face of the bole.
7. **Independent trees that grow together:** If two or more independent stems have grown together at or above the point of DBH continue to treat them as separate trees.
8. **Missing wood or bark.** Do not reconstruct the DBH of a tree that is missing wood or bark or at the point of measurement. Record the diameter, to the nearest 0.1cm, of the wood and bark that is still attached to the tree. If a tree has a localized abnormality (gouge, depression, etc.) at the point of DBH, apply the procedure described for trees with irregularities at DBH.
9. **Live windthrown tree:** Measure from the top of the root collar along the length to 1.3 meter.
10. **For trees with prop roots.** Measure the diameter at 1.0 meter above the top of the prop root.

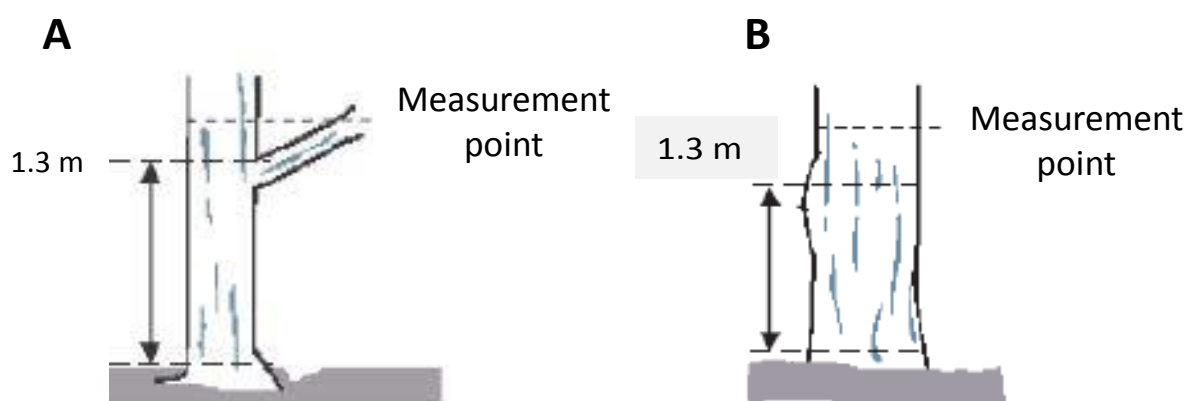


Figure 41: (A) Method for trees with a branch at 1.3 m; (B) Method for trees with swells at 1.3 m.

12.8.1 DIAMETER AT BREAST HEIGHT (CM)

[tree_dia]

Unless one of the special situations described in section 12.8.1 is encountered, measure DBH at 1.3 meter above the top of the root collar on the uphill side of the tree. Round each measurement down to the last 0.1 cm. For example, a reading of 3.68 cm is recorded as 3.6 cm. *Note: Although stumps do not meet DBH criteria, their DIAMETERS are recorded in this data item.

When collected:	All trees > 1.0 cm DBH and standing dead trees > 10.0 cm DBH	
Field Width:	4 digits	
Tolerance:	Live trees and dead trees with DECAY CLASS 1	+/- 0.5 cm per 50.0 cm increment of measured diameter
	Dead trees with DECAY CLASS 2,3	+/- 2.5 cm in per 20.0 cm increment of measured diameter
Values:	1.0 to 999.9	

12.8.2 HEIGHT TO MEASUREMENT POINT (M)

[tree_htdmp]

If the diameter is not measured at 1.3 meter, record the actual height of measurement for each recorded tree greater than 10 cm DBH.

When collected:	tree_dia ≥ 10cm
Field Width:	4 digits
Tolerance:	+/- 0.3 meter
Values:	00.1 – 3.0 (auto-populated with 1.3 - updatable)

12.9 TOTAL TREE LENGTH (M)

[tree_total_lgt]

The TOTAL TREE LENGTH of the tree is recorded from the top of the root collar (measured from the uphill side of a tree on a slope) to the top most portion of the tree still present and attached to the trunk.

When collected:	All trees ≥ 2.0 cm DBH and standing dead tally trees ≥ 10.0 cm DBH	
Field Width:	3 digits	
Tolerance:	+/- 5 percent of true length for live trees < 20 meter	
	+/- 10 percent of true length for live trees ≥ 20 meter and all dead trees	
Values:	001 to 400	

12.10 BOLE LENGTH (M)

[tree_bole_lgt]

The BOLE LENGTH of the tree is recorded from the top of the root collar and crown point (the position of the first crown forming live or dead branch). This variable is measured only for one in every five trees.

When collected:	All trees ≥ 10 cm DBH and standing dead tally trees ≥ 10.0 cm DBH
Field Width:	3 digits
Tolerance:	+/- 5 percent of true length for live trees < 20 meter +/- 10 percent of true length for live trees ≥ 20 meter and all dead trees
Values:	001 to 60

12.11 TREE LENGTH METHOD

[tree_lgt_method]

Record the code that indicates the method used to determine tree lengths.

When collected:	All live trees ≥ 2.0 cm DBH and standing dead trees ≥ 10.0 cm DBH	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Laser Range Finder, TruePulse or other hypsometer
	2	Clinometer or tape
	3	Estimate

12.12 TREE DAMAGE

[tree_dam]

Record the first damage type observed that meets the damage threshold definition in the lowest location. Damage categories are recorded based on the numeric order that denotes decreasing significance from damage 01 - 31.

When known, record the specific name of the damaging agent (genus and species, or common name of fungal pathogens, insects, parasites...) in tree notes.

When collected:	All trees ≥ 10 cm DBH; tree_status = 2	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	0	None observed: No damage observed at time of assessment
	1	Insect: Defoliation caused by insect predation
	2	Disease: Necrosis or other symptoms of ill health observed (usually on foliage)
	3	Fire: Defoliation structural damage caused by fire
	4	Animal : Over grazed
	5	Storm: damage caused by storms
	6	Vegetation: Vegetation (suppression, competition, vines/kudzu)
	7	Human: Human-caused (cultural, logging, accidental, etc.)
	8	Physical: Roots are undermined by erosion, hit by falling tree
	99	Other: Unknown/not sure/other – includes death from human activity not related to silvicultural and land clearing activity (accidental, random, etc.) (include notes)

12.13 DAMAGE SEVERITY

[tree_damsev]

When collected:	All trees ≥ 10 cm DBH; tree_status = 2	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Low: Damage is affecting less than 30% of the canopy or trunk; the tree is likely to recover from the damage; the damage is unlikely to affect the longevity of the tree.
	2	Moderate: Damage is observed on more than 50% of the tree canopy or trunk; the tree may make a partial recovery however the damage is likely to reduce the tree's natural life expectancy
	3	Severe: Significant damage observed on up to 100% of the canopy and/or trunk of the tree; the tree is unlikely to recover from the damage; the trees longevity is significantly affected.

12.14 YEAR CUT

[year_cut]

Only for stumps. Estimated time since the tree was cut.

When collected:	tree_status > 2	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	< 1 year
	2	1-5 years
	3	5-10 years
	4	>10 years

12.15 DECAY CLASS

[tree_decay]

Record the stage of decay for each standing dead tree greater than 10.0 cm in diameter.

When collected	tree_status = 2 and DBH ≥ 10.0 cm	
Field Width:	1 digit	
Tolerance:	+/- 1 class	
Values:	Code	Description
	1	Most branches present: Original branch structure still present with many fine branches still attached
	2	Few branches present: Few limbs and no fine branches, sound at base though advancing decay in upper bole
	3	No branches / few stubs only: Predominantly a single trunk, minor stubs, significant decay in all parts of tree



Figure 42: Examples of dead tree decay status. Class 1 trees retain twigs and small branches. Class 2 is a broad category including trees with no twigs or small branches; these may have large branches, or stem only. Adapted from Walker et al. (unpubl.).

12.16 TREE NOTES

[tree_notes]

Record notes pertaining to an individual tree as called for to explain or describe another variable.

When collected:	All tree, as needed
Field Width:	2000 characters
Tolerance:	N/A
Values:	Words, phrases and numbers

13 BAMBOO DETAILS

Bamboo is recorded in the M Plot (8 m radius from plot centre) in all locations.

13.1 CLUMP ID

[bamboo_id]

Sequential, unique identifier assigned by the application automatically.

When collected:	All bamboo clumps
Field Width:	2 digits
Tolerance:	No errors
Values:	1 to 99

13.2 LAND FEATURE NUMBER

[bamboo_lf]

Record the land feature code.

When collected:	All bamboo clumps
Field Width:	1 digits
Tolerance:	No errors
Values:	1 to 90

13.3 SPECIES

[bamboo_sp]

Record the botanical name of the Bamboo. If the species name is not known, record as "Bamboo sp."

When collected:	All bamboo clumps
Field Width:	4 digits
Tolerance:	No errors
Values:	Tree Species List for species codes

13.4 BEARING (DEG)

[bamboo_bear]

Sight the BEARING from the subplot center to the center of the bamboo clump. Record the BEARING to the nearest degree. Use 360 for north.

When collected:	All bamboo clumps
Field Width:	3 digits
Tolerance:	+/- 5 degrees;
Values:	001 to 360

13.5 HORIZONTALDISTANCE (M)

[bamboo_dist]

Record the HORIZONTAL DISTANCE, from the base of the subplot center, to the centre of the Bamboo clump

When collected:	All bamboo clumps
Field Width:	3 digits
Tolerance	+/- 0.3
Values:	0.1 to 8m

13.6 LENGTH (M)

[bamboo_lgt]

Average LENGTH of the Bamboo culm is recorded from the ground level (measured from the uphill side of the slope) to the highest remaining portion of the Bamboo.

When collected:	All bamboo clumps
Field Width:	2 digits
Tolerance:	+/- 5 percent of true length/height < 20 meter +/- 10 percent of true length/ height ≥ 20 meter
Values:	001 to 50

13.7 LENGTH METHOD

[bamboo_lgt_method]

Record the code that indicates the method used to determine bamboo lengths.

When collected:	All bamboo clumps	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Laser Range Finder, TruePulse or other hypsometer
	2	Clinometer or tape
	3	Estimate

13.8 DIAMETER (CM)

[bamboo_dia]

Record the average of the ten most representative stems (culm) DBH at 1.3 meter from ground level.

When collected:	Bamboo_lgt >1.3
Field Width:	4 digits
Tolerance:	+/- 0.5 cm
Values:	1.0 to 999.9

13.9 STEM NUMBER (COUNT)

[bamboo_number]

The number of Bamboo stems is counted.

When collected:	ALL
Field Width:	4 digits
Tolerance:	+/- 2
Values:	1.0 to 999.9

13.10 NOTES

[bamboo_notes]

Record notes pertaining to an individual bamboo clump.

When collected:	All bamboo clumps, as needed
Field Width:	2000 characters
Tolerance:	N/A
Values:	Words, phrases and numbers

14 FINALISATION

14.1 LF SKETCH

[lf_sketch]

Take a photo of the land feature proportioning sketch described in Section 8.2.

when collected:	number of (subplot_lf) >1 and subplot_status<3
field width:	2 digits
tolerance:	+/- 10%
values:	1 to 99

14.2 NEXT LOCATION

[plot_to]

Record the location the crew is arriving from. If the crew is arriving from another plot (that has been measured/visited in the morning, select 2 and record the number of the previous plot visited in the other field.

When collected:	All plots	
Field Width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	FD Field Office
	2	Another plot/Other

14.3 FOREST OFFICE (TO)

[plot_do_to]

Record the decentralized forest office you are going to.

When collected:	All plots
Field width:	List
Tolerance:	No errors
Values:	1 to 162

14.4 PLOT NOTES

[plot_notes]

Use these fields to record notes pertaining to the entire plot. If the notes apply only to a specific subplot or other specific aspect of the plot, then make that clear in the notes.

When collected:	All plots
Field Width:	2000 characters
Tolerance:	N/A
Values:	Words, phrases and numbers

14.5 END TIME

[time_end]

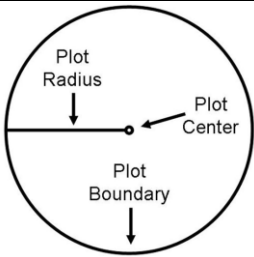
Record the time the team finished recording data on the plot.

When collected:	plot status <4
Field Width:	3 digits
Tolerance:	1 hour
Values:	0 to 99.5

15 APPENDICES

APPENDIX 1. DEFINITIONS

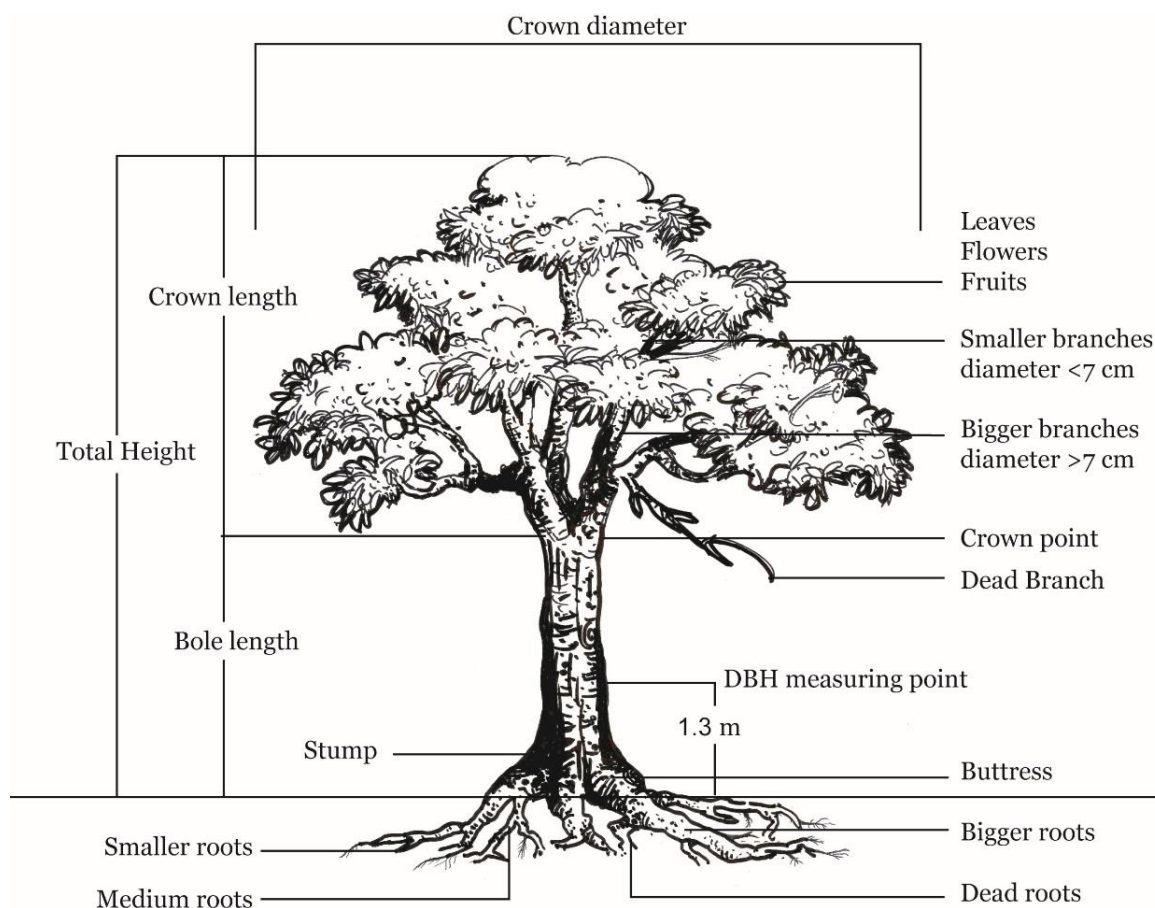
Abiotic	Pertaining to the non-living parts of an ecosystem, such as soil particles, bedrock, air, and water.
Afforestation	The establishment of a forest or stand in areas where the preceding vegetation or land use was not forest.
Agroforestry	A collective name for land-use systems and practices in which trees and shrubs are deliberately integrated with non-woody crops and (or) animals on the same land area for ecological and economic purposes.
Artificiality	Artificiality refers to the extent to which an area is cultivated or managed.
Azimuth	Azimuth is the horizontal angle measured clockwise from any fixed reference plane or easily established base direction line.
Biotic factor	A biotic factor is any living component that affects the population of another organism, or the environment
Bole height	The height between ground level and the crown point (point is the position of the first crown forming live or dead branch)
Breast height	A standard height for tree diameter measurement point. Generally, this height is 1.3 m from the ground level, or from the seeding point.
Canopy	The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees.
Canopy cover	The percentage of the ground or the horizontal forest area covered by a vertical projection of the outermost perimeter of the natural spread of the foliage of plants. Cannot exceed 100 percent (also called crown closure).
Clear Cut	A method of harvesting used in even-aged stands, involves removing all or most of the trees in an area in one operation.
Coarse Woody Debris	Includes downed, dead tree and shrub boles, large limbs, and other woody pieces that are ≥ 8 cm in diameter and severed from their original source of growth.
Crown cover	Defined here as the proportion or percentage of the ground surface covered by the vertical projection of the tree crowns
Dead tree	A tree is regarded as dead tree if it does not have any living branches. Trees that are alive but so badly damaged that cannot grow in the next growing season (e.g. trees felled by storm) are regarded as dead trees.
Dead wood	All non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country. Explanatory note: The country may use another threshold value than 10 cm, but in such a case the threshold value used must be documented.
DGPS measurements	Differential Global Positioning System which provides improved accuracy of up to 10 cm.
Edaphic	Relating to soil, especially as it affects living organisms. Edaphic characteristics include such factors as water content, acidity, aeration, and the availability of nutrients. Influenced by factors inherent in the soil rather than by climatic factors.
Even-aged	A stand that contains trees of one or two age classes; usually managed with clear cut harvest system
Field team	The field team is in charge of the measuring the plot.
Fine Woody Debris	Includes downed, dead branches, twigs, and small tree or shrub boles < 8 cm in diameter that are not attached to a living or standing dead source.

Forked tree	In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less.
Forked tree (alternative definition)	If the forking point is below the breast height (1.3 m), the tree is recorded by giving a unique stem number for each fork, and all stems get the same tree number. If the forking point is above the breast height, a tree is recorded as one stem.
High-precision GPS	GPS receiver capable to process real-time differential correction (DGPS) in the field. NAFORMA uses OmniStar correction signal for
Horizontal distance	Distance between two points taken from the same horizontal level
L plot	Data that describe a larger area (19 m radius) around the subplot center.
Land Feature Class	A discrete combination of landscape attributes that describe the land feature size, owner group, reserved status, environmental problem, crown cover, type of object, object attributes, and attribute details the environment on all or part of the plot.
Land feature point	Is the location where the land feature is described.
Leaf cover	The amount and compactness of foliage in a plot
Litter	Remains of fallen leaves or needles, dead ground vegetation, parts of tree bark and thin branches lying on the ground.
Live tree	Trees are alive if they have any living parts (leaves, buds, cambium) at or above the point of diameter measurement at DBH. Trees that have been temporarily defoliated are still alive. Uprooted trees with signs of life above the point of diameter are considered alive as long as some roots are still in substrate.
Living tree	A live tree must have living branches. The tree must be able to survive at least to the next growing season/next year.
M plot	Data that describe a medium area (8 m radius) within a subplot.
Object attributes	Vegetated: Trees, shrubs, grasses/herbs, Non-vegetated: Linear, Non liner, bare ground, dump site etc., Water: river, lake, pond, canal/ stream
Object type	Vegetated, Non-vegetated and Water
Planted forest	Forest predominantly composed of trees established through planting and/or deliberate seeding. Explanatory notes: 1. In this context, predominantly means that the planted/seeded trees are expected to constitute more than 50 percent of the growing stock at maturity. 2. Includes coppice from trees that were originally planted or seeded. 3. Includes rubber wood and non-food tree plantations. 4. Excludes self-sown trees of introduced species.
Plot	Data that describe the entire cluster of three or five subplots.
Plot attributes	Plot attributes record information about the plot location, the field crew visit, and landowner contact.
Protected areas	Areas especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.
Plot radius, center and boundary	 <p>The diagram shows a circle representing a plot. A horizontal line segment from the center to the left edge is labeled 'Plot Radius'. A point on this line is labeled 'Plot Center'. The entire circle is labeled 'Plot Boundary'.</p>

QA/QC team	Team dedicated to the integrity of field data through a process of Quality Assurance and Quality Control executed through a process of Hot Checks and Cold Checks.
Reference point	It is an object that is prominent, apt to be present at next visit and easily located on the ground.
S plot	Data that describe a small area (2.5 m radius) within a subplot to collect data on seedlings and saplings
Sample tree	A selected tree for measurements of variables.
Sapling	Trees with DBH ≥ 2.0 cm and < 10.0 cm DBH.
Seeding point	Seeding point is usually at the ground level. Trees that grow on the top of a stone or old stump, the seeding point is the point where the propagules have started to grow.
Seedling	Data describing plant individual with DBH < 2 cm and height is ≥ 10 cm
Shrub	Shrubs are woody perennial plants, generally of more than 0.5 m and (usually) less than 5 m in height on maturity with several major branches and without a definite crown and distinct trunk
Slope distance	Measured distance that follows a bearing of slope.
Soil depth	Depth of soil above the bedrock or a layer impermeable for roots.
Standing dead tree (snag)	To qualify as a standing dead tally tree, dead trees must be at least 10.0 cm in diameter, have a bole which has an ACTUAL HEIGHT of at 1.3 meter for DBH, and lean less than 45 degrees from vertical as measured from the base of the tree to the point of diameter measurement. Dead standing tally trees, and partially separated boles of dead tally trees, do not have to be self-supported. They may be supported by other trees, branches, or their crown. Portions of boles on dead trees that are separated greater than 50 percent (either above or below the point of diameter measurement), are considered severed. For woodland species with multiple stems, a tree is considered down if more than 2/3 of the volume is no longer attached or upright.
Stump height	Stump height is the level of the upper most root collar. If no root collars exist, stump height is expected to be 15 cm from the ground level.
Stump Sprouts	Stump sprouts originate between ground level and 1.3 meter on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be 1/3 of the diameter of the dead bole.
Subplot	Data that describe a single subplot of a cluster.
Tally tree	Live or dead standing tree in the concentric circular plot.
Tolerance	Acceptable range of measurement
Tree	A woody perennial plant, typically having a single stem or trunk capable of reaching 5 meters height in situ and bearing lateral branches at varying intervals
Total height	The height (or stem length) from ground line to the top of green terminal bud
Undergrowth	Undergrowth usually refers to the vegetation in the lower part of a forest, which can obstruct passage through the forest. The height of undergrowth is usually considered to be 0.3 – 3 m. Undergrowth can also refer to all vegetation in a forest which is not in the canopy.
Uneven-aged	A stand that contains trees of all, or almost all, age classes; usually managed with selection harvest system
Witness object	Used to reference the center pin with nearby objects/trees.

APPENDIX 2.

ILLUSTRATION OF DIFFERENT PARTS OR COMPONENTS OF A TREE



APPENDIX 3. SLOPE CORRECTION TABLE

Slope percentage to slope angel converter

Slope (%)	Slope (°)	Cos (α)	Slope (%)	Slope (°)	Cos (α)	Slope (%)	Slope (°)	Cos (α)
1	0.57	0.99995	51	27.02	0.890835	101	45.29	0.70358
2	1.15	0.9998	52	27.47	0.887217	102	45.57	0.700071
3	1.72	0.99955	53	27.92	0.883573	103	45.85	0.696581
4	2.29	0.999201	54	28.37	0.879905	104	46.12	0.693109
5	2.86	0.998752	55	28.81	0.876216	105	46.40	0.689655
6	3.43	0.998205	56	29.25	0.872506	106	46.67	0.68622
7	4.00	0.997559	57	29.68	0.868777	107	46.94	0.682805
8	4.57	0.996815	58	30.11	0.865031	108	47.20	0.679408
9	5.14	0.995974	59	30.54	0.861269	109	47.47	0.676031
10	5.71	0.995037	60	30.96	0.857493	110	47.73	0.672673
11	6.28	0.994004	61	31.38	0.853704	111	47.98	0.669334
12	6.84	0.992877	62	31.80	0.849903	112	48.24	0.666016
13	7.41	0.991656	63	32.21	0.846092	113	48.49	0.662717
14	7.97	0.990342	64	32.62	0.842271	114	48.74	0.659438
15	8.53	0.988936	65	33.02	0.838444	115	48.99	0.656179
16	9.09	0.987441	66	33.42	0.834609	116	49.24	0.65294
17	9.65	0.985856	67	33.82	0.83077	117	49.48	0.649721
18	10.20	0.984183	68	34.22	0.826927	118	49.72	0.646522
19	10.76	0.982424	69	34.61	0.82308	119	49.96	0.643343
20	11.31	0.980581	70	34.99	0.819232	120	50.19	0.640184
21	11.86	0.978653	71	35.37	0.815383	121	50.43	0.637046
22	12.41	0.976644	72	35.75	0.811534	122	50.66	0.633928
23	12.95	0.974555	73	36.13	0.807687	123	50.89	0.63083
24	13.50	0.972387	74	36.50	0.803842	124	51.12	0.627752
25	14.04	0.970143	75	36.87	0.8	125	51.34	0.624695
26	14.57	0.967823	76	37.23	0.796162	126	51.56	0.621658
27	15.11	0.965429	77	37.60	0.792329	127	51.78	0.618641
28	15.64	0.962964	78	37.95	0.788502	128	52.00	0.615644
29	16.17	0.960429	79	38.31	0.784682	129	52.22	0.612667
30	16.70	0.957826	80	38.66	0.780869	130	52.43	0.609711
31	17.22	0.955157	81	39.01	0.777064	131	52.64	0.606774
32	17.74	0.952424	82	39.35	0.773268	132	52.85	0.603858
33	18.26	0.949629	83	39.69	0.769481	133	53.06	0.600961
34	18.78	0.946773	84	40.03	0.765705	134	53.27	0.598084
35	19.29	0.943858	85	40.36	0.761939	135	53.47	0.595228
36	19.80	0.940887	86	40.70	0.758185	136	53.67	0.59239
37	20.30	0.937862	87	41.02	0.754443	137	53.87	0.589573
38	20.81	0.934784	88	41.35	0.750714	138	54.07	0.586775
39	21.31	0.931655	89	41.67	0.746997	139	54.27	0.583997
40	21.80	0.928477	90	41.99	0.743294	140	54.46	0.581238
41	22.29	0.925252	91	42.30	0.739605	141	54.65	0.578499
42	22.78	0.921982	92	42.61	0.735931	142	54.85	0.575779
43	23.27	0.918669	93	42.92	0.732272	143	55.03	0.573078
44	23.75	0.915315	94	43.23	0.728628	144	55.22	0.570396
45	24.23	0.911922	95	43.53	0.724999	145	55.41	0.567733
46	24.70	0.90849	96	43.83	0.721387	146	55.59	0.565089
47	25.17	0.905024	97	44.13	0.717792	147	55.77	0.562464
48	25.64	0.901523	98	44.42	0.714213	148	55.95	0.559857
49	26.10	0.89799	99	44.71	0.710651	149	56.13	0.55727
50	26.57	0.894427	100	45.00	0.707107	150	56.31	0.5547

Slope (%)	Slope (°)	Cos (α)	Slope (%)	Slope (°)	Cos (α)	Slope (%)	Slope (°)	Cos (α)
151	56.49	0.552149	201	63.55	0.445431	251	68.28	0.370114
152	56.66	0.549617	202	63.66	0.443661	252	68.36	0.368846
153	56.83	0.547102	203	63.77	0.441903	253	68.43	0.367585
154	57.00	0.544605	204	63.89	0.440157	254	68.51	0.366332
155	57.17	0.542127	205	64.00	0.438424	255	68.59	0.365088
156	57.34	0.539666	206	64.11	0.436702	256	68.66	0.363851
157	57.51	0.537223	207	64.22	0.434992	257	68.74	0.362621
158	57.67	0.534798	208	64.32	0.433294	258	68.81	0.3614
159	57.83	0.53239	209	64.43	0.431608	259	68.89	0.360186
160	57.99	0.529999	210	64.54	0.429934	260	68.96	0.358979
161	58.15	0.527626	211	64.64	0.42827	261	69.04	0.35778
162	58.31	0.525269	212	64.75	0.426619	262	69.11	0.356588
163	58.47	0.52293	213	64.85	0.424978	263	69.18	0.355404
164	58.63	0.520607	214	64.95	0.423349	264	69.25	0.354227
165	58.78	0.518302	215	65.06	0.421731	265	69.33	0.353057
166	58.93	0.516013	216	65.16	0.420124	266	69.40	0.351895
167	59.09	0.51374	217	65.26	0.418527	267	69.47	0.350739
168	59.24	0.511484	218	65.36	0.416942	268	69.54	0.349591
169	59.39	0.509244	219	65.46	0.415367	269	69.61	0.348449
170	59.53	0.50702	220	65.56	0.413803	270	69.68	0.347314
171	59.68	0.504812	221	65.65	0.412249	271	69.75	0.346187
172	59.83	0.50262	222	65.75	0.410706	272	69.81	0.345066
173	59.97	0.500444	223	65.85	0.409173	273	69.88	0.343951
174	60.11	0.498284	224	65.94	0.407651	274	69.95	0.342844
175	60.26	0.496139	225	66.04	0.406138	275	70.02	0.341743
176	60.40	0.494009	226	66.13	0.404636	276	70.08	0.340649
177	60.53	0.491895	227	66.23	0.403144	277	70.15	0.339561
178	60.67	0.489796	228	66.32	0.401661	278	70.22	0.33848
179	60.81	0.487712	229	66.41	0.400189	279	70.28	0.337405
180	60.95	0.485643	230	66.50	0.398726	280	70.35	0.336336
181	61.08	0.483589	231	66.59	0.397273	281	70.41	0.335274
182	61.21	0.481549	232	66.68	0.395829	282	70.47	0.334218
183	61.35	0.479524	233	66.77	0.394395	283	70.54	0.333169
184	61.48	0.477513	234	66.86	0.392971	284	70.60	0.332125
185	61.61	0.475517	235	66.95	0.391555	285	70.67	0.331088
186	61.74	0.473535	236	67.04	0.390149	286	70.73	0.330056
187	61.86	0.471567	237	67.12	0.388752	287	70.79	0.329031
188	61.99	0.469613	238	67.21	0.387364	288	70.85	0.328012
189	62.12	0.467673	239	67.30	0.385985	289	70.91	0.326998
190	62.24	0.465746	240	67.38	0.384615	290	70.97	0.325991
191	62.37	0.463834	241	67.46	0.383254	291	71.04	0.324989
192	62.49	0.461934	242	67.55	0.381902	292	71.10	0.323993
193	62.61	0.460049	243	67.63	0.380558	293	71.16	0.323003
194	62.73	0.458176	244	67.71	0.379223	294	71.21	0.322018
195	62.85	0.456317	245	67.80	0.377897	295	71.27	0.321039
196	62.97	0.45447	246	67.88	0.376579	296	71.33	0.320066
197	63.09	0.452637	247	67.96	0.37527	297	71.39	0.319098
198	63.20	0.450816	248	68.04	0.373968	298	71.45	0.318136
199	63.32	0.449009	249	68.12	0.372675	299	71.51	0.317179
200	63.43	0.447214	250	68.20	0.371391	300	71.57	0.316228

APPENDIX 4. FIELD EQUIPMENT

Bangladesh Forest Inventory

Checklist for field equipment

Item Description	Quantity per team	Function
Data Recording Items		
Hand-held data recorder: Panasonic, Tablet Computer, FZ-B2 series	1	
Handheld GPS: GARMIN GPSMAP 64	1	To record the coring position
Mechanical pencils, red photo pen, black pen, eraser	1 / crew	
Note pad	1 / crew	
Blank forms for plot, subplot, LCCS attributes; tree tally; veg profile; and subplot diagram	-	
Calculator	1	
Field procedures manual	1	
Plant ID guide	1	
Plot Measuring Items		
Mirrored compass: Suunto MC2G Navigator Compass with Global Needle, Azimuth with Metric Scales	3	
Clinometer(s): SUUNTO, PM-5/1520	2	
Densimeter: GRS Densitometer™	3	
Diameter tape	3	
30 meter tape	1	
Laser height/rangefinder: TRUPULSE™ 200 / 200B	1	
Retractable carpenter's tape	5	To measure the depth of soil core and determine the thickness of soil sampled
Plant press or plastic bags for plant specimens	1	
Plot Referencing Items		
30 cm (length) steel bar	1	
Aluminum nails	1/crew	
Tree number tags	1/crew	
Flagging tape		
Cruiser spray paint	3	
Personal/Crew and Safety Gear		
Emergency Kit	1	
Waterproof bags to protect instruments	1/crew	
Canteens with water	1/crew	
Utility pouch	3	
Rain gear		
Gloves		
Flashlight and batteries	1	
Extra clothing		
Iodine tablets		
Headlamps		
Soil Measurement (per plot)		
Soil Auger (Small)	1	Texture sampling
Soil Auger (Large) for mangrove zones	1	Bulk density - C organic and texture sampling

Soil Core Sampler	6	Bulk density - C organic sampling
Shovel and Garden Shovel	1	To extract soil
Plastic Jar small and medium size	6/9	To store soil texture sample
Garden secateurs	1	To clear the surface
Plastic bag (Zip lock) small and medium size	100	To store samples
Masking tape	2	To label the sample
Cutter and knife	1	To subsample the core
Dry and wet cloth	1	To clean the core
Stainless steel spoon	2	To collect soil sample from auger
Measuring tape	1	To measure the depth of soil
Small stool	1	Used when preparing soil samples
Permanent marker	1	To label the sample
Large Plastic sheet	1	To place soil sample
Writing board	2	To write the field form
Hammer	1	To push core sampler
Plastic bags	5	To store litter sample
1m x 1m frame	1	For litter collection
Other items		
Metal Ruler	7	To determine soil layer interval
Machete	2	
Rechargeable battery with charger	2	
Torch light (Rechargeable)	5	
Red Stick	1	
Thin Ropes	30 m/team	
Stapler machine	2	
Permanent Marker	14	To label the core
Folder plastic	7	
Wooden Pencils	28	
Eraser	14	
Sharpener	14	
Red & White bamboo Poles (one side sharp)	7	
Coin Tags (Aluminum)	1000	
Metal bar (30 cm length & 10 mm dia) one side sharp	100	
Paint Spray	5	
Reflectors (Pasted on twin-wall plastic sheet)	5	
Thin Cloth bags for garbage	50	

APPENDIX 5. FIELD FORMS







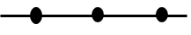




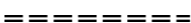





Bangladesh Forest Inventory

F1 – PLOT 1 / 2

PLOT DATA COLLECTION (6)			
PLOT RECORD (61)			
PLOT NUMBER (611)		INVENTORY DATE (612)	/ /
ARRIVING FROM (613)	<input type="checkbox"/> 1 FD Field Office:	<input type="checkbox"/> 2 Another plot/ Other:	
DEPARTURE TIME (614) :	START TIME (616) :
PLOT LOCATION (62)			
DIVISION (621)		FOREST DIVISION (625)	
DISTRICT (622)		FOREST RANGE (626)	
UPAZILA (623)		FOREST BEAT/SFPC (627)	
UNION (624)		ZONE (628)	
PLOT COORDINATE (6.2.9)	Easting:	Northing:	
PLOT DETAILS (63)			
TEAM NUMBER (631)	TEAM LEADER (632)	DEPUTY TEAM LEADER (633)	
PLOT STATUS (634)	<input type="checkbox"/> 1 Sampled completely <input type="checkbox"/> 2 Partially sampled <input type="checkbox"/> 3 Inaccessible plot <input type="checkbox"/> 4 Not sampled		
NONSAMPLED REASON (635)	<input type="checkbox"/> 1 Denied access <input type="checkbox"/> 2 Hazardous <input type="checkbox"/> 3 Restricted area <input type="checkbox"/> 4 Water <input type="checkbox"/> 96 Other:		
REFERENCE POINT (RP) (64)			
RP SUBPLOT (641)	<input type="checkbox"/> 1 N <input type="checkbox"/> 2 E <input type="checkbox"/> 3 S <input type="checkbox"/> 4 W	RP TYPE (642)	<input type="checkbox"/> 1 Tree <input type="checkbox"/> 2 Electricity Pole <input type="checkbox"/> 3 House/structure <input type="checkbox"/> 4 Other
RP SPECIES (643) ⁴		RP BDH (644)	
RP BEARING (645)		RP HORIZ. DISTANCE (646)	
RP GPS – COORDINATES (647)	Easting:	Northing:	
RP PICTURE (648)	RP NOTES (649)		
FINALISATION (14)			END TIME (145) :
NEXT LOCATION (412)	<input type="checkbox"/> 1 FD Field Office:	<input type="checkbox"/> 2 Another plot/ Other:	
PLOT NOTE (144)			

⁴ S: Scientific name, V: Vernacular Name, L: Language or dialect

ROUTE TO THE FIELD PLOT (253)

Symbol	Code	Name
	Bg	Bridge
	R1	Highway: Hard surface, more than two lanes, connected to secondary roads
	R2	Secondary Road: Hard Surface, One lane, connected to R1
	R3	Residential Road: Loose Surface, one lane, unpaved
	R4	Pedestrian road: Loose surface
	Rw	Railway
	W	Wall
	Po	Pond/ Ditch
	Fo	Decentralized Forest Office
	Mq	Religious Place: Mosque, Church, Temple etc.
	Rv	River/ Stream
	C	Canal/ Channel
	Ep	Electric Pole
	F	Park/ Sports Field
	Rs	Rural Settlement: Cluster of houses
	M	Market Area
		Trajectory/Direction

Note:

PLOT NUMBER (611)			
LAND FEATURE DETAILS (71)			
LAND FEATURE (711)	LAND FEATURE STATUS (712)	<input type="checkbox"/> 1 Centre subplot <input type="checkbox"/> 2 North subplot <input type="checkbox"/> 3 East subplot <input type="checkbox"/> 4 South subplot <input type="checkbox"/> 5 West subplot <input type="checkbox"/> 6 Outside plot centre	
SIZE OF LAND FEATURE (713)	<input type="radio"/> < 0.5 ha <input type="radio"/> > 5 ha		
OWNER GROUP (714)	<input type="checkbox"/> 1 Private <input type="checkbox"/> 2 Forest Department <input type="checkbox"/> 3 Government <input type="checkbox"/> 99 Unknown <input type="checkbox"/> 96 Other		
LEGAL STATUS (715)	<input type="checkbox"/> 0 Not protected <input type="checkbox"/> 1 Reserved Forest <input type="checkbox"/> 2 Protected Forest <input type="checkbox"/> 3 Vested Forests <input type="checkbox"/> 4 Acquired Forests <input type="checkbox"/> 5 Un-classed State Forest <input type="checkbox"/> 6 Protected Areas <input type="checkbox"/> 7 Notified Area <input type="checkbox"/> 8 Coastal Afforestation <input type="checkbox"/> 9 Social Forest <input type="checkbox"/> 99 Unknown		
LAND FEATURE SERVICES (716)	<input type="checkbox"/> 0 No data <input type="checkbox"/> 1 Fruits <input type="checkbox"/> 2 Rattan <input type="checkbox"/> 3 Plant medicines <input type="checkbox"/> 4 Dying <input type="checkbox"/> 5 Wildlife <input type="checkbox"/> 6 Beekeeping <input type="checkbox"/> 7 Windbreak. <input type="checkbox"/> 8 Education and Research <input type="checkbox"/> 9 Recreation <input type="checkbox"/> 10 Cultural / Spiritual <input type="checkbox"/> 11 Merchantable Timber <input type="checkbox"/> 96 Other:		
MIN CROWN COVER (7171)	<input type="checkbox"/> 0 <input type="checkbox"/> 10 <input type="checkbox"/> 20 <input type="checkbox"/> 30 <input type="checkbox"/> 40 <input type="checkbox"/> 50 <input type="checkbox"/> 60 <input type="checkbox"/> 70 <input type="checkbox"/> 80 <input type="checkbox"/> 90 <input type="checkbox"/> 100		
MAX CROWN COVER (7172)	<input type="checkbox"/> 0 <input type="checkbox"/> 10 <input type="checkbox"/> 20 <input type="checkbox"/> 30 <input type="checkbox"/> 40 <input type="checkbox"/> 50 <input type="checkbox"/> 60 <input type="checkbox"/> 70 <input type="checkbox"/> 80 <input type="checkbox"/> 90 <input type="checkbox"/> 100		
LAND FEATURE ISSUES (718)	<input type="checkbox"/> 0 Not existing <input type="checkbox"/> 1 Over grazing <input type="checkbox"/> 2 Water pollution <input type="checkbox"/> 3 Fire <input type="checkbox"/> 4 Erosion <input type="checkbox"/> 5 Landslide <input type="checkbox"/> 6 Drought <input type="checkbox"/> 7 Waterlogging <input type="checkbox"/> 8 Flooding <input type="checkbox"/> 9 Pests/Insect/Fungus <input type="checkbox"/> 10 Cyclone/tidal Surges damage <input type="checkbox"/> 11 Illicit felling <input type="checkbox"/> 12 Leaf collection <input type="checkbox"/> 13 Storm damage <input type="checkbox"/> 14 Siltation <input type="checkbox"/> 96 Other:		
FIRE (7181)	<input type="checkbox"/> 0 No fire <input type="checkbox"/> 1 Recent fire <input type="checkbox"/> 2 Old fire		
EROSION (7182)	<input type="checkbox"/> 1 No <input type="checkbox"/> 2 General <input type="checkbox"/> 3 Sheet <input type="checkbox"/> 4 Rill <input type="checkbox"/> 5 Gully <input type="checkbox"/> 6 River		
IMPACT (7183)	LAND FEATURE ISSUE ...	LAND FEATURE ISSUE ...	LAND FEATURE ISSUE ...
<i>Slightly disturbed</i>			
<i>Moderately disturbed</i>			
<i>Heavily disturbed:</i>			
LAND FEATURE PHOTOS (719)	PHOTO POSITION (7110)		
RECOMMENDED CLASS NAME ⁵ (7111)			

⁵ See APPENDIX 6

LAND FEATURE OBJECT DESCRIPTION (72)							PLOT NUMBER (611):			
83 VEGETATION DETAILS										
OBJECT ID (721)	VEGETATION TYPE (723) ⁶	ARTIFICIALITY ⁷ (724)	OBJECT % OF COVER (725)	GROWTH FORM / AGE ⁸ (726)	MANAGEMENT ⁹ (727)	TREATMENT ¹⁰ (728)	ROTATION ¹¹ (729)	CROP (72101)	CULTIVATION STATE ¹² (72102)	WATER SUPPLY ¹³ (72103)
84 NON-VEGETATED DETAILS						85 WATER BODY DETAILS				
OBJECT ID (721)	NON-VEGETATED OBJECT TYPE (7211 ¹⁴)		NON-VEG % COVER (7212)			WATER BODY (7213) ¹⁵		WATER SALINITY ¹⁶ (7214)		WATER % COVER (7215)
LAND FEATURE NOTES (7216)										

⁶ Vegetated object types: 1. Tree, 2. Shrub, 3. Herbs

⁷ 1: Natural or semi-natural | 2: Cultivated

⁸ 1: Uneven age natural forest | 2: Uneven age semi-natural forest | 3: Uneven plantation | 4: Even age planation | 5: Even age young plantation | 6: Even age mature plantation

⁹ 0: None observed | 1: Rubber Plantation | 2: Tea garden | 3: Strip Plantation | 4: Medicinal Plantation | 5: NTFP Plantation | 6: Woodlot plantation | 7: Coastal plantation | 8: Plantation (general) | 9: Agro-forestry system | 10: Orchard | 11: Cropland | 12: Jhum | 13: Urban parkland | 14: Bamboo groves | 15: Village Common Forests | 96: Other

¹⁰ 0: None observed | 1: Thinning | 2: Weeding | 3: Selective felling | 4: Group felling | 5: Strip felling | 6: Clear felling | 7: Sanitary cutting | 8: Prescribed burning | 9: Natural Regeneration | 10: Assisted Natural Regeneration | 11: Artificial regeneration | 12: Climber cutting | 96: Other | 99: Not known

¹¹ 1: Less than 10 years | 2: 10 to 20 years | 3: 20 to 30 years | 4: Greater than 30 years | 99: Unknown

¹² 1: Fallow | 2: Conventional tilling | 3: Reduced tilling | 4: No tilling | 5: Recently harvested

¹³ 0: Not irrigated | 1: Irrigated | 2: Post Flooding | 3: Rainfed | 4: Rainfed and Irrigated | 96: Other | 99: Unknown

¹⁴ Non-vegetated object types: 1. Soil | sand deposit | 2. Building/Houses | 3. Road/Rail/Communication infrastructure | 4. Dump sides/Extraction | 5. Salt pans | 6. Mud flats | 7. Beach | 8. River banks

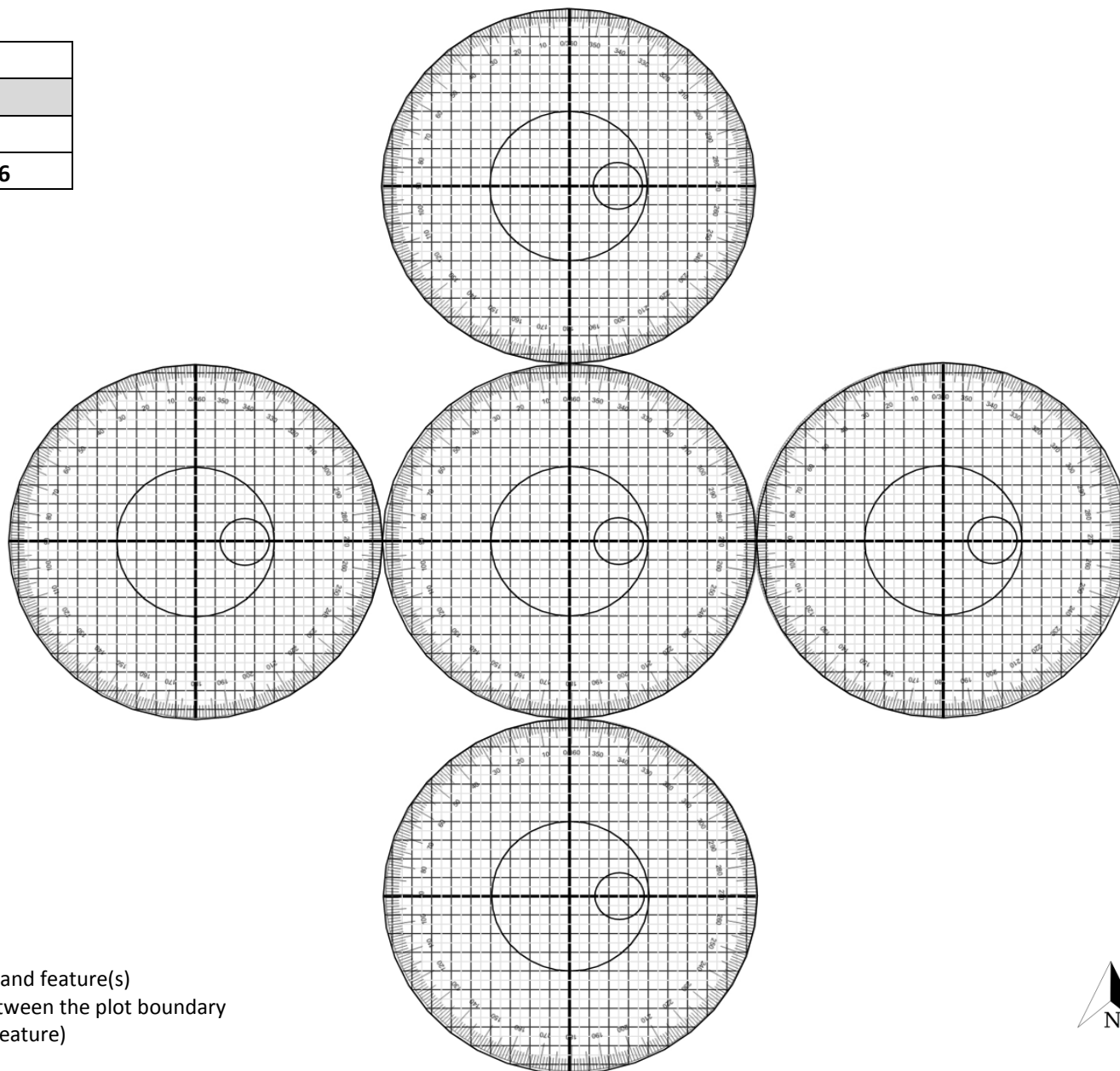
¹⁵ Water body: 1. River | 2. Pond | 3. Baor/Oxbow lake | 4. Beers/Haors | 5. Lake | 6. Stream | 7: Canal | 96: Other

¹⁶ 1: Fresh | 2: Saline

Bangladesh Forest Inventory F5 – LAND FEATURE

PLOT NUMBER (611)	
SUBPLOT LAND FEATURE PROPORTIONING (82)	
TOTAL NUMBER OF SQUARE IN ONE M SUBPLOT	44
TOTAL NUMBER OF SQUARE IN ONE L SUBPLOT	256

SUBPLOT (8.1.1)	LF No. (823)	NUMBER OF SQUARES	
		(824)	(825)
		M	L
1	LF1		
1	LF2		
1	LF3		
1	LF4		
2	LF1		
2	LF2		
2	LF3		
2	LF4		
3	LF1		
3	LF2		
3	LF3		
3	LF4		
4	LF1		
4	LF2		
4	LF3		
4	LF4		
5	LF1		
5	LF2		
5	LF3		
5	LF4		



Indicate on the form the part of the subplot covered the land feature(s)
 Mark on the form where are located the intersections between the plot boundary
 &the land feature (in case you have more than one land feature)

PLOT NUMBER (611)			SUBPLOT NUMBER (811)									
SUBPLOT DATA COLLECTION (8)												
SUBPLOT DETAILS (81)												
	<div style="display: flex; justify-content: space-between;"> <div> 1 Center subplot 2 North subplot 3 East subplot 4 South subplot 5 West subplot </div> </div>											
SUBPLOT STATUS (812)	1 Sampled 2 Inaccessible 3 Nonsampled											
SUBPLOT SLOPE (%) (813)			SUBPLOT SLOPE (BEARING) (814)									
SUBPLOT LEAF COVER (COUNT) (815)	1	2	3	4	5	6	7	8	9	10	north – south transect	COUNT: _____.
	1	2	3	4	5	6	7	8	9	10	east – west transect	COUNT: _____.
S PLOT CENTER LAND FEATURE CLASS (816)	1 Centre subplot		2 North subplot		3 East subplot		4 South subplot		5 West subplot			
SUBPLOT NOTES (84)												
SUBPLOT WITNESS OBJECTS (83)												
WO RECORD NUMBER (831)	WO 1				WO 2				WO 3			
WITNESS OBJECT TYPE (832)	1 Tree 2 Rock 3 Shrub 96 Other:				1 Tree 2 Rock 3 Shrub 4 Other:				1 Tree 2 Rock 3 Shrub 4 Other:			
WO SPECIES (833)												
WO DBH (834)												
WO BEARING (835)												
WO SLOPE DISTANCE (836)												
TREE TAG NUMBER (837)												
WO NOTES (8398)												

PLOT NUMBER (611)	
SUBPLOT NUMBER (811)	
SAPLING DETAILS (92)	

[illegible]

PLOT NUMBER (611)	
DOWN WOODY MATERIAL (10)	
FINE WOOD DEBRIS (102)	

SUBPLOT (811)	FWD TRANSECT (1021)	LAND DEATURE ID (1022)	SMALL FWD COUNT (1023)	MEDIUM FWD COUNT (1024)	LARGE FWD COUNT (1025)	HIGH COUNT REASON (1026)
1	45					
1	135					
1	225					
1	315					
2	45					
2	135					
2	225					
2	315					
3	45					
3	135					
3	225					
3	315					
4	45					
4	135					
4	225					
4	315					
5	45					
5	135					
5	225					
5	315					

SUBPLOT NOTES (84)

PLOT NUMBER (611)	
SOIL AND LITTER MEASUREMENTS (11)	

SUBPLOT NUMBER (811)	LAND FEATURE NUMBER (1131)	GENERAL SOIL CONDITION ¹⁷ (1132)	SOIL DEPTH OF HUMUS (CM) (1133)	SOIL TEXTURE SAMPLE DEPTHS ¹⁸ (1134)	SOIL CORE PICTURE (1135)	BULK DENSITY SAMPLE DEPTHS ¹⁹ (1136)	LITTER COLLECTION ²⁰ (1141)	SOIL AND LITTER NOTES (1142)
1								
2								
3								

¹⁷ 1: Wet | 2: Moist | 3: Dry | 4: Very hard

¹⁸ List all samples taken: 0. Sample not taken | 1. 5cm - 10cm | 2. 20cm-25cm | 3. 65cm -70cm | 96. Other depth - specify

¹⁹ List all samples taken: 0. Sample not taken | 1. 5cm - 10cm | 2. 20cm-25cm | 3. 65cm -70cm | 96. Other depth - specify

²⁰ Sample taken – Yes/No – If no specify in notes

²¹1: Laser Range Finder TruePulse or other hypsometer | 2: Clinometer tape | 3: Estimate
²²0: None observed | 1: Insect | 2: Disease | 3: Fire | 4: Animal | 5: Weather | 6: Vegetation | 7: Human | 8: Physical | 96: Other
²³1: Low | 2: Moderate | 3: Severe
²⁴1: < 1 year | 2: 1-5 years | 3: 5 - 10 years | 4: >10 years
²⁵1: Most branches present | 2: Few branches present | 3: No branches / few stubs only
²⁶ Indicate in note if the diameter height is different from 1.3m and if different methods have been used for the tree height measurement.

PLOT NUMBER (611)	
BAMBOO (13)	

CLUMP ID (131)	LAND FEATURE INUMBER (132)	SPECIES (133)	BEARING (134)	HORIZONTAL DISTANCE (135)	LENGTH (136)	LENGTH METHOD ²⁷ (137)	DIAM. (138)	STEM NUMBER (139)	NOTES (1310)
SUBPLOT 1									
SUBPLOT 2									
SUBPLOT 3									
SUBPLOT 4									
SUBPLOT 5									

²⁷1: Laser Range Finder TruePulse or other hypsometer | 2: Clinometer tape | 3: Estimate

[illegible]

APPENDIX 6.**NATIONAL LAND COVER LEGEND CLASSES**

Code	Class	Description
FEh	Hilly Forest (Mixed & Evergreen)	The hilly forest consists of a mixture of moist tropical evergreen and semi-evergreen trees. The forests are generally uneven-aged and shrubs, herbs and grasses occur fewer in number as undergrowth in this forest.
BF	Bamboo Forest	Bamboo forest is woody grass of more than 4 m and its occurrence is more than 80% within the patches. The bamboo resources in the villages areas not included in this class.
FDp	Plain Land Forest (Sal Forest)	Land dominated with tropical moist deciduous forests are known as plain land Sal forest. Sal forests have a fairly wide but interrupted distribution in drier central and northern part of the country, mostly occurring in Gazipur, Tangail, Mymensingh, Jamalpur, Comilla, Dinajpur, Thakurgaon, Rangpur and Rajshahi districts.
S	Shrub Dominated Area (Terrestrial)	The geographic area with natural woody vegetation with a height less than 5 meters. The uppermost canopy layer is dominated by trees.
H	Herbs Dominated Area (Terrestrial)	Herbaceous life forms, which are relatively short lived; generally small, seasonal or annual.
FPr	Rubber Plantation	The large geographic area where rubber is planted for latex production. It is broadleaved, deciduous in the drier month for a very short period. Trees are planted in well-drained soil with 3%-32% slope. .
FPd	Forest Plantation (Deciduous)	The forest plantation areas where trees lose their leaves seasonally and trees are generally even-aged, planted and managed in rows, and cover a large enough area.
OT	Orchards & Other Plantations (Trees)	Land dominated with tree species for harvesting fruits. In general, trees are even-aged, planted and managed in rows and cover a large enough area. Marginal land plantations (road, railway, embankment, and canal side) are also included in this class.
OS	Orchards & Other Plantations (Shrub)	Land dominated by shrubs which are cultivated and managed for fruits and leaf harvesting. This class mainly includes tea gardens. The use of shade trees in tea cultivation is a vital and integral component.
PCs	Single Crop	This class includes permanent agriculture lands cultivated with a single herbaceous crop in a year and the same herbaceous crop is cultivated in the same land for several years.
PCm	Multiple Crop	This class includes permanent agriculture lands which are cultivated with more than one herbaceous crop (Two or Three) in different growing season sequentially (crop diversified in time) within a year and the same crop rotation is practiced in the same land for several years.
SC	Shifting Cultivation	This class includes lands where herbaceous crops are cultivated temporarily, then abandoned and allowed to return to their natural vegetation while the farmer moves on to another area.
SF	Swamp Forest	Land dominated by evergreen trees which are inundated with freshwater seasonally. They normally occur along the lower reaches of rivers. Main trees of this forest are Koroch and Hizal tree.
NMF	Mangrove Forest	The geographical area dominated by halophytic trees with a canopy cover of 85% to 100% and tree height vary from 5m - 17m. The forest floor inundated twice daily by brackish water.

FMp	Mangrove Plantation	Mangrove plantations on newly accreted land in the estuaries of the Bay of Bengal to provide protection against natural calamities and land erosion.
PRs	Single Crop (Aquatic/Regularly flooded)	This class includes agriculture lands which is cultivated with a single herbaceous crop in a year and the herbaceous crop is flooded during growing season of the crops. Deep water rice crop lands are included in this class.
MF	Mud Flats	Mud flats are coastal wet land areas near the estuary where mud is deposited by tides or rivers and the mud flats are submerged and exposed approximately twice daily.
BS	Beaches/Sand Bar	Beaches are narrow, gently sloping strip of natural land that lies along the coast, which are composed of sand. Sand bar are sand deposits within the river channels or in the estuary which are emerging as islands.
RB	River Banks	The river bank is the natural land alongside the bed of a river which usually consists of soil and sand deposits and inundated when water course flows with full capacity.
IA	Intertidal Area	The natural land that is above water at low tide and under water at high tide (the area between tide marks).
AP	Airport	Built-up areas with facilities for flights to take off and land.
BNl	Built up linear	All artificial and impervious surfaces which is functionally linked with vegetated areas, recreational parks and water bodies and cover the land with hard materials.
B	Brickfield	Geographic areas used for bricks production
DS	Dump Sites/Extraction Sites	Land used for disposal of waste materials is known as dump sites. Extraction sites are defined by the absence of the original land cover which is removed by human activity or machinery for extraction of sand, stone, minerals or coal.
SP	Salt Pans	Land used for salt production from seawater by solar evaporation.
Ba	Baor	Baors are oxbow lakes - old river channels which have limited connection to their parent rivers through channels in the monsoon season.
BH	Perennial Beels/Haors	The standing water bodies located in the low lying depression on the flood plain where water persists 12 months are known as perennial (core) beels and haors.
R	Rivers and Khals	Natural water courses serving as water drainage channels.
AL	Lake	A lake is an artificial surface of standing water that is usually bigger (> 50 ha) than a pond and have irregular shape.
Po	Ponds	A pond is an artificial surface of standing water that is usually smaller than a lake and has a regular shape.
FWa	Fresh Water Aquaculture	Fresh water ponds used for year round aquaculture.
Bwa	Brackish Water Aquaculture	Large brackish water ponds used for year round brackish water aquaculture
RS	Rural Settlement	Geographic areas of clustered or linear rural dwellings (mainly wooden and tin roof) covered by fruit trees and other plantation and functionally linked with small scale vegetables gardens, open spaces and ponds around the dwellings.
Other	Other	Land use which do on match with any mentioned criteria.

APPENDIX 7. LIST OF DECENTRALIZED OFFICES

Code	Zone	Division	Range Name	Type	Name
1	Hill	Chittagong North Forest Division	Hathazari	Range Office	Hathazari Range Office
2	Hill	Chittagong North Forest Division	Olinagar	Range Office	Olinagar Range Office
3	Hill	Chittagong North Forest Division	Mirsarai	Range Office	Mirsarai Range Office
4	Hill	Chittagong North Forest Division	Sitakunda	Range Office	Sitakunda Range Office
5	Hill	Chittagong North Forest Division	Hazarikhil	Range Office	Hazarikhil Range Office
6	Hill	Chittagong North Forest Division	Karerhat	Range Office	Karerhat Range Office
7	Hill	Chittagong North Forest Division	Narayanhat	Range Office	Narayanhat Range Office
8	Hill	Chittagong North Forest Division	Narayanhat	Range Office	Narayanhat Range Office
9	Hill	Chittagong North Forest Division	Mirsarai	Range Office	Mirsarai Range Office
10	Hill	Chittagong North Forest Division	Bariyadhala	Range Office	Bariyadhala Range Office
11	Hill	Chittagong North Forest Division	Kumira	Range Office	Kumira Range Office
12	Hill	Chittagong North Forest Division	Chittagong North Town	Range Office	Chittagong North Town Range Office
13	Hill	Chittagong North Forest Division	Icchamoti	Range Office	Icchamoti Range Office
14	Hill	Chittagong North Forest Division	Kalurghat	Range Office	Kalurghat Range Office
15	Hill	Chittagong South Forest Division	Patiya	Range Office	Patiya Range Office
16	Hill	Chittagong South Forest Division	Barobakia	Range Office	Barobakia Range Office
17	Hill	Chittagong South Forest Division	Padua	Range Office	Padua Range Office
18	Hill	Chittagong South Forest Division	Dohajari	Range Office	Dohajari Range Office
19	Hill	Chittagong South Forest Division	Chunati	Range Office (CTG South)	Chunati Range Office (CTG South)
20	Hill	Chittagong South Forest Division	Chunati	Range Office (Wildlife)	Chunati Range Office (Wildlife)
21	Hill	Chittagong WMNC Division	Bashkhali Eco-Park	Range Office	Bashkhali Eco- Park Range Office
22	Hill	Chittagong South Forest Division	Jaldi	Range Office	Jaldi Range Office
23	Hill	Chittagong South Forest Division	Bashkhali	Range Office	Bashkhali Range Office
24	Hill	Chittagong South Forest Division	Chhanua	Range Office	Chhanua Range Office
25	Hill	Chittagong South Forest Division	Khurshia	Range Office	Khurshia Range Office
26	Hill	Chittagong South Forest Division	Kalipur	Range Office	Kalipur Range Office
27	Hill	Lama Forest Division	Lama Division	Division Office	Lama Forest Division Office
28	Hill	Lama Forest Division	Matamuhari	Range Office	Matamuhari Range Office

Code	Zone	Division	Range Name	Type	Name
29	Hill	Lama Forest Division	Tain	Range Office	Tain Range Office
30	Hill	Lama Forest Division	Lama Sadar	Range Office	Lama Sadar Range Office
31	Hill	Chittagong Hill Tracts (South)	Alikhiang	Range Office	Alikhiang Range Office
32	Hill	Chittagong Hill Tracts (South)	Changrachari	Range Office	Changrachari Range Office
33	Hill	Chittagong Hill Tracts (South)	Farua	Range Office	Farua Range Office
34	Hill	Rangamati (Jhum Control)	Tinkonia	Range Office	Tinkonia Range Office
35	Hill	Chittagong Hill Tracts (North)	Pablakhali	Range Office	Pablakhali Range Office
36	Hill	Chittagong Hill Tracts (North)	Sisok	Range Office	Sisak Range Office
37	Hill	Chittagong Hill Tracts (North)	Baghaihat	Range Office	Baghaihat Range Office
38	Hill	Chittagong Hill Tracts (North)	Masalong	Range Office	Masalong Range Office
39	Hill	Chittagong Hill Tracts (North)	Naraichari	Range Office	Naraichari Range Office
40	Hill	Rangamati (Jhum Control)	Hajachari	Range Office	Hajachari Range Office
41	Hill	Rangamati (Jhum Control)	Merung	Range Office	Merung Range Office
42	Hill	Chittagong Hill Tract North	Kaptai	Range Office	Kaptai Range Office
43	Coastal	Patuakhali Coastal Division	Patharghata	Range Office	Patharghata Range Office
44	Coastal	Patuakhali Coastal Division	Mohipur	Range Office	Mohipur Range Office
45	Coastal	Patuakhali Coastal Division	Patuakhali	Range Office	Patuakhali Range Office
46	Coastal	Patuakhali Coastal Division	Char Montaz	Range Office	Char Montaz Range Office
47	Coastal	Patuakhali Coastal Division	Galachipa	Range Office	Galachipa Range Office
48	Coastal	Patuakhali Coastal Division	Dashmina	Range Office	Dashmina Range Office
49	Coastal	Noakhali Coastal Division	Nalcchira	Range Office	Nalcchira Range Office
50	Coastal	Noakhali Coastal Division	Nalchira	Range Office	Nalchira Range Office
51	Coastal	Noakhali Coastal Division	Sagoria	Range Office	Sagoria Range Office
52	Coastal	Noakhali Coastal Division	Habibiya	Range Office	Habibiya Range Office
53	Coastal	Noakhali Coastal Division	Chor bata	Range Office	Chor bata Range Office
54	Coastal	Noakhali Coastal Division	Noakhali Sadar	DFO Office	Noakhali DFO Office
55	Coastal	Chittagong Coastal Division	Urirchar	Range Office	Urirchar Range Office
56	Coastal	Noakhali Coastal Division	Jahajmara	Range Office	Jahajmara Range Office
57	Coastal	Chittagong Coastal Division	Sandwip	Range Office	Sandwip Range Office
58	Coastal	Chittagong Coastal Division	Mirsarai	Range Office	Mirsarai Range Office

Code	Zone	Division	Range Name	Type	Name
59	Coastal	Chittagong Coastal Division	Sitakunda	Range Office	Sitakunda Range Office
60	Coastal	Chittagong Coastal Division	Bashkhali	Range Office	Bashkhali Range Office
61	Coastal	Chittagong Coastal Division	Chhanua	Range Office	Chhanua Range Office
62	Hill	Cox'sbazar South Division	Inani	Range Office	Inani Range Office
63	Hill	Cox'sbazar South Division	Shilkhali	Range Office	Shilkhali Range Office
64	Hill	Cox'sbazar South Division	Teknaf	Range Office	Teknaf Range Office
65	Hill	Cox'sbazar South Division	Whykheong	Range Office	Whykheong Range Office
66	Hill	Cox'sbazar South Division	Ukhia	Range Office	Ukhia Range Office
67	Hill	Cox'sbazar North Division	P.M. Khali	Range Office	P.M. Khali Range Office
68	Hill	Cox'sbazar South Division	Panerchara	Range Office	Panerchara Range Office
69	Hill	Cox'sbazar South Division	Dhoapalong	Range Office	Dhoapalong Range Office
70	Hill	Cox'sbazar South Division	Rajarkul	Range Office	Rajarkul Range Office
71	Hill	Cox'sbazar North Division	Baghkhali	Range Office	Baghkhali Range Office
72	Hill	Cox'sbazar North Division	Joarianala	Range Office	Joarianala Range Office
73	Hill	Cox'sbazar North Division	Meherghona	Range Office	Meherghona Range Office
74	Hill	Cox'sbazar North Division	Fulchari	Range Office	Fulchari Range Office
75	Hill	Cox'sbazar North Division	Eidgaon	Range Office	Eidgaon Range Office
76	Hill	Cox'sbazar North Division	Fashiakhali	Range Office	Fashiakhali Range Office
77	Hill	Chittagong North Forest Division	Chittagong North Town	Range Office	Chittagong North Town Range Office
78	Hill	Chittagong North Division	Kalurghat	Range Office	Kalurghat Range Office
79	Hill	Chittagong South Forest Division	Barobakia	Range Office	Barobakia Range Office
80	Hill	Chittagong Wildlife Division	Bashkhali Eco Park	Range Office	Bashkhali Eco Park Range Office
81	Hill	Chittagong South Forest Division	Jaldi	Range Office	Jaldi Range Office
82	Hill	Chittagong South Forest Division	Kalipur	Range Office	Kalipur Range Office
83	Hill	Chittagong North Forest Division	Mirsarai	Range Office	Mirsarai Range Office
84	Hill	Chittagong North Forest Division	Bariyadhala	Range Office	Bariyadhala Range Office
85	Hill	Chittagong North Forest Division	Kumira	Range Office	Kumira Range Office
86	Coastal	Bhola Coastal Division	Bhola	Range Office	Bhola Range Office
87	Coastal	Bhola Coastal Division	Char Fashion	Range Office	Char Fashion Range Office
88	Coastal	Bhola Coastal Division	Lalmohon	Range Office	Lalmohon Range Office

Code	Zone	Division	Range Name	Type	Name
89	Coastal	Bhola Coastal Division	Daulat Khan	Range Office	Daulat Khan Range Office
90	Coastal	Bhola Coastal Division	Dhal Char	Range Office	Dhal CharRange Office
91	Coastal	Bhola Coastal Division	Char Kukri Mukri	Range Office	Char Kukri Mukri Range Office
92	Coastal	Bhola Coastal Division	Manpua	Range Office	Manpura Range Office
93	Hill	Cox's Bazar South Forest Div.	Inani	Range Office	Inani
94	Hill	Cox's Bazar South Forest Div.	Shilkhali	Range Office	Shilkhali
95	Hill	Cox's Bazar South Forest Div.	Teknaf	Range Office	Teknaf
96	Hill	Cox's Bazar South Forest Div.	Whykheong	Range Office	Whykheong
97	Hill	Cox's Bazar South Forest Div.	Ukhia	Range Office	Ukhia
98	Hill	Cox's Bazar South Forest Div.	Panerchara	Range Office	Panerchara
99	Hill	Cox's Bazar South Forest Div.	Dhoapalong	Range Office	Dhoapalong
100	Hill	Cox's Bazar South Forest Div.	Rajarkul	Range Office	Rajarkul
101	Hill	Cox's Bazar North Forest Div.	P.M.Khali	Range Office	P.M.Khali
102	Hill	Cox's Bazar North Forest Div.	Bagkhali	Range Office	Bagkhali
103	Hill	Cox's Bazar North Forest Div.	Joarianala	Range Office	Joarianala
104	Hill	Cox's Bazar North Forest Div.	Meherghona	Range Office	Meherghona
105	Hill	Cox's Bazar North Forest Div.	Fulchari	Range Office	Fulchari
106	Hill	Lama Forest Division	Lama	DFO Lama	Lama DFO
107	Hill	Cox's Bazar North Forest Div.	Eidgarh	Range Office	Eidghar
108	Hill	Cox's Bazar North Forest Div.	Eidgaon	Range Office	Eidgaon
109	Hill	Cox's Bazar North Forest Div.	Fashiakhali	Range Office	Fashiakhali
110	Sal	Tangail Forest Division	Dokkhola	Range office	Dokkhola Range office
111	Sal	Tangail Forest Division	Aryankhola	Range office	Aryankhola Range office
112	Sal	Rangpur Forest Division	Rangpur	DFO Office	Rangpur DFO Office
113	Sal	Rangpur Forest Division	Mitha Pukur	Range Office	Mitha Pukur Range Office
114	Sal	Rajshahi Social Forest Division	Paikbanda	Range Office	Paikbanda Range Office
115	Sal	Mymensingh Forest Division	Rasulpur	Range office	Rasulpur Range office
116	Sal	Mymensingh Forest Division	Bhaluka	Range office	Bhaluka Range office
117	Sal	Mymensingh Forest Division	Modhu Tilla	Range Office	Modhu Tilla Range Office
118	Sal	Mymensingh Forest Division	Rangtia	Range Office	Rangtia Beat Office

Code	Zone	Division	Range Name	Type	Name
119	Sal	Mymensingh Forest Division	Bali Juri	Range Office	Bali Juri Beat Office
120	Sal	Mymensingh Forest Division	Rangtia	Range Office	Rangtia Range Office
121	Sal	Mymensingh Forest Division	Bali Juri	Range Office	Bali Juri Range Office
122	Sal	Dinajpur Forest Division	Charkai	Range Office	Charkai Range Office
123	Sal	Dhaka WMNC Division	Bhawal	Range office	Bhawal Range office
124	Sal	Dhaka WMNC Division	Bhurulia	Range office	Bhurulia Range office
125	Sal	Dhaka WMNC Division	National Park	Range office	National Park Range office
126	Sal	Dhaka WMNC Division	Bangabandhu Safari Park	Range office	Bangabandhu Safari Park Range office
127	Sal	Dhaka WMNC Division	Rajendrapur	Range office	Rajendrapur Range office
128	Sundarban	Sundarban East Forest Division	Chandpai	Range Office	Chandpai RO
129	Sundarban	Sundarban West Forest Division	Nalian	Range Office	Khulna RO, Nalian
130	Sundarban	Sundarban West Forest Division	Burigoalini	Range Office	Satkhira RO, Burigoal
131	Sundarban	Sundarban East Forest Division	Sarankhola	Range Office	Sarankhola RO
132	Hill	Sylhet Forest Division	Satchari	Range Office	Satchari Range Office
133	Hill	Sylhet Forest Division	Raghunandan	Range Office	Raghunandan Range Office
134	Hill	Sylhet Forest Division	Moulavibazar Wild Life Sanctuary	Division Office	Moulavibazar Wild Life Division Office
135	Hill	Sylhet Forest Division	Moulavibazar Wild Life (Sreemangal)	Range Office	Moulavibazar Wild Life (Sreemangal) Range Office
136	Hill	Sylhet Forest Division	Kalenga	Range Office	Kalenga Range Office
137	Hill	Sylhet Forest Division	Rajkandi	Range Office	Rajkandi Range Office
138	Hill	Sylhet Forest Division	Kulaura	Range Office	Kulaura Range Office
139	Hill	Sylhet Forest Division	Juri	Range Office	Juri Range Office
140	Hill	Sylhet Forest Division	Borolekha	Range Office	Borolekha Range Office
141	Swamp	Sylhet Forest Division	Sunamgonj	Range Office	Sunamgonj Range Office
142	Hill	Sylhet Forest Division	Sari	Range Office	Sari Range Office
143	Hill	Cox's Bazar North Forest Div.	Cox'sbazar	Division Office	Cox's Bazar Forest Div.
144	Hill	Bandarban Pulpwood Division	Bandarban	Division Office	Bandarban Pulpwood Forest Division
145	Hill	Chittagong Hill Tracts (South)	Chittagong	Division Office	Chittagong Hill Tracts (South)
146	Hill	Khagrachari Forest Division	Khagrachari	Division Office	Khagrachari Forest Division
147	Sal	Dhaka Forest Division	Dhaka	Doivision Office	Dhaka Forest Division

Code	Zone	Division	Range Name	Type	Name
148	Sundarban	Sundarban East Forest Division	Bagerhat	Division Office	Sundarban East Forest Division
149	Sundarban	Sundarban West Forest Division	Khulna	Division office	Sundarban West Forest Division
150	Coastal	Bhola Coastal Division	Bhola	Division Office	Bhola Coastal Division
151	Coastal	Patuakhali Coastal Division	Patuakhali	Division Office	Patuakhali Coastal Division
152	Coastal	Noakhali Coastal Division	Maijdee	Division Office	Noakhali Coastal Division
153	Non Forest	Rajshahi Social Forest Division	Rajshahi	Division Office	Rajshahi Social Forest Division
154	Non Forest	Rangpur Forest Division	Rangpur	Division Office	Rangpur Forest Division
155	Non Forest	Pabna Social Forest Division	Pabna	Division Office	Pabna Social Forest Division
156	Non Forest	Jessore Forest Division	Jessore	Division Office	Jessore Forest Division
157	Non Forest	Barisal Coastal Forest Division	Barisal	Division Office	Barisal Coastal Forest Division
158	Non Forest	Sylhet Forest Division	Sylhet	Division Office	Sylhet Forest Division
159	Non Forest	Comilla Social Forest Division	Comilla	Division office	Comilla Social Forest Division
160	Non Forest	Mymensingh Forest Division	Mymensingh	Division Office	Mymensingh Forest Division
161	Non Forest	Dhaka Social Forest Division	Dhaka	Division Office	Dhaka Social Forest Division
162	Non Forest	Faridpur Social Forest Division	Faridpur	Division Office	Faridpur Social Forest Division

APPENDIX 8. FOREST DIVISIONS

Code	Division
1	Dhaka WMNC
2	Chittagong WMNC
3	Sylhet WMNC
4	Khulna WMNC
5	National Botanical Garden, Mirpur, Dhaka
6	Botanical Garden and Ecopark, Chittagong
7	Management Plan , Dhaka
8	Management Plan , Chittagong
9	Management Plan , Khulna
10	Dhaka Social Forest
11	Comilla Social Forest
12	Feni Social Forest
13	Pabna Social Forest
14	Dinajpur Social Forest
15	Bogra Social Forest
16	Rajshahi Social Forest
17	Jessore Social Forest
18	Kushtia Social Forest
19	Bagerhat Social Forest
20	Faridpur Social Forest
21	Barisal Social Forest
22	Dhaka Forest
23	Tangail Forest
24	Mymensingh Forest
25	Sylhet Forest
26	Cox'sbazar North Forest
27	Cox'sbazar South Forest
28	Bandarban Forest
29	Lama Forest
30	Pulpwood Plantation Division, Bandarban
31	CHT South Forest
32	Utilization Forest
33	CHT North Forest
34	USF Forest
35	Pulpwood Plantation , Kaptai
36	Khagrachari Forest
37	Jhum Control Forest , Rangamati
38	Bhola Coastal Forest
39	Patuakhali Coastal Forest
40	Noakhali Coastal Forest
41	Chittagong Coastal Forest
42	Sundarban East Forest
43	Sundarban West Forest

APPENDIX 9. FOREST RANGES

Code	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
51	Shalgaria SFNTC	101	Gopalganj SFNTC	151	Sgreebordi SFNTC	201	Fashiakhali	251	Game Sanctuary (Rangamati)	301	Char Montaz
52	Shujanagar SFNTC	102	Rajbari SFNTC	152	Karimganj SFNTC	202	Fulchari	252	Cox'sbazar SFNTC	302	Patharghata
53	Sirajganj SFNTC	103	Faridpur SFNTC	153	Juri	203	Eidgaon	253	Maheshkhali SFNTC	303	Amtali
54	Royganj SFNTC	104	Purba Gagabati SFNTC	154	Kulaura	204	Meherghona	254	Rangamati North HQ	304	Doshmina
55	Dinajpur HQ	105	Madaripur SFNTC	155	Borolekha	205	Joarinala	255	Karnaphully	305	Mohipur
56	Charkai	106	Shariatpur SFNTC	156	Rajkandi	206	Bakkhali	256	Subalong	306	Patuakhali SFNTC
57	Madhyapara	107	Kashipur SFNTC	157	Moulvivazar	207	PM Khali	257	Farua	307	Barguna SFNTC
58	Deviganj	108	Gournadi SFNTC	158	Sari	208	Chakaria Sundarban	258	Sharangchari	308	Ranagopaldi SFNTC
59	Ramsagar	109	Jhalokathi SFNTC	159	Sylhet HQ	209	Cox'sbazar (North) HQ	259	Alikhong	309	Charbata
60	Uttar Govindapur SFNTC	110	Pirojpur SFNTC	160	Raghunandan	210	Fashiakhali SFNTC	260	Firingibazar	310	Jahajmara
61	Kaharol SFNTC	111	Boyra SFNTC	161	Sunamganj	211	Teknaf	261	Rangamati HQ (USF)	311	Char Alauddin
62	Thakurgaon SFNTC	112	Muladi SFNTC	162	Sylhet Town	212	Shilkhali	262	Kutukchari	312	Habibia
63	Panchgarh SFNTC	113	Barisal HQ SFNTC	163	Shayestaganj	213	Cox'sbazar (South) HQ	263	Thaingchama	313	Nalchira
64	Bogra Sadar SFNTC	114	Rajendrapur	164	Kalenag	214	Panerchara	264	Kangalchari	314	Sagoria
65	Sherpur SFNTC	115	Sreepur	165	Satchari	215	Khuniapalong	265	Mahalchari	315	Companiganj
66	Dupchachia SFNTC	116	Kachighata	166	Sunamganj SFNTC	216	Rajarkul	266	Khagrachari	316	Char Alexander

Code	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
67	Joypurhat SFNTC	117	Kaliakoir	167	Sylhet SFNTC	217	Ukhia	267	Nursey (USF)	317	Bhabaniganj
68	Kalai SFNTC	118	Mouchak SFNTC	168	Kulaura SFNTC	218	Inani	268	Bhaibone	318	Noakhali SFNTC
69	Bogra HQ SFNTC	119	Tangail HQ	169	Moulvibazar SFNTC	219	Whykheong	269	Dhanuchari	319	Feni SFNTC
70	Poba SFNTC	120	Baheratali	170	Habiganj SFNTC	220	Cox'sbazar SFTNTC	270	Rajvilla	320	Laxmipur SFNTC
71	Charghat SFNTC	121	Hatia	171	Chittagong (North_ Town	221	Tangkabati	271	Rajshatli	321	Mirshari
72	Natore SFNTC	122	Bashtail	172	Suravi	222	Betsara	272	Noapatang	322	Sitakinda
73	Bagatipara SFNTC	123	Dalapara	173	Kumira	223	Tain	273	Rohanra	323	Chittagong HQ (Coastal)
74	Chapai Nawabganj SFNTC	124	Madhupur	174	Baiyadhala	224	Ruma	274	Bagmara	324	Banshkhali
75	Nachole SFNTC	125	Dokhola	175	Hathazari	225	Paindu	275	Leergaon	325	Kutubdia
76	Naogaon SFNTC	126	Aronkhola	176	Karerhat	226	Dhanshi	276	Kapati HQ	326	Gorakghata
77	Niamatpur SFNTC	127	Uttar Madhupur Park	177	Narayanhat	227	Lama	277	Khagrachari HQ	327	Teknaf
78	Paikbandha	128	Tangail SFNTC	178	Kalurghat	228	Matamuhuri	278	Khagrachari	328	Sandwip
79	Sapahar	129	Kalihati SFNTC	179	Olinagar	229	Naikkhingchar i	279	Panchari	329	Maheshkhali
80	Jessore HQ SFNTC	130	Madhupur SFNTC	180	Hazarikgil	230	Sangu	280	Matiranga	330	Charandwip
81	Jhenaidah SFNTC	131	Rasulpur SFNTC	181	Hasnabad	231	Doluchari	281	Jaliapari	331	Urirchar
82	Kotchandpur SFNTC	132	Bhaluka SFNTC	182	Mirershari	232	Bandraban (Pulpwood) HQ	282	Ramgarh	332	Chhanua
83	Narail HQ SFNTC	133	Mymensingh Special	183	Mirersharai	233	Terecha	283	Manikchari	333	Patiya SFNTC
84	Satkhira HQ SFNTC	134	Angogora	184	Nasirabad SFNTC	234	Chemi	284	Khagrachari SFTC	334	Raojan SFNTC

Code	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
85	Sharsha SFNTC	135	Rasulpur	185	Hathazari SFNTC	235	Poli	285	Seed & Nursery , Khagrachari	335	Harhazari SFNTC
86	Magura HQ SFNTC	136	Santoshpur	186	Raujan SFNTC	236	Boangchari	286	Ultachari	336	Rangunia SFNTC
87	Kushtia HQ SFNTC	137	Rangamati	187	Chittagong (South) Town	237	Painthing	287	Phulgazi	337	Fatikchari SFNTC
88	Bheramara SFNTC	138	Rangtia	188	Kalurghat	238	Mirakha	288	Kashkhali	338	Chandpai
89	Chuadanga SFNTC	139	Madhutila	189	Patiya	239	Rematripasha	289	Kushtubdia	339	Sharankhola
90	Jiban Nagar SFNTC	140	Sandhyakura	190	Rangunia	240	Supply Chittagong	290	Tinkunia	340	Khulna
91	Meherpur SFNTC	141	Botkuchi	191	Khurushia	241	Forest Utilization Chittagong	291	Merang	341	Satkhira
92	Gangni SFNTC	142	Shameshchura	192	Madarsha	242	Pablakhali	292	Hazachari		
93	Bagerhat HQ	143	Balijuri	193	Jaldi	243	Baghaihat	293	Bhedbhedi		
94	Bagerhat East	144	Durgapur	194	Kalipur	244	Sishahk	294	Bhola HQ		
95	Bagerhat West Rangr	145	Agricultural University SFNTC	195	Barobakia	245	Naraichari	295	Daulatkhan		
96	Bagerhat South	146	Gouripur SFNTC	196	Padua	246	Laksmichari West	296	Manpura		
97	Khulna SFNTC	147	Netrokona SFNTC	197	Dohazari	247	Laksmichari East	297	Char Fasson		
98	Bagehat SFNTC	148	Kishoreganj SFNTC	198	Chunati	248	Mesalong North	298	Kumrimukri		
99	Phultala SFNTC	149	Jamalpur SFNTC	199	Pomora SFNTC	249	Mesalong South	299	Patuakhali HQ		
100	Jagati SFNTC	150	Sherpur SFNTC	200	Patiya SFNTC	250	Rangamati	300	Golachipa HQ		

APPENDIX 10. FOREST BEATS

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
1	Rajendrapur West	61	Ghior SFPC	121	Dinajpur HQ	181	Nozirpur SFPC	241	Sadarpur SFPC
2	Bishoya Kuribari	62	Saturia SFPC	122	Birol	182	Paikbandha SFPC	242	Charvadrashan SFPC
3	Baraipara	63	Shibaloy SFPC	123	Charkai	183	Dhamoirhat SFPC	243	Alfadanga SFPC
4	Bhabanipur	64	Daultpur SFPC	124	Pragpur	184	Patnitala SFPC	244	Madhukhali SFPC
5	Bhawal N. Park	65	Singair SFPC	125	Nababganj	185	Sapahar SFPC	245	Boalmari SFPC
6	Baupara	66	Harirampur SFPC	126	Haripur	186	Porsh SFPC	246	Gangabordi SFPC
7	Bankhoira	67	Manikganj HQ SFPC	127	Bhaduria	187	Putiya SFPC	247	Madaripur HQ SFPC
8	Chunati	68	Bandar SFPC	128	Hakimpur	188	Durgapur SFPC	248	Shibchar SFPC
9	Aziznagar	69	Narayanganj HQ SFPC	129	Birampur	189	Charghat SFPC	249	Rajoir SFPC
10	Harbang	70	Araihasar SFPC	130	Madhyapara	190	Bagha SFPC	250	Kalkiki SFPC
11	Puichari	71	Rupganj SFPC	131	Kushdah	191	Naldanga SFPC	251	Shariatpur SFPC
12	Napora	72	Sonargaon SFPC	132	Aftabganj	192	Natore SFPC	252	Moksudpur SFPC
13	Chambal	73	Monohardi SFPC	133	Bhabaipur	193	Shingra SFPC	253	Noria SFPC
14	Banshkhali	74	Belabo SFPC	134	Parbatipur	194	Boraigram SFPC	254	Jajira SFPC
15	Dulahazara	75	Shibpur SFPC	135	Ghoraghat	195	Gurudaspur SFPC	255	Bhedarganj SFPC
16	Rehabilitation	76	Narsingdi HQ SFPC	136	Phulbari	196	Bagatipara SFPC	256	Damuddya SFPC
17	Tourism	77	Roypura SFPC	137	Singra	197	Lalpur SFPC	257	Goshaihat SFPC
18	Kotbari HQ	78	Palash SFPC	138	Pirganj	198	Chapai Nawabganj HQ SPPC	258	Kashipur SFPC
19	Rajeshpur	79	Munshiganj HQ SFPC	139	Bieganj	199	Shibganj SFPC	259	Babuganj SFPC
20	Jashpur	80	Tangibari SFPC	140	Anjamkhor	200	Nachole SFPC	260	Banaripara SFPC
21	Amanganda	81	Sreenagar SFPC	141	Deviganj	201	Bholahat SFPC	261	Agoijhora SFPC
22	Jagannath Dighi	82	Lauhajong SFPC	142	Boteshwari	202	Gomastapur SFPC	262	Gaournadi SFPC
23	Jambari	83	Gazaria SFPC	143	Boda SFPC	203	Naogaon HQ SFPC	263	Ujirpur SFPC

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
24	Kalikrishna Nagar	84	Sirajdikhan SFPC	144	Panchagarh Beat	204	Mahadevpur SFPC	264	Jhalokathis SFPC
25	Boro Dharmapur	85	Bilonoa SFPC	145	Tetulia Beat	205	Badalgachi SFPC	265	Kathalia SFPC
26	Kotbari HQ SFPC	86	Char Abdullah	146	Uttar Govindapur SFPC	206	Atrai SFPC	266	Rajapur SFPC
27	Laksam SFPC	87	Taraganj SFPC	147	Khanshama SFPC	207	Raninagar SFPC	267	Nalsity SFPC
28	Monohorganj SFPC	88	Mithapukur HQ	148	Chirir Bandar SFPC	208	Niamatpur SFPC	268	Mehendiganj SFPC
29	Chauddagram SFPC	89	Jharbishla	149	Kaharol SFPC	209	Manda SFPC	269	Hijla SFNTC
30	Nagalkot SFPC	90	Helencha	150	Bochaganj SFPC	210	Jessore HQ SFPC	270	Bakerganh SFPC
31	Burishchong SFPC	91	Khoraganj	151	Birgang SFPC	211	Keshabpur SFPC	271	East Rajendrapur
32	Barura SFPC	92	Lohanipara	152	Thakurgaon HQ SFPC	212	Monirampur SFPC	272	West Rajendrapur
33	Devidwar SFPC	93	Kadirabad	153	Pirganj SFPC	213	Avoy Nagar SFPC	273	Surjanarayanpur
34	Chandina SFPC	94	Domar	154	Ranishangkoil SFPC	214	Bagharpara SFPC	274	Shalna
35	Homna SFPC	95	Dimla	155	Haripur SFPC	215	Sharsha SFPC	275	Gazipur
36	Dudkandi SFPC	96	Goshaiganj	156	Baliadanga SFPC	216	Jhikorgacha SFPC	276	Monipur
37	Titas SFPC	97	Satjan	157	Panchgarh HQ SFPC	217	Chaugacha SFPC	277	Sreepur
38	Meghna SFPC	98	Sundarkhata	158	Atoari SFPC	218	Kumarkhali SFPC	278	Goshinga
39	Muradnagar HQ SFPC	99	Chatunama	159	Tetulia SFPC	219	Khoksha SFPC	279	Pakiabo
40	Chandpur HQ SFPC	100	Hatibandha	160	Bogra HQ SFPC	220	Kushtia HQ SFPC	280	Satkhaimair
41	Hajiganj SFPC	101	Ishwardi SFPC	161	Nandigram SFPC	221	Bheramara SFPC	281	Kaoraid
42	Shahrasti SFPC	102	Atgharia SFPC	162	Sonatala SFPC	222	Mirpur SFPC	282	Rathura
43	Kachua SFPC	103	Chatmohor SFPC	163	Shibganj SFPC	223	Daulatpur SFPC	283	Shimlapara
44	Matlab North SFPC	104	Bhangura SFPC	164	Sherpur SFPC	224	Alamdanga SFPC	284	Sinratoli
45	Matlab South SFPC	105	Pabna HQ SFPC	165	Dhunat SFPC	225	Chuadanga HQ SFPC	285	Kachghata
46	Haimchar SFPC	106	Shagaria SFPC	166	Gab tali SFPC	226	Damurhuda SFPC	286	Jatila

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
47	Faridganj SFPC	107	Sathia SFPC	167	Sariakandi SFPC	227	Jibon Nagar SFPC	287	Khoilshjani
48	Brahmanbaria HQ SFPC	108	BIRA SFPC	168	Dupchachia SFPC	228	Meherpur SFPC	288	Chandra
49	Kasba SFPC	109	Faridpur SFPC	169	Kahalu SFPC	229	Gangni SFPC	289	Baroipara
50	Nasir Nagar SFPC	110	Sijanagar SFPC	170	Adamdighi SFPC	230	Gopalganj HQ SFPC	290	Kashimpur
51	Nabi Nagar SFPC	111	Kamarkhand SFPC	171	Joypurhat SFPC	231	Tungipara SFPC	291	Mauchak
52	BancharampurSFPC	112	Belkuchi SFPC	172	Akkelpur SFPC	232	Kotalipara SFPC	292	Roghunathpur
53	Sarail SFPC	113	Chauhali SFPC	173	Panchbibbi SFPC	233	Kashiani SFPC	293	Shonatala
54	Akhaura SFPC	114	Sirajganj HQ SFPC	174	Kalai SFPC	234	Rajbari SFPC	294	Kodda
55	Dhamrai SFPC	115	Shahjadpur SFPC	175	Khetlal SFPC	235	Baliakandi SFPC	295	Boali
56	savar SFPC	116	Tarash SFPC	176	Paba SFPC	236	Pangsha SFPC	296	Govindpur
57	Dohar SFPC	117	Kazipur SFPC	177	Mohanpur SFPC	237	Goalando SFPC	297	Vannara
58	Nawabganj SFPC	118	Ullapara SFPC	178	Bagmara SFPC	238	Faridpur HQ SFPC	298	Gazipur HQ SFPC
59	Keraniganj SFPC	119	Rouganj SFPC	179	Tanore SFPC	239	Nagarkanda SFPC	299	Kaliakoir SFPC
60	Dhaka HQ SFPC	120	Dharmapur	180	Godagari SFPC	240	Bhanga SFPC	300	Kaliganj SFPC

APPENDIX 11. LIST OF BFI CONTACTS

Sl. No.	Name	Team	Designation	Mobile No.	E-mail
TRAINERS FROM FOREST DEPARTMENT					
1	Mr. Baktiar Nur Siddiquie	All	DFO, Dhaka Forest Division	01711819670	dfochts@gmail.com
2	Mr. Hossain Md. Nishad	All	DFO, Dhaka Social Forest Division	01715005677	imranforest@gmail.com
3	Mr. Zaheer Iqbal	All	DCF, RIMS	01711443750	newaz.y@gmail.com
QA/QC TEAM LEADERS					
1	Mr. Md. Salahuddin	Q1	DFO/Chittagong Hill Tracts South Division	01712263767	dfochts@gmail.com
2	Mr. Imran Ahmed	Q2	DFO/ Social Forest Division, Rajshahi	01761494600	imranforest@live.com
3	Mr. ANM Yasin Newaz	Q3	Director FSTI/Chittagong	01711447161	newaz.y@gmail.com
4	Mr. Belayet Hossain	Q4	ACF/Cox'sbazar Forest Division	01712567849	belayet.hossen70@yahoo.com
5	Mr. Md. Matlubur Rahman	Q5	ACF/Chittagong South Forest Division, Chittagong	01712627900	mrahman10169@gmail.com
6	Mr. Abu Bakar Siddique	Q6	ACF/Chittagong North Forest Division, Chittagong	01718848759	abakeracf@gmail.com
QA/QC DEPUTY TEAM LEADERS					
1	Khulna University	Q1	Khulna University		
2	Khulna University	Q2	Khulna University		
3	University of Chittagong	Q3	University of Chittagong		
4	University of Chittagong	Q4	University of Chittagong		
5	Shahjalal University of Science and Technology	Q5	Shahjalal University Of Science and Technology		
6	Shahjalal University of Science and Technology	Q6	Shahjalal University Of Science and Technology		
QA/QC SKILLED PERSON					
1	Mr. Absar Uddin Bhuiyan	Q1	Forest Guard, USF Afforestation Division	01828813575	-
2	Mr. Md. Tariqul Islam	Q2	Forest Guard, Sundarban East Forest Division, Bagerhat	01727305861	-
3	Mr. Abu SayeemMd. Anis	Q3	Forest Guard, Chittagong North Forest Division	01819887562	-
4	Mr. Md. Jashim Uddin-2	Q4	Forest Guard, Chittagong South Forest Division	01918870482	-
5	Mr. Md. Mamunur Rashid	Q5	Forest Guard, Chittagong South Forest Division	01845694108	-
6	Mr. Md. Yunus Miah	Q6	Forest Guard, Cox'sbazar North Forest Division	01710994643	-
FIELD TEAM LEADERS (TL)					

1	Mr. Touhidur Rahman	T1	Forester/Sundarban East Forest Division	01712643117	tauhidor.rahaman@yahoo.com
2	Mr. Abdullah-al-Mamun	T2	ACF/Sylhet Forest Division	01776834219	almamun.0022@gmail.com
3	Mr. Md. Sahin Kabir	T3	ACF/Chittagong North Forest Division	01741520030	sheikhshah00@gmail.com
4	Mr. Md. Anisur Rahman	T4	ACF/Chittagong South Forest Division	01966138236	anisur.boi@gmail.com
5	Mr. Mohammad Sohal Rana	T5	ACF/Cox'sbazar South Forest Division	01843712087	md_rana7777@yahoo.com
6	Mr. Md. Sajjaduzzaman	T6	ACF/Tangail Forest Division	01720658107	sajjaduzzamn9@gmail.com
7	Mr. AZM Hasanur Rahman	T7	ACF/Sylhet Forest Division	01711944771	sdfohobigonj@yahoo.com
8	Dr. Prantosh Chandra Roy	T8	ACF/Social Forest Division, Rangpur	01712224429	prantoshchandraroy@yahoo.com
9	Mr. Enamul Haq	T9	ACF/Dhaka Forest Division	01711052796	enamul44@yahoo.com
10	Mr. Shyamal Kumer Ghoshe	T10	ACF/Social Forest Division, Dhaka	01711015945	shyamalacffd@gmail.com
11	Mr. Md. Mahedizzaman	T11	ACF/Sundarban East Forest Div, Bagerhat	01819751874	mahedizzaman.fd@gmail.com
12	Mr. Md. Rafiquzzaman Shah	T12	ACF/Social Forest Division, Dinajpur	01711315835	shahrafiq68@gmail.com
13	Mr. Md. Farid Meah	T13	ACF/Coastal Forest Division, Bhola	01761494740	acffarid6@gmail.com
FIELD DEPUTY TEAM LEADERS (DTL) Foresters (Fr)					
1	Mr. Saiful Islam	T1	Forester /Cox'sbazar South Forest Division, Chittagong	01712815219	-
2	Mr. Md. Abdul Hamid	T2	Forester/Noakhali Forest Division	01740585543	-
3	Mr. Md. Shahinur Rahman	T3	Forester/Chittagong North Forest Division	01714867846	-
4	Mr. Sorowar Jahan	T4	Forester/Chittagong South Forest Division	01979797955	-
5	Mr. Sazzad Hossain	T5	Forester/Cox'sbazar South Forest Division	01740966357	-
6	Mr. Touhidur Rahman	T6	Forester/Sundarban East Forest Division	01712643117	-
7	Mr. Md. Rezaul Karim	T7	Forester/Jhum Control Forest Division	01556574858	-
8	Mr. Robiul Islam	T8	Forester/USF Division, Rangamati	01717209012	-
9	Mr. Uhlamong Chowdhury	T9	Forester/USF Division, Rangamati	01556773953	-
10	Mr. Mohammed Mizanur Rahman Chowdhury	T10	Forester/CHT South Forest Division, Rangamati	01819137817	-
11	Mr. Md. Saidur Rahman	T11	Forester/Social Forest Division, Rajshahi	01712211102	-

12	Mr. Masud Rana	T12	Forester/Khagrachari Forest Division, Khagrachari	01532682152	-
13	Mr. Monir Hossain	T13	Foreaster/WMNCD, Dhaka	01716582641	-
SKILLED PERSON FOR FIELD TEAM (FOREST GUARD)					
1	Mr. Mohammad Hamid	T1	Coastal Forest Division, Chittagong	01823941482	-
2	Md. Abdur Rauf	T2	Pulpwood Plantation Division Kaptai	01710478089	-
3	Mr. Md. Bazlur Rashid	T2	Sylhet Forest Division	01714290028	-
4	Mr. Ahmad Ali	T2	Sylhet Forest Division	01712280817	-
5	Mr. Didarul Islam	T3	Coastal Forest Division, Chittagong	01818536911	-
6	Mr. Pravash Chandra Khastogir	T3	Pulpwood Pltn. Division, Kaptai	01813538066	-
7	Mr. Md. Atiqur Rahman	T4	Cox'sbazar South Forest Div	01712599896	-
8	Mr. Khondkar Mahfuz Ali	T4	Lama Forest Division, Lama	01857273660	-
9	Mr. Md. Ilias Hossain	T5	Cox'sbazar North Forest Div	01731882073	-
10	Mr. Md. Moslem Uddin	T5	Cox'sbazar South Forest Div	01815499336	-
11	Md.Nazmul Kabir	T6	Social Forest Division, Jessore	01711003445	-
12	Mr. Md. Tauhidur Rahman	T6	Social Forest Division, Faridpur	01726748451	-
13	Mr. Md. Monir Hossain	T7	Jhum Control Division, Rangamati	01536078370	-
14	Mr. Md. Quamrul Islam	T7	Khagrachari Forest Division	01722440541	-
15	Mr. Shamim Al Mamun	T8	CHT North Forest Division	01820328087	-
16	Mr. Ishtiaq Hassan	T8	Social Forest Division, Rangpur	01712456828	-
17	Mr. Md. Quamruzzaman	T9	CHT North Forest Division	01828804475	-
18	Mr. Tapan Kanti Das	T9	CHT South Forest Division	01731756615	-
19	Mr. Md. Abdul Latif	T10	Coastal Forest Div, Noakhali	01820088850	-
20	Mr. Surjya Kumar Singh	T10	Bandarban Forest Div, Bandarban	01822484095	-
21	Mr. Md. Kamal Hossain	T11	Sundarban East Forest Div, Bagerhat	01716007244	-
22	Mr. Syed Habibur Rahman	T11	Sundarban West Forest Div, Khulna	01719836507	-
23	Mr. Md. Zhilon Miah	T12	Coastal Forest Division, Patuakhali	01765631001	-
24	Mr. S.M. Amir Hamza	T12	Coastal Forest Division, Bhola	01714730149	-
25	Mr. Md. Shoeb Khan	T13	Coastal Forest Division, Bhola	01714730149	-

26	Mr.Md. Shahadat Hossain Siddiqui	T13	Coastal Forest Division, Noakhali	01981123821	-
SUPERVISORS					
1	Mr. Md. Abdul Latif Miah	S1	CF, Chittagong	01732500300	latifmd1959@yahoo.com
2	Mr. Mohammad Shamsul Azam	S2	CF, Rangamati	01196050789	shamsforest@gmail.com
3	Mr. Md. Abu Naser Khan	S3	CF, Coastal, Barisal	01727601217	khan1972bd@yahoo.com
4	Mr. Zahir Uddin Ahmed	S4	CF, Khulna	01711581429	zahirfd84@yahoo.com

APPENDIX 12. SPECIES IDENTIFICATION

LEAF TYPES



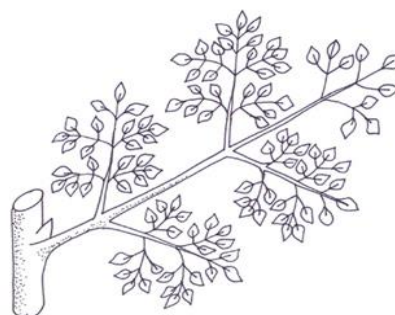
Palmate



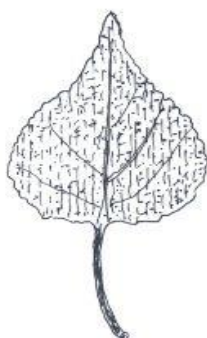
Pinnate



Bipinnate



Tripinnate



Deltoid



Lobed



Serrate

BARK TYPES



1. EXFOLIATING

Peels off in sheets leaving a mottled colour pattern



2. FISSURED

Moderate to deep cracks and grooves in bark



3. FURROWED

Shallow, vertical lines or grooves



4. PLATED

Small, frequent segmented or tessellated pattern.



5. SHREDDY

Peels off in shreds or string-like portions



6. SMOOTH

Flat and smooth to the touch. Limited colour variation



7. WINGED

Flattened woody protrusions attached to stems



8. SPIKEY

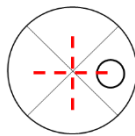
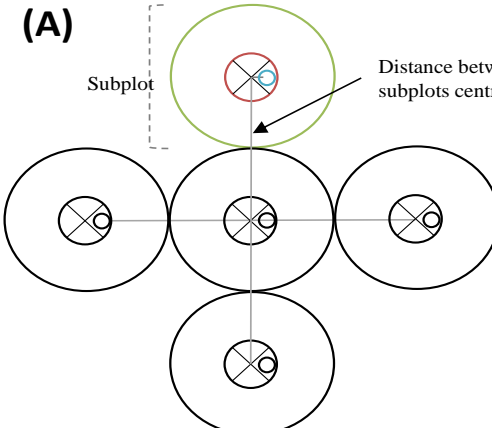
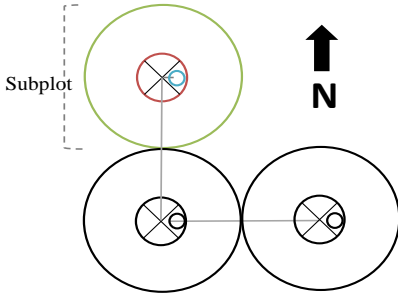
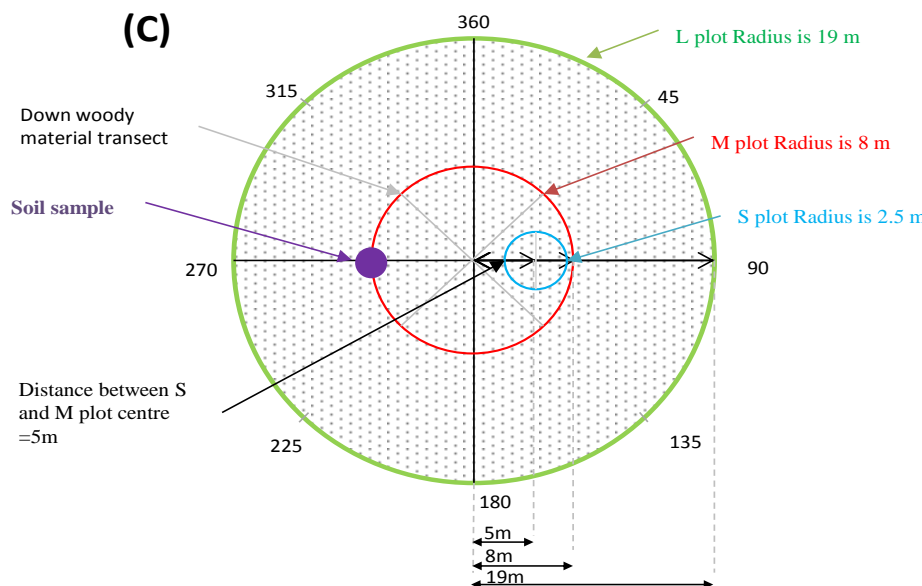
Pointed spikes protrusions attached to stems

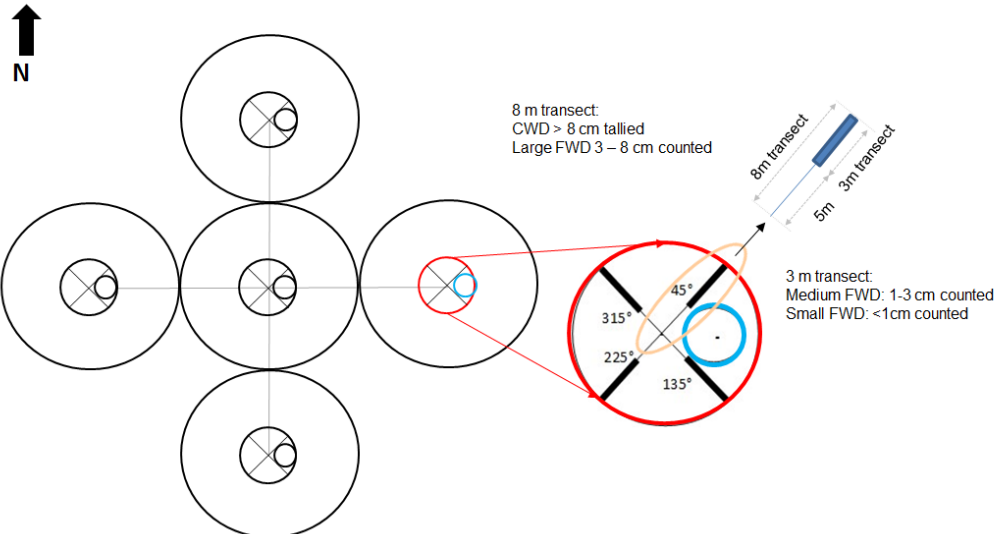
APPENDIX 13. CHECK LIST FOR RECORDING INFORMATION ON THE PLOT

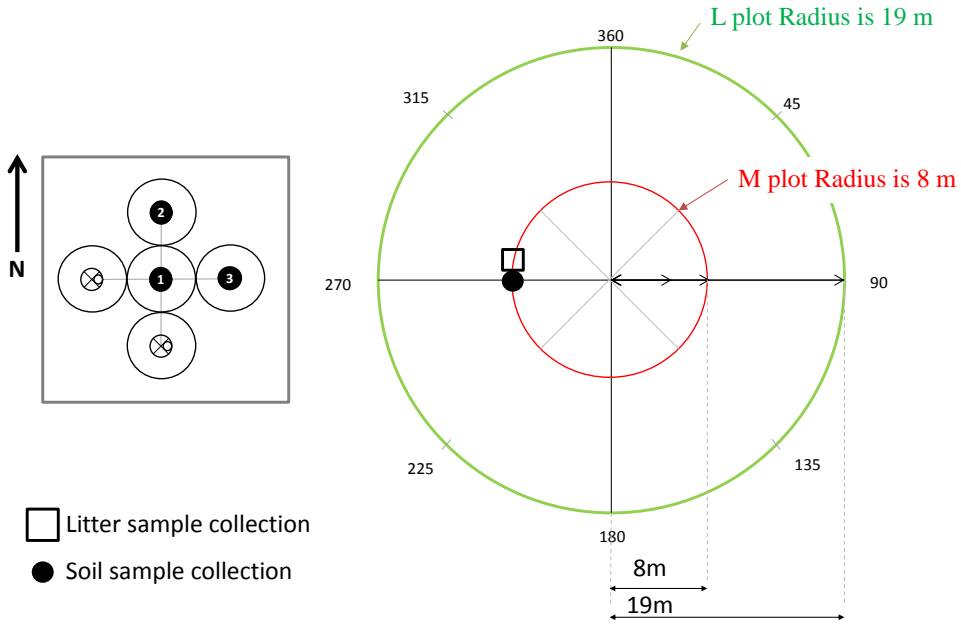
Recommended work distribution for team members

- 1 person with TAB + LF (Land Feature)
- 1 person (plot sketch+ LC (Leaf cover)
- 2 persons (RP+ WO, tree measurement)
- 1 person (Soil and litter)
- 2 persons (plot set up, S plot, DWM)

Step No.	Description	Manual Section
1	Undertake an equipment check before departure	Appendix 4
2	Reaching the plot by navigating the GPS	2.5
3	Locate the plot center and install the red/white pole at plot center (Install metal rod at the plot centre)	3.1
4	Complete the Plot access sketch	2.5.3
5	Set up 5 subplot centers	3.2
6	Take 4 photos of the land feature and record the land feature details <div data-bbox="316 1025 1289 1798"> </div>	4 and 7
7	Identify one (1) Reference point and record the following details: <ul style="list-style-type: none"> • Bearing RP to centre, • HD, • GPS coordinate • If tree take DBH and species name • Spray paint, metal tag at 2 meter • Picture x 1 	6.4

	<ul style="list-style-type: none">Note		
8	<p>Record Subplot information including:</p> <ul style="list-style-type: none">Plot statusSUBPLOT SLOPE (%)SLOPE ASPECT BEARINGLEAF COVER - along two 10 m transectLAND FEATURE CLASS and area	<div><p>M Plot</p><p>10m transect</p></div>	8
9	<p>Record the leaf cover percentage using the densitometer</p> <p>10 m transects in north-south and east west direction either side of the plot centre</p>		
10	<p>Layout the plot:</p> <ul style="list-style-type: none">3 WO (make a triangle with 3 tree with the center)OBJECT TYPEIF TREE THENSPECIESDBHBEARINGSLOPE DISTANCETREE TAGPAINT MARK AT THE POINT OF SLOPE DISTANCE MEASUREDPICTURENOTE		8
11	<p>Record trees at the appropriate distance from plot centre respecting the L, M and S plot diameters</p> <div><div><p>(A)</p><p>Subplot</p><p>Distance between subplots centres is 38 m</p></div><div><p>(B)</p><p>Subplot</p><p>N</p></div><div><p>(C)</p><p>Down woody material transect</p><p>Soil sample</p><p>Distance between S and M plot centre = 5m</p><p>L plot Radius is 19 m</p><p>M plot Radius is 8 m</p><p>S plot Radius is 2.5 m</p><p>360</p><p>315</p><p>45</p><p>270</p><p>90</p><p>225</p><p>135</p><p>180</p><p>5m</p><p>8m</p><p>19m</p></div></div>	1.4	

	<table border="1"> <thead> <tr> <th>NESTED PLOT DIMENSIONS</th><th>THRESHOLDS FOR MEASUREMENT</th><th>WHERE TO MEASURE</th></tr> </thead> <tbody> <tr> <td>L PLOT (19-meter radius)</td><td>All live and dead standing trees ≥ 30.0 cm DBH. Stumps (live or dead) ≥ 30.0 cm diameter</td><td>Measure horizontal distance and bearing of live and dead trees (DBH ≥ 30 cm) from subplot center</td></tr> <tr> <td>M PLOT (8-meter radius)</td><td>All live and dead standing trees ≥ 10.0 cm DBH Bamboo clumps Stumps (live or dead) ≥ 10.0 cm diameter</td><td>Measure horizontal distance and bearing of live and dead trees (DBH ≥ 10 cm) from subplot center</td></tr> <tr> <td>S PLOT (2.5-meter radius)</td><td>All live and dead saplings DBH ≥ 2 cm to < 10 cm Nypa and Goran (<i>Ceriops decandra</i>) Stumps (live or dead) ≥ 2 cm diameter and < 10 cm</td><td>Measure horizontal distance and bearing of live and dead trees (DBH ≥ 2 cm to < 10 cm) from 'S' plot center</td></tr> </tbody> </table>	NESTED PLOT DIMENSIONS	THRESHOLDS FOR MEASUREMENT	WHERE TO MEASURE	L PLOT (19-meter radius)	All live and dead standing trees ≥ 30.0 cm DBH. Stumps (live or dead) ≥ 30.0 cm diameter	Measure horizontal distance and bearing of live and dead trees (DBH ≥ 30 cm) from subplot center	M PLOT (8-meter radius)	All live and dead standing trees ≥ 10.0 cm DBH Bamboo clumps Stumps (live or dead) ≥ 10.0 cm diameter	Measure horizontal distance and bearing of live and dead trees (DBH ≥ 10 cm) from subplot center	S PLOT (2.5-meter radius)	All live and dead saplings DBH ≥ 2 cm to < 10 cm Nypa and Goran (<i>Ceriops decandra</i>) Stumps (live or dead) ≥ 2 cm diameter and < 10 cm	Measure horizontal distance and bearing of live and dead trees (DBH ≥ 2 cm to < 10 cm) from 'S' plot center	
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	<p>Take measurement for L plot including:</p> <ul style="list-style-type: none"> • Tree status • Species • Bearing • HD • DBH/ height to dia measurement • Tree length • Bole length (every 5th tree) • Tree damage & decay class 													
12	<p>Record data for Seedlings including:</p> <ul style="list-style-type: none"> • Species name • DBH • Bearing from S plot centre (check the table for more information) 	9												
13	<p>Record details of coarse and fine wood debris along 4 transects (45, 135, 225, 315 degree)</p>  <p>8 m transect: CWD > 8 cm tallied Large FWD 3 – 8 cm counted</p> <p>3 m transect: Medium FWD: 1-3 cm counted Small FWD: <1cm counted</p>	10												

14	<p>If bamboo clump available collect the following information:</p> <ul style="list-style-type: none"> • Bearing • HD (Horizontal Density) • Length • DBH • Stem number • Bamboo note 	13
15	<p>Record information for Soil: Collect soil samples from subplot 1, 2, 3 (figure 2, page 68)</p>  <ul style="list-style-type: none"> • Soil texture sample • Soil bulk density • Take picture of the soil core, record soil depth of humus • Label: plot no/subplot no/depth/sample type/Land Feature. 	11
16	<p>Record information for Litter: 1 m x 1 m plot, north from where the soil core is collected Collect the dead leaves, flowers, fruits, seeds and bark fragments (excluding woody particles)</p>	11.4
17	Complete the Land Feature Proportioning sketch	8.2.2

	<p>The diagram illustrates a field study layout with five circular subplots. A central subplot is surrounded by four others (top, bottom, left, right). A dashed red line forms a 'V' shape, separating the left and right subplots from the top and bottom ones. This line is labeled 'Boundary between land feature 1 & 2'. The left and right subplots are labeled 'Land feature 1' and contain green dots representing trees. The top and bottom subplots are labeled 'Land feature 2' and contain blue dots representing trees. Each subplot contains several 'Witness objects' (small circles with a central dot). A 'Reference point' (a box with an 'X') is located in the top-left area. A legend in the bottom-right corner defines the symbols: green dot for 'Trees of Land feature 1', blue dot for 'Trees of Land feature 2', circle with dot for 'Witness object', box with X for 'Reference point', dashed red line for 'Boundary between land feature 1 & 2', and solid grey line for 'Subplot boundary'.</p>	
18	Undertake a final equipment check	Appendix 4

16 REFERENCES

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