Field Instructions for the
**Bangladesh Forest Inventory**

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 elemets of the process to assist in institutionalising the Bangladesh Forest Inventory as permanent tool for forest monitoring in Bangladesh.

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6. Chittagong University

Version 1.0

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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 persued 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 acknowldeged 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:

- Plot data
- Land feature data
- Subplot data
- Seedling details

- Down woody material
- Soil and litter measurements
- Tree and sapling details
- Bamboo details

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.
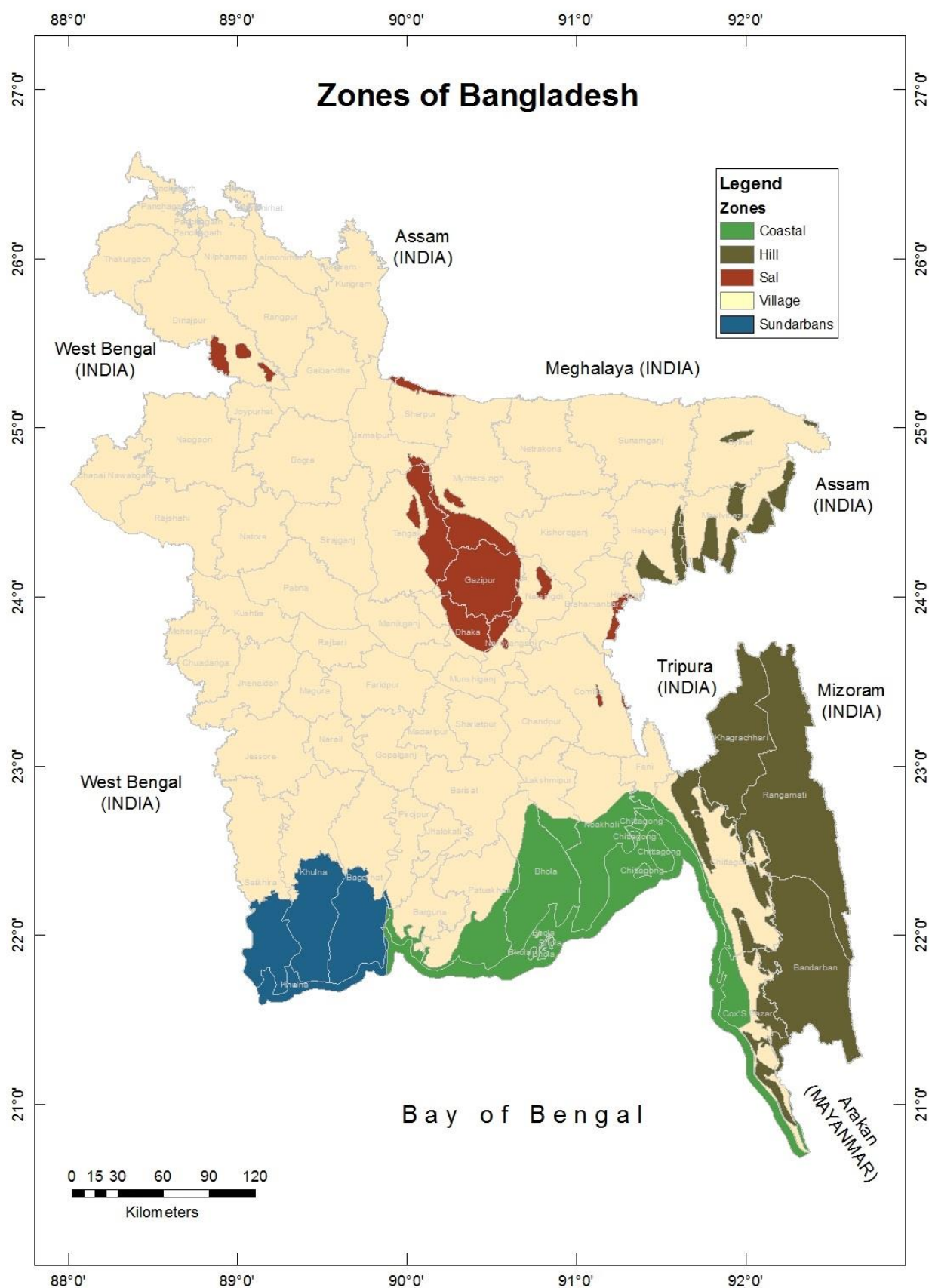
*Figure 1: Zones used for stratification of the Bangldesh Forest Inventory*

## 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 ($^{\circ}$)
- 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.
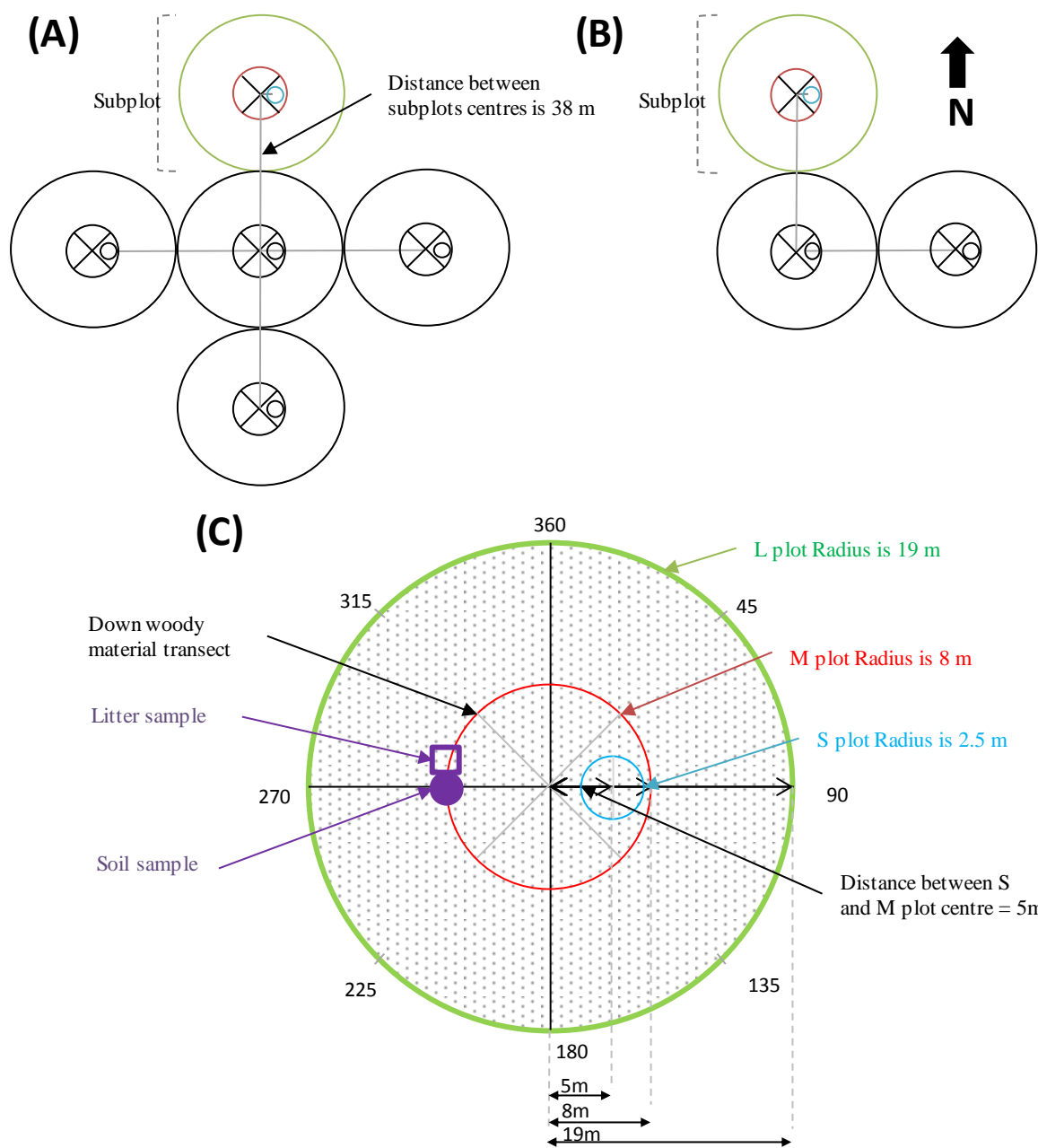
*Figure 2: Plot Diagram (A) for Sal, Hill, Coastal and Village zones, (B) Sundarbans zones and (C) Subplot structure*

*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 |

**L PLOT**
**Tree dbh ≥ 30cm**

**M PLOT**
**Tree  dbh ≥ 10cm**

**S PLOT**
**Seedling dbh ≥ 2cm**



19  8  2.5

| Live and dead standing tree with DBH ≥ 30 cm and stumps (live and dead) ≥ 30 cm diameter | | |
|---|---|---|
| | Live and dead standing trees with DBH ≥ 10 cm and stumps (live and dead) ≥ 10 cm diameter | |
| | Bamboo clumps | |
| | Down woody material | |
| | | Nypa (clump) |
| | | *Ceriops decandra* (<2 cm collar dia seedlings counted, ≥ 2 cm collar dia  recorded as sapling/tree) |
| | | Sapling ≥ 2 DBH < 10 cm |
| | | Single most vigorous shoot from live stumps ≤  2 & < 10 cm DBH |
| | | Seedling DBH < 2 cm & height ≥ 10 cm |
| | | Stumps (live /dead) ≥ 2  cm and < 10 cm  DBH |

*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 | MEASUREMENTTHRESHOLDS | 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 (*Ceriops decandra*) 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.
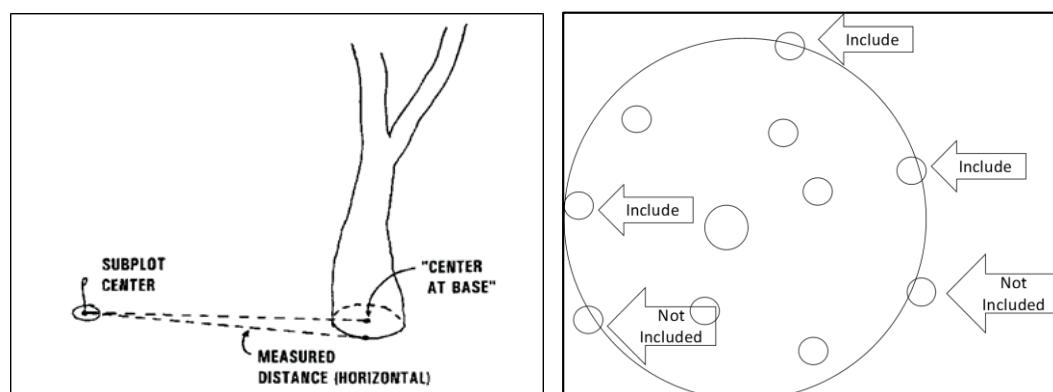


*Figure 4: Criteria for trees inside the plot boundary*

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 country[1]. 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).

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[1]All 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 collect[2] 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 theTeam 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.

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[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 Unitshould be contacted when replacement items are needed.

**Take shelter in bad weather:** Severe weather such as high winds, lightning or extreme heatshould 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 PLOTSON 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 images[3] 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.

**(A)**                                    **(B)**                                    **(C)**
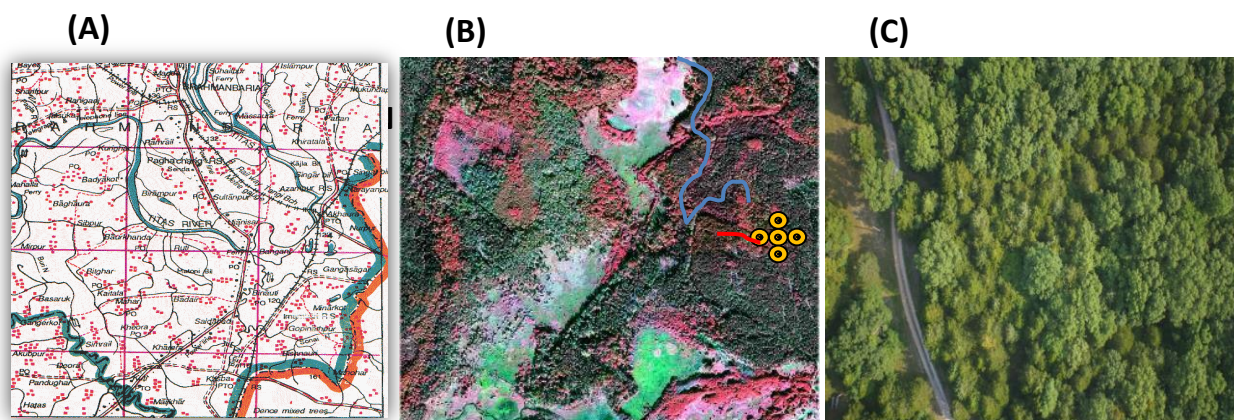


*Figure 5: Use of different maps, pictures and images to guide the location of plot (A) topographic map, (B) high resolution satellite images and (C) aerial photo*

### 2.5.3    ROUTE TO THE FIELD PLOT

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[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.



| 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 |
| P | Po | Pond/ Ditch |
| DFO | Fo | Decentralized Forest Office |
| △ | Mq | Religious Place: Mosque, Church, Temple etc. |
| ══════ | Rv | River/ Stream |
| ════════ | C | Canal/ Channel |
| ★ | Ep | Electric Pole |
| ☐ | F | Park/ Sports Field |
| R | Rs | Rural Settlement: Cluster of houses |
| M | M | Market Area |
| ———→ | | Trajectory/Direction |

*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 tothe 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 6.3.5). If all or part of the plot is inaccessible note the reason based on the list described in 6.3.6.

### 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 groundand 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 casesdetailed 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 subplotcentre.

**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. Take one picture of each WO.

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.
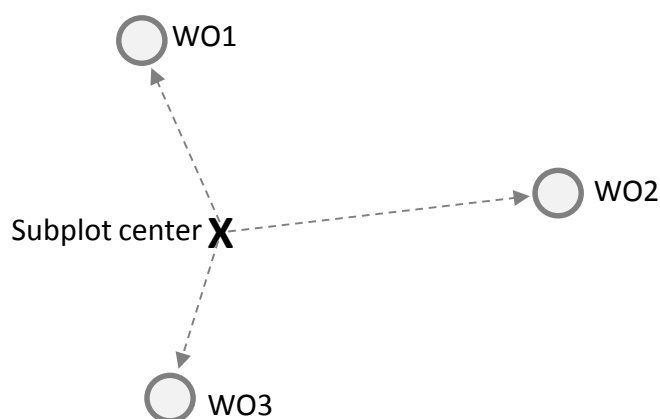


*Figure 7: Ideal distribution of thee witness objects (WO) around plot center so that they can be used to triangulate plot center (PC).*

### 3.1.5    ADDITIONAL INFORMATION TO REFERENCE PLOT AND SUBPLOT CENTRES

**STEP 14:** In "Plot Notes"record any information that may assist the relocationof 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.
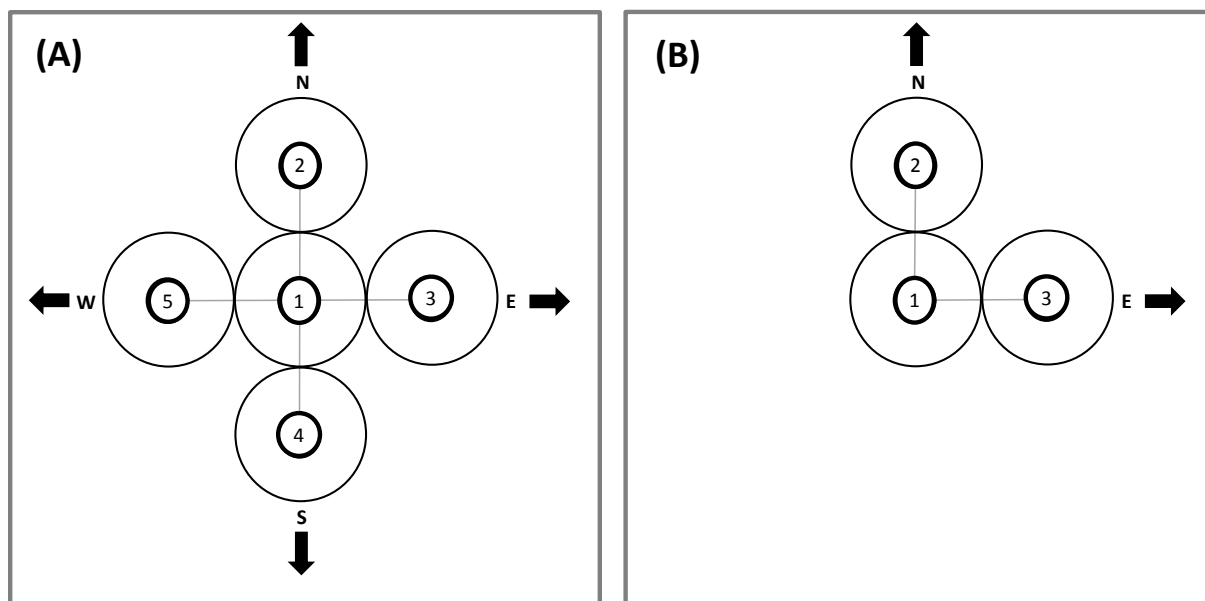


*Figure 8: Subplot numbers (A) in Hill, Sal, Coastal and Village zones, (B) in Sundarbans.*

# 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 mangers 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).
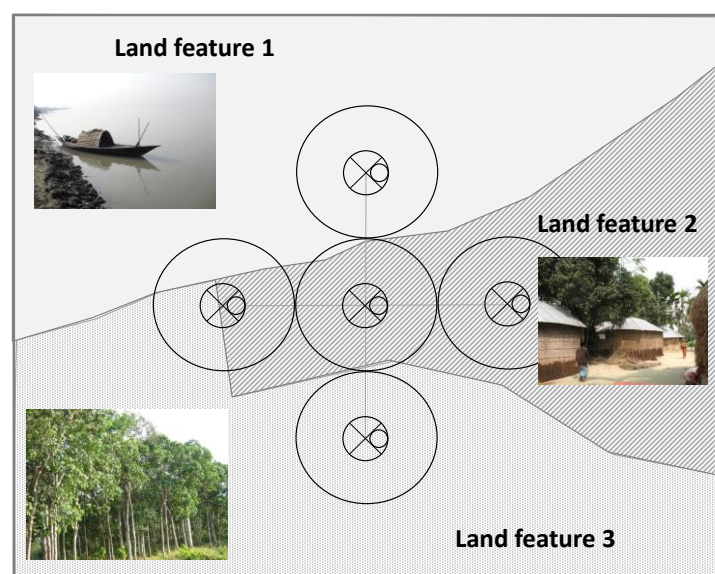


Figure 9: A plot may straddle more than one land feature class (in this case three different land features are present in one plot)

## 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 inTable 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 with 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<br>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<br>Vegetated, Non-vegetated and Water | Water | Vegetated and Non-vegetated | Vegetated |
| OBJECT ATTRIBUTES<br>Vegetated: Trees, shrubs, grasses/herbs<br>Non-vegetated: Linear, Nonlinear, bare ground, dump site etc.<br>Water: river, canal, stream, lake, pond | River | Vegetated: Trees Non-vegetated: Building/structure | Trees |
| ARTIFICIALITY (OBJECT ATTRIBUTES) | Natural/ Semi-natural | Cultivated | Cultivated |
| ATTRIBUTE DETAILS<br>Trees: Artificiality, Growth Form/Age, Management, Rotation<br>Shrubs: Management<br>Grasses/herbs: Crop, cropping pattern, management<br>Non-vegetated: Comments required<br>River: Salinity<br>Lake: Salinity<br>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 of 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).
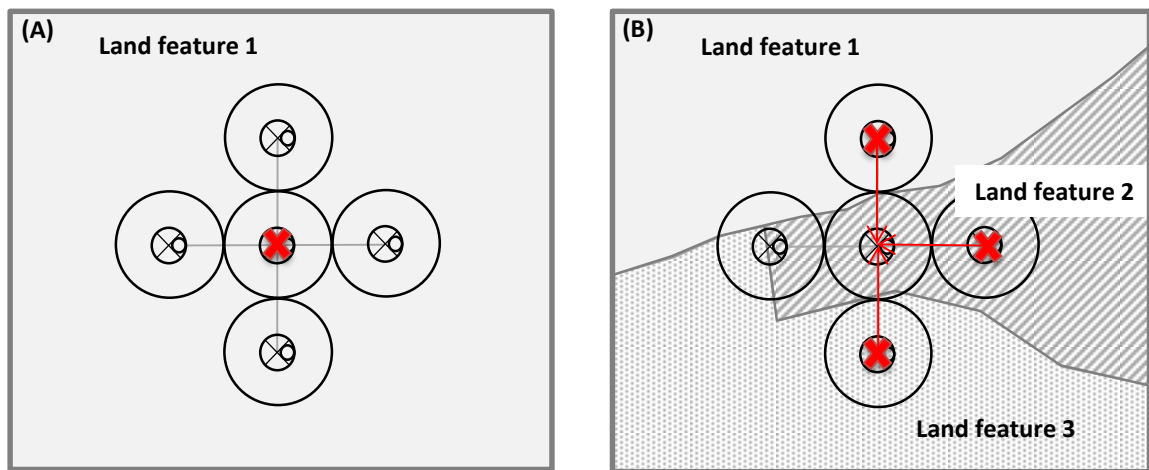
*Figure 10: Assigning geographic locations to land features:(A) the plot is found in one land feature (the description is performed at the center of the plot), (B) the land features are described at the center of three subplots.*

# 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.
  - o   Only turn AIRPLANE MODE off when connecting to Wi-Fi to submit the data (as explained 5.2).
  - o   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 [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.*
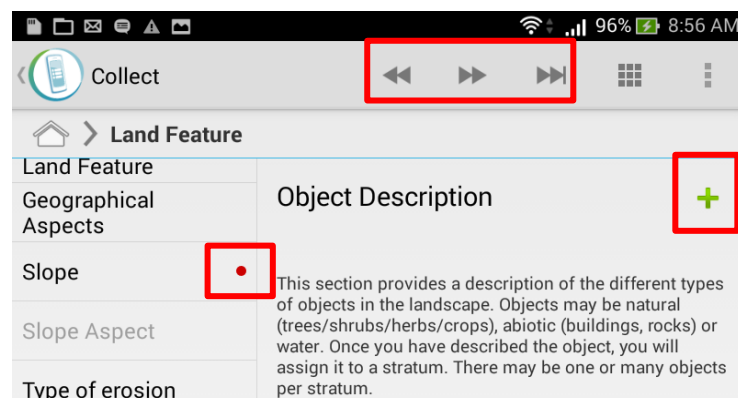


*Figure 11: Navigating controls on the OFC application. Red dots show errors that must be corrected.*

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. Export can be completed in three ways: by transferring to a server (Dropbox), via blue tooth, or by connecting the tablet via cable to a PC.

The preferred method is by uploading directly to Dropbox [icon] 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.
5. Press OK.

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 five minutes or more.

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
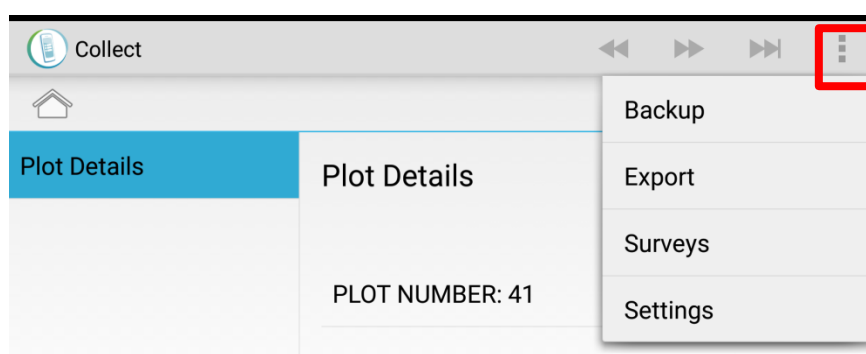


*Figure 13: Setting are accessed via the icon displayed as three dots.*

### 5.2.1    BACKUP DATA TO SECONDARY DEVICE

Data should be backed up to a secondary device every time field crews return to a decentralised office.

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.
3. Now plug a USB pen drive into the device.
4. 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 file has a .collect-data file extension.
5. Press and hold the file until the option to copy appears at the top of the screen. Press Copy.
6. Navigate to the USB folder located at Storage >USB 1.
7. Press paste.
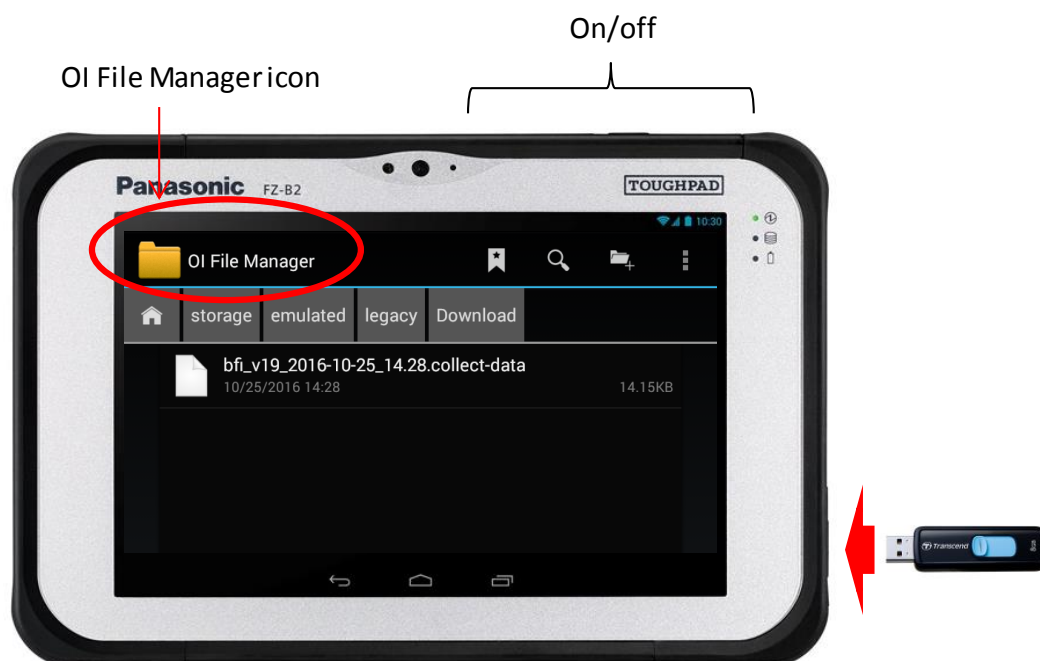


*Figure 14: Data is transferred to USB using OI File Manager.*

## 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.

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| 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    AQUIRING SATTELITES

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*andscroll 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.
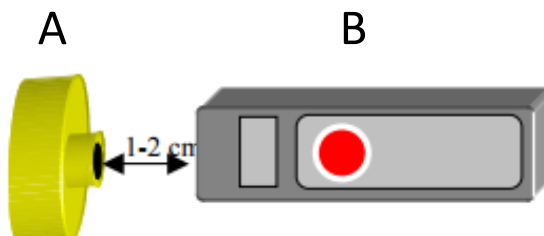


*Figure 17: To turn on, hold the transponder (A) near the DME (B) and press the red button.*

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. *See F4 for prism factor selection*. 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, *see [F2]* 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.
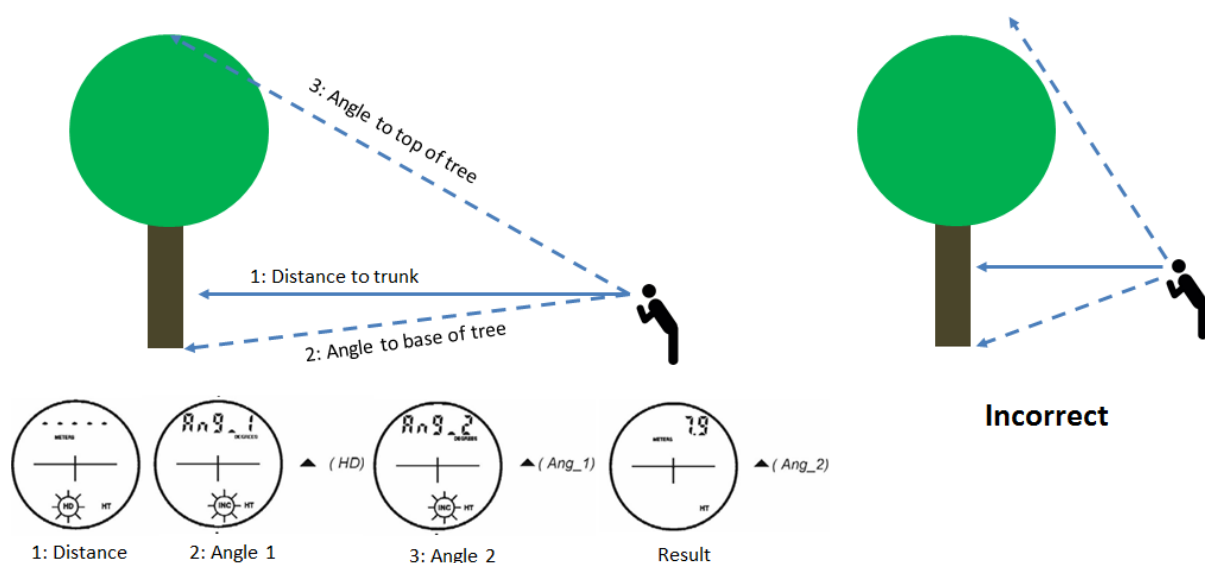


*Figure 19: Correct method (left) of height measurement. The icons show the tree step prompts as viewed through the eye piece. Incorrect method (right) occurs if the person is standing too close to the tree.*

### 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 treeand 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



*Figure 20: Suunto compass and clinometer*

$$Height = (a \times d)/100$$ *Where:*
a = angle between tree top and base in percentage;
d = horizontal distance from the tree

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

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

*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 (seeFigure 22). 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.

### 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 DEGREE.
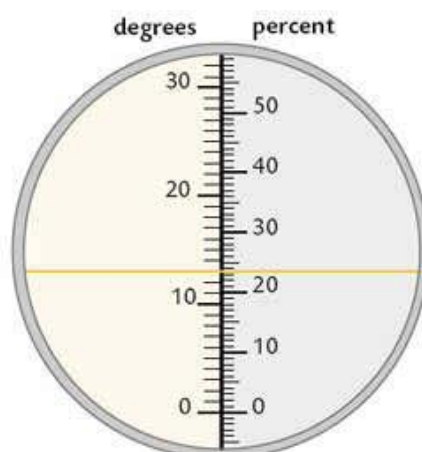


*Figure 21: Slope measurement scale in the Sunnto clinometer.*

**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 degreescale 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.
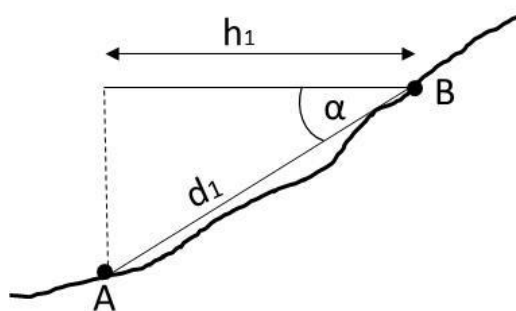
*Figure 22.Distances on slope.h1 Displays Horizontal distance. d1 displays Slope Distance. Note: The distance between two points, measured along slope (d₁) is always longer than an equivalent horizontal distance (h₁). On slope terrain, the horizontal distance must be multiplied by a factor that corresponds 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:

*Horizontal distance = Slope distance$\times$Cos($\alpha$)*

Where $\alpha$ = slope angle in degrees.

Sloping distance = 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 correctionsfor distances on slope are required.

### 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, recordthe 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.



Suunto clinometer

Targeted tree

*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



1. Needle with red end that points to magnetic north
2. Direction-of-travel arrow for pointing to target and when moving
3. Baseplate with straight edges and scales for working on map
4. Bezel with directional scale for using as a protractor
5. Rotating capsule for setting direction to target
6. Bearing index for reading numerical bearing from bezel
7. Orienting lines used to align capsule with meridian lines on map
8. Orienting arrow for aligning with needle to find direction to target
9. Clinometer for measuring vertical angle
10. Center line for aligning target and compass
11. Notch, mirror and hole for precise sighting of an object

*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 thetime 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     INVENTORY TYPE

[inventory_type]

Record the code to indicate the type of plot data collected, using the following codes:

| When collected: | All plots | |
|---|---|---|
| Field width: | 1 digits | |
| Tolerance: | No errors | |
| Values: | Code | Definition |
| | 0 | Training: Test data only |
| | 1 | Standard plot |

| | 2 | Cold check |
| --- | --- | --- |
| | 3 | Hot check |

### 6.3.5 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 |

### 6.3.6 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 access – 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. |

### 6.3.7 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 3.1.3ESTABLISH 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 inSection 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 LAND FEATURE STATUS

[lf_status]

Three potential cases can occur, depending on the presence of one of more land feature within a plot as described in p. 24). 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 are present, you must select which the subplot centre best represents your land feature.

| 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

[lf_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 | >5ha |

### 7.1.4    OWNER GROUP

[lf_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. |
| | 10 | Private Forests - Trees growing in lands belonging to individuals, families, communities, other than public land |
| | 99 | Unknown |

### 7.1.6  LAND FEATURE SERVICES

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

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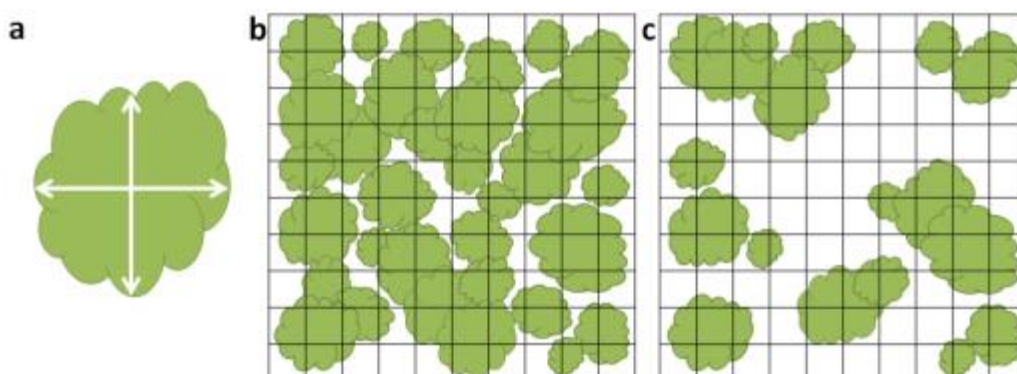
Crown cover considers the total area of crown where the crown is measured at its outer extremity (or drip line) (a). The CROWN COVER value should be representative of the entire land feature and is assigned based on a range over two fields: Min and Max. Sketching the CROWN COVER on a grid as shown above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

### 7.1.7.1 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 |

| | 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 7.1.2 - LAND FEATURE STATUS. 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.
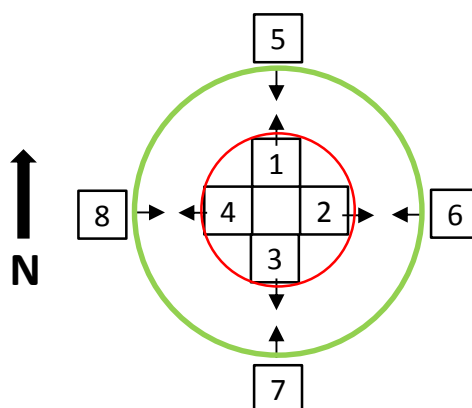


*Figure 26: Indicate the photo positon for each photo.*

| 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 agenatural 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 |

| | 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 ashouses, 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 m$^2$ (or an area of approximately 55 m$^2$).

| 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 (seeFigure 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    PROPORTIONINGLAND 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 features 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.
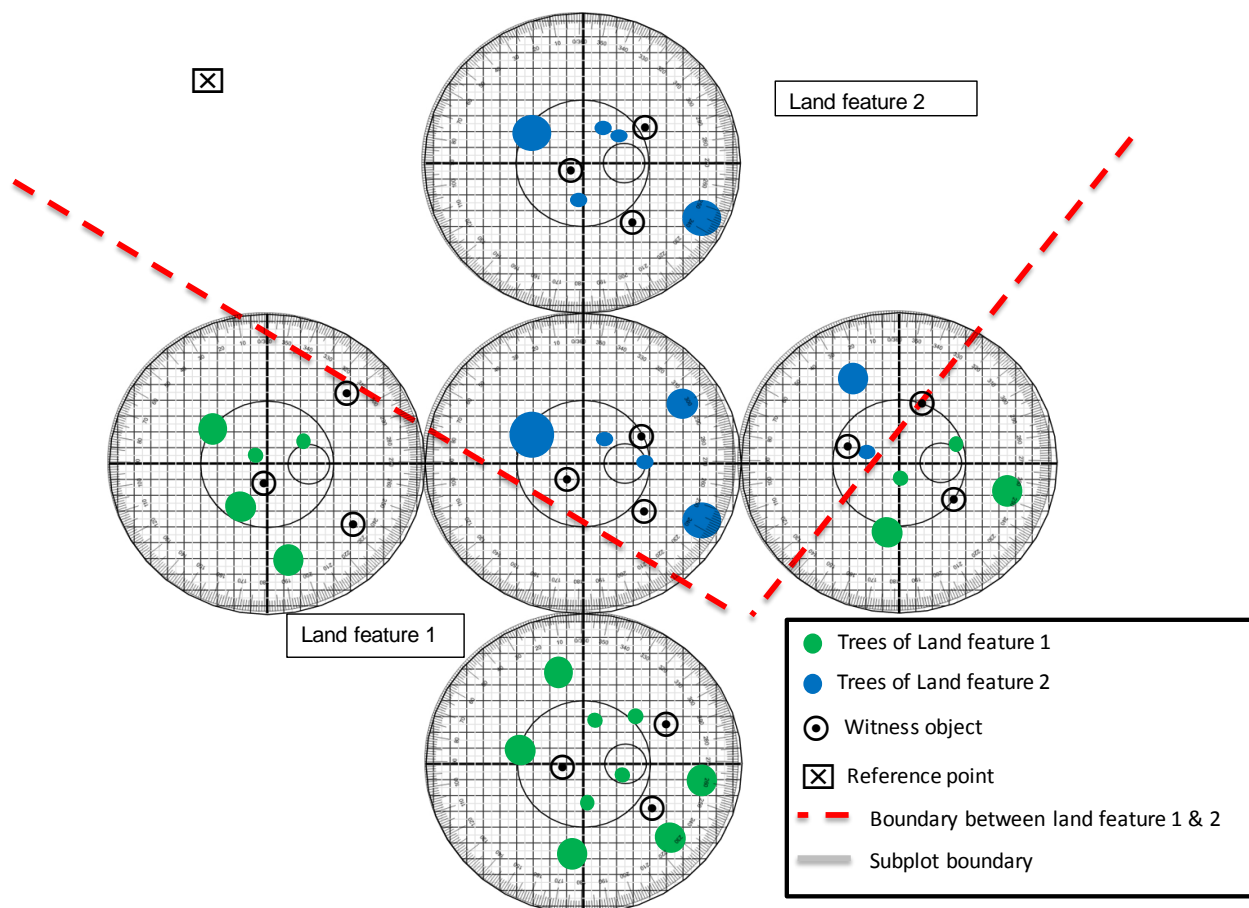


*Figure 28: Each complete square is 2 m x  2 m (4 m$^2$). Mark the squares are within each land feature, the boundary between land features, the intersections between the plot boundary and the land feature boundary.*

### 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 <u>Figure 28</u> 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 described in <u>Figure 28</u> and see  Section4 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 (<u>from subplot centre to witness object</u>), slope distance to the plot centre and a record note to describe the object are recorded for eachwitness 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     WOSLOPEDISTANCE (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 PICTURE

[wo_pic]

A picture of each WO is taken.

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

### 8.3.9    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 DETAILS

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 seedings (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 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 |

## 9.2    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 |

## 9.3    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 |

# 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.

<u>LOCATING AND ESTABLISHING LINE TRANSECT</u>

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.
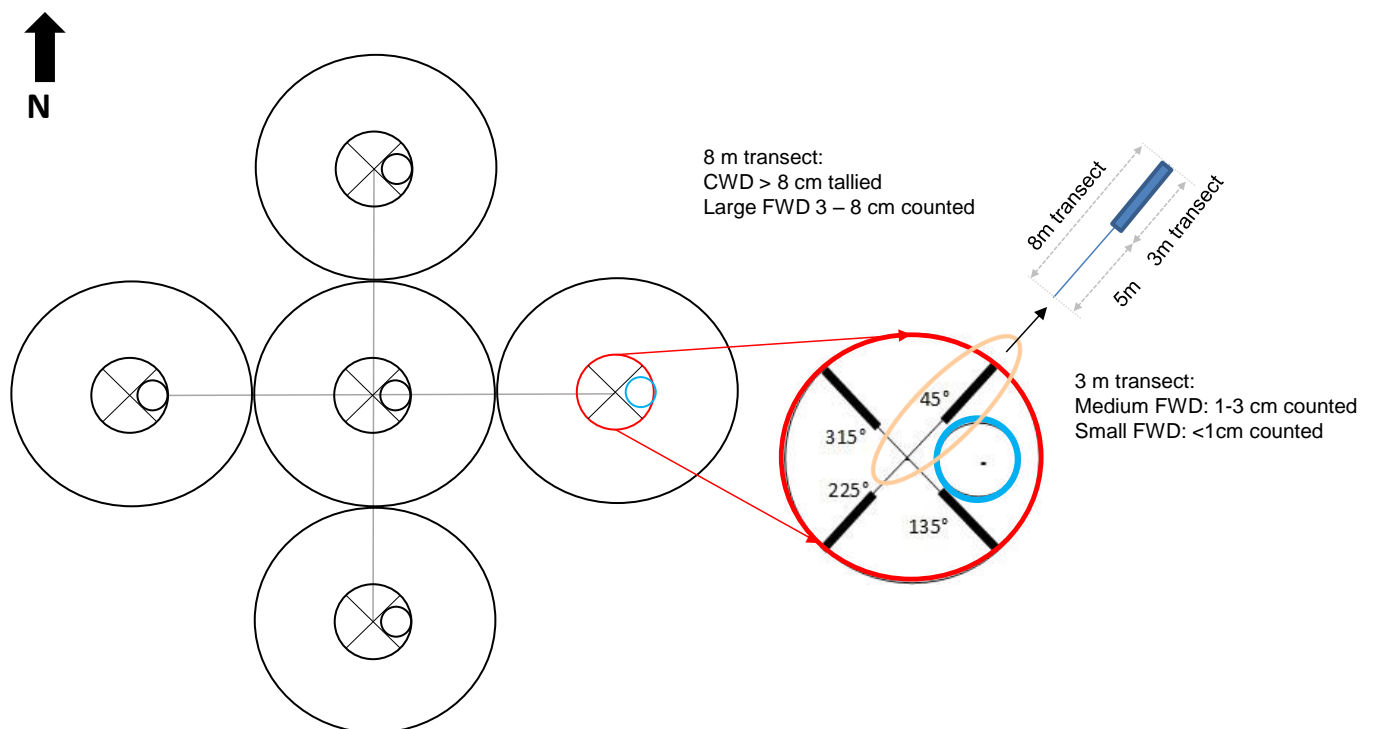


*Figure 29: Plot Diagram and S and M plot/transect details*

<u>SAMPLING OF COARSE WOODY DEBRIS (CWD)</u>

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.

<u>Coarse woody debris (CWD)</u> 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.
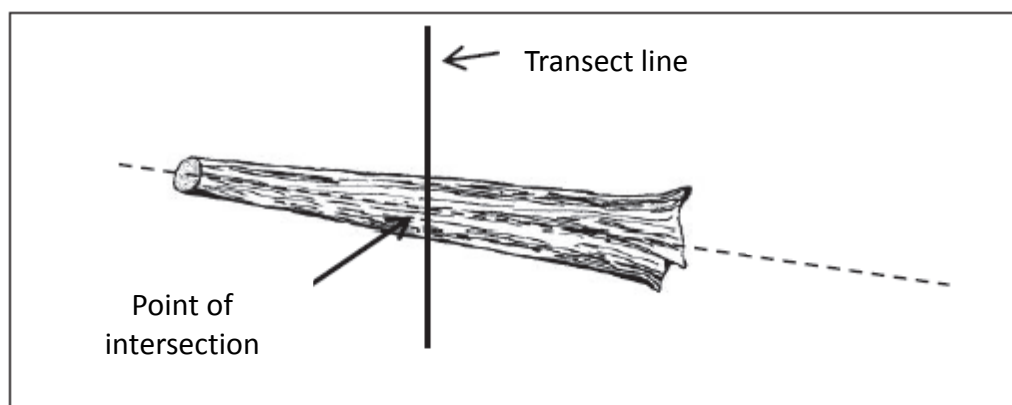
*Figure 30: Rule for surveying CWD.*

**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 >50.0 cm <br> 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 <br> 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 exceeds20, 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 |
| 1m x 1m Litter frame | Permanent marker |
| Large and small shovels | Small stool |
| Plastic Jar (500g) | 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) (seeFigure 31). A soil sample should be representative of the area from which it is taken to ensure accurate results.
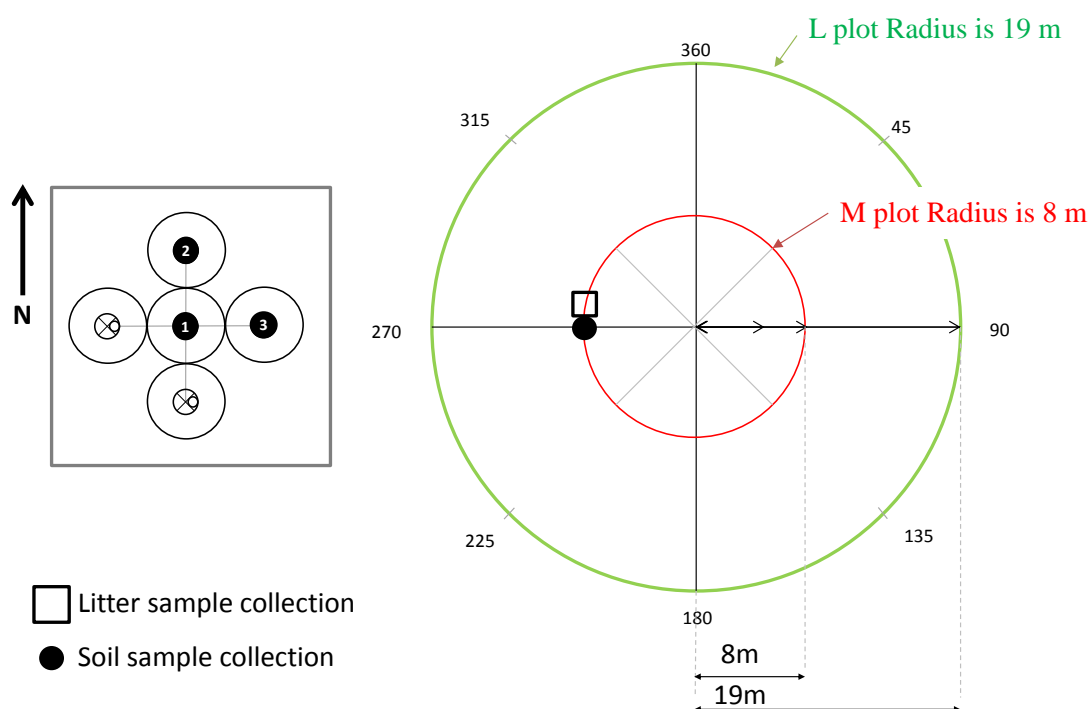


*Figure 31: Soil and litter samples are collected in subplots 1-3 in all zones.*

**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 no 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 TEXTURESAMPLE 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 examplefor 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 ppushing. 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 asPlot / 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 CORE 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 |

SUNDARBANS & COASTAL                    OTHER ZONES

0 – 15 cm      → 5 – 10 cm              → 5 – 10 cm

15 - 30 cm     → 20 – 25 cm            → 20 – 25 cm

30 - 100 cm

               → 65 – 70 cm

*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 littlefurther 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 coresas 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 jor or zip lock bag.
7. Label it with permanent marker asPlot / Subplot/Depth/BDC/Land Feaure 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 AND SAPLINGDETAILS

This chapter describes how and where to sample live trees, standing dead trees (snags) and saplings. 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, saplings 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 diameterand height.

| When collected: | All live saplings 2.0 < 10.0 cm in S Plot; 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.
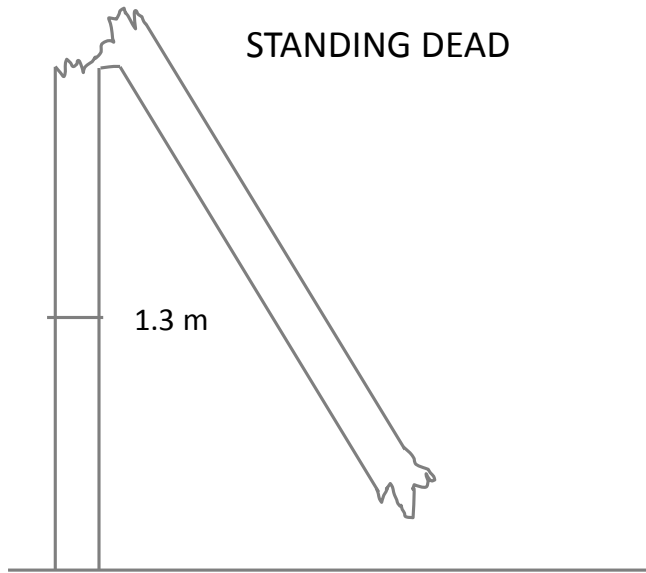


*Figure 36: Example of an unbroken bole to 1.3 meter = STANDING DEAD*
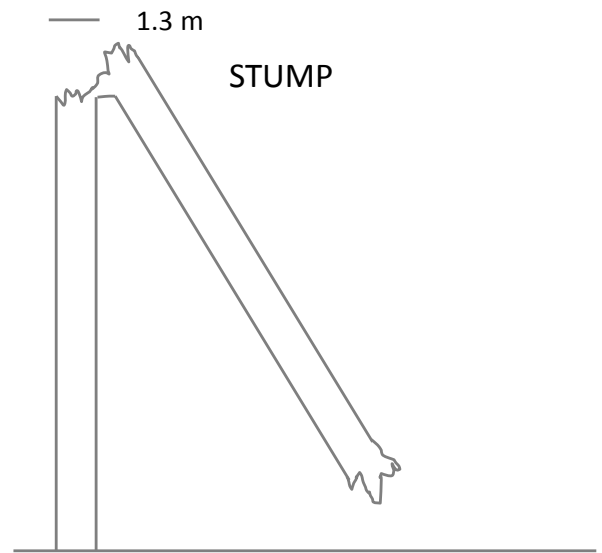


*Figure 37: Example of a broken bole of less than 1.3 meter = STUMP*
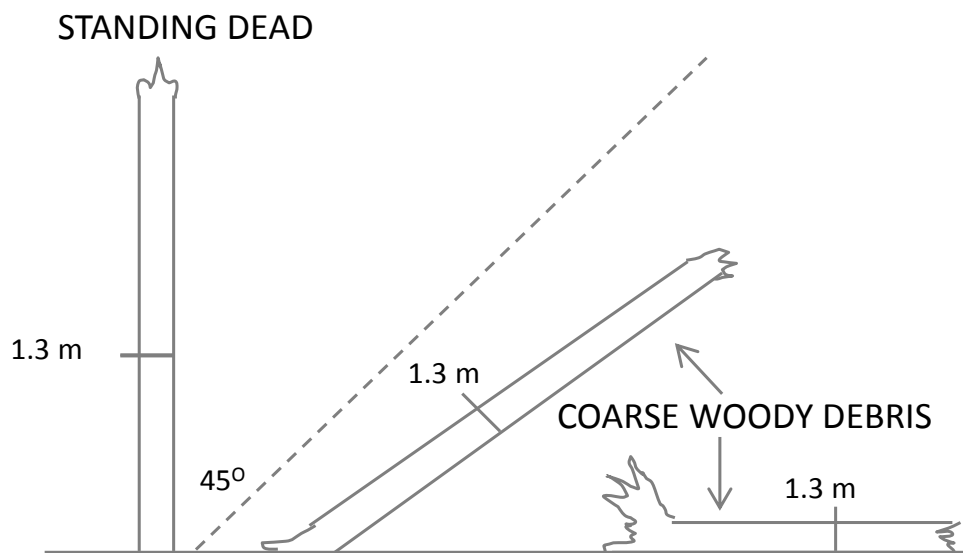


*Figure 38: Other examples of dead trees*

## 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, provideany descriptive details here and consult withthe 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'sFORM 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    PHOTO 4: DATA FORM

[tree_unk_pic3]

If the tree is recorded as "Other" or "Unknown", fill out form F14 and take a photo of the completed form.

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

## 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) or S Plot center (for trees greater than or equal to 2.0 cm and less than 10.0 cm DBH) to the pith of the tree at the top of the root collar.

| When collected: | All live tally trees ≥ 2.0 cm DBH and standing dead trees ≥ 10.0 cm DBH and saplings 2.0 < 10.0 cm from S Plot centre |
|---|---|
| Field Width: | 3 digits |
| Tolerance: | S Plot: +/- 0.1 meter |
| | 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 ($\geq$10 cm dia) and L ($\geq$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.
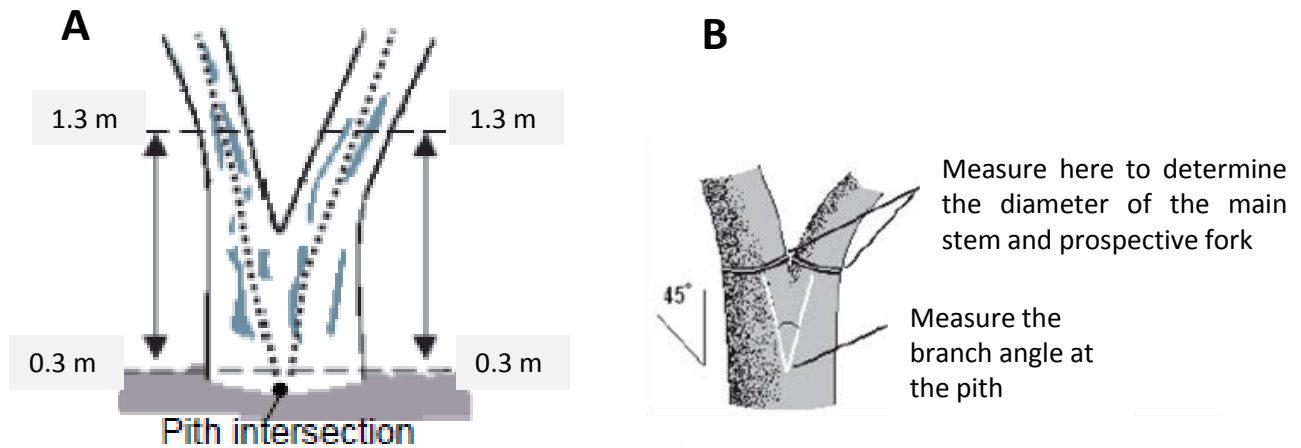
Figure 39: (A) Method for trees forked below 0.3 m; (B) Method for trees forked between 0.3 and 1.3 m.
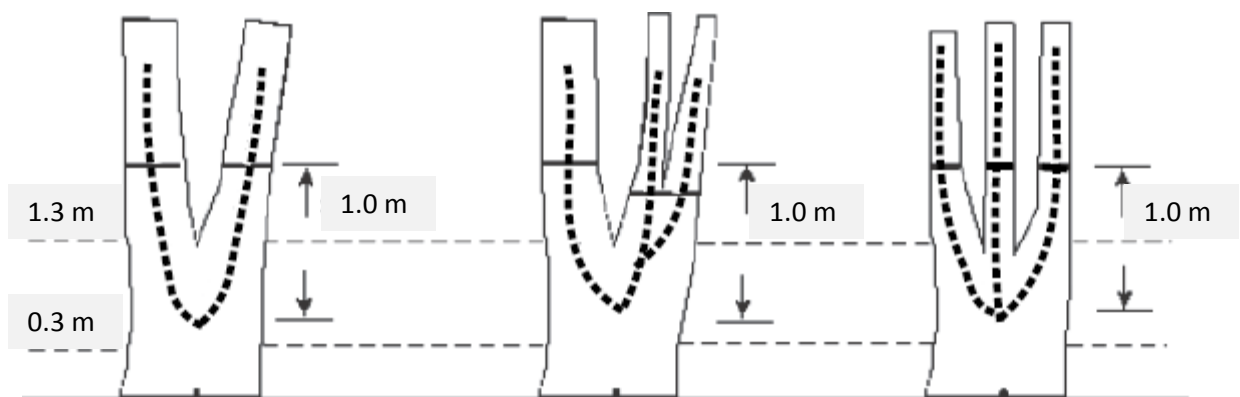


Figure 40: Method for trees forked above 0.3 m.

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.
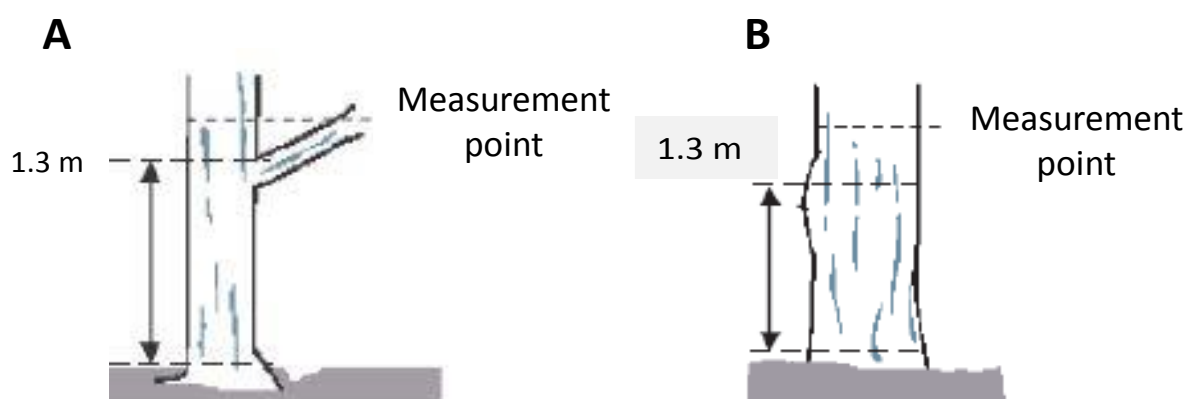


*Figure 41: (A) Method for trees with a branch at 1.3 m; (B) Method for trees with swells at 1.3 m.*

### 12.8.1    DIAMETER AT BREAST HEIGHT (CM)

[tree_dia]

Unless one of the special situations described in section12.8.1  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 cmincrement 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 mostportion 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 = 2and DBH $\geq$ 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]
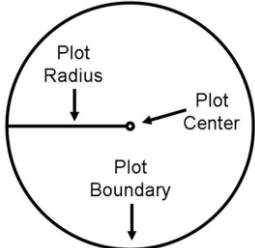
Record the time the team finished recording data on the plot.

| 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.<br>Explanatory notes:<br>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.<br>2. Includes coppice from trees that were originally planted or seeded.<br>3. Includes rubber wood and non-food tree plantations.<br>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 |  |

| | |
|---|---|
| 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.<br>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
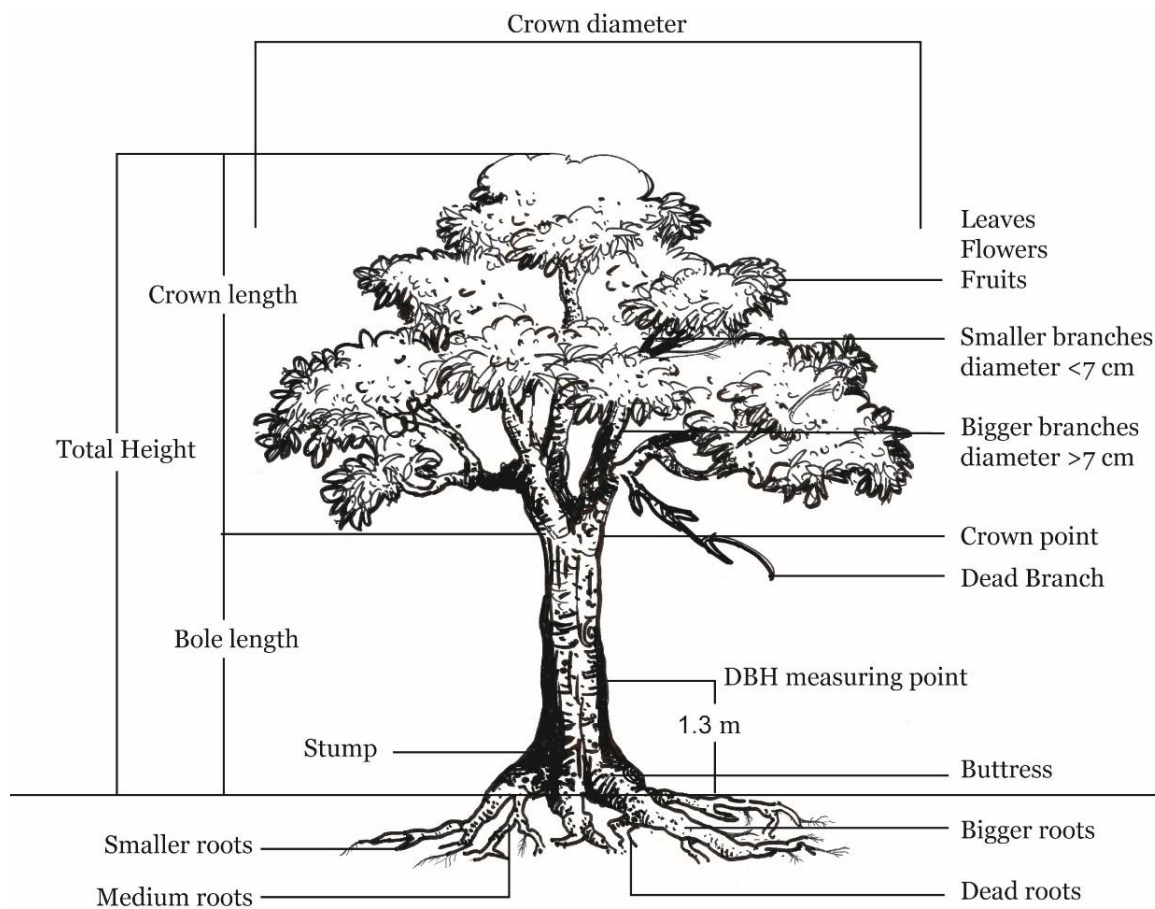
## APPENDIX 3. SLOPE CORRECTION TABLE

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 |

93

| Slope (%) | Slope (°) | Cos (α) | Slope (%) | Slope (°) | Cos (α) | Slope (%) | Slope (°) | Cos () |
|---|---|---|---|---|---|---|---|---|
| 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

| 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 | |
| Densiometer: GRS Densiometer™ | 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** | | |
| 50 cm (length) galvanized 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 | 1 | Bulk density - C organic sampling |
| Shovel and Garden Shovel | 1 | To extract soil |
| Plastic Jar small and medium size | 20 | 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 | 10 | 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

| PLOT DATA COLLECTION (6) | | |
|---|---|---|

**PLOT RECORD (61)**

| PLOT NUMBER (611) | | INVENTORY DATE (612) | | /        / |
|---|---|---|---|---|
| ARRIVING FROM (613) | ☐1 FD Field Office: | ☐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) |
|---|---|---|
| | | |
| INVENTORY TYPE (634) | ☐1 Standard  ☐2 Cold check  ☐3 Hot check ☐4 Training ☐0 Test | |
| PLOT STATUS (635) | ☐1 Sampled completely  ☐2 Partially sampled  ☐3 Inaccessible plot  ☐4 Not sampled | |
| NONSAMPLED REASON (636) | ☐1 Accessible ☐2 Denied access ☐3 Hazardous ☐4 Restricted access ☐5 Inaccessible ☐6 Skipped visit ☐7 Other: ……………………………………………………… | |

**REFERENCE POINT (RP) (64)**

| RP SUBPLOT (641) | ☐1 N ☐2 E ☐3 S ☐4 W | RP TYPE (642) | ☐1 Tree ☐2 Electricity Pole ☐3 House/structure ☐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) | ☐1 FD Field Office: | ☐2 Another plot/ Other: | |

| PLOT NOTE (144) |
|---|
| |

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[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 |
| P | Po | Pond/ Ditch |
| DFO | Fo | Decentralized Forest Office |
| △ | Mq | Religious Place: Mosque, Church, Temple etc. |
| ══════ | Rv | River/ Stream |
| ======== | C | Canal/ Channel |
| ★ | Ep | Electric Pole |
| ▢ | F | Park/ Sports Field |
| R | Rs | Rural Settlement: Cluster of houses |
| M | M | Market Area |
| ⟶ | | Trajectory/Direction |

Note:

| LANDOWNER CONTACT FORM |
|---|
| Include a record of conversations with a plot landowner/contact. While not a part of the official plot record, this information documents that permission was obtained. |

**N**

| PLOT NUMBER (611) | | | |
|---|---|---|---|
| **LAND FEATURE DETAILS (71)** | | | |
| LAND FEATURE (711) | | LAND FEATURE STATUS (712) | 1 Centre subplot 2 North subplot 3 East subplot 4 South subplot 5 West subplot 6 Outside plot centre |
| SIZE OF LAND FEATURE (713) | ◯ < 0.5 ha     ◯ >5 ha | | |
| OWNER GROUP (714) | 1 Private 2 Forest Department 3 Government 99 Unknown 96 Other | | |
| LEGAL STATUS (715) | 0 Not protected 1 Reserved Forest 2 Protected Forest 3 Vested Forests 4 Acquired Forests 5 Un-classed State Forest 6 Protected Areas 7 Notified Area 8 Coastal Afforestation 9 Social Forest 10 Private Forests 99 Unknown | | |
| LAND FEATURE SERVICES (716) | 0 No data 1 Fruits 2 Rattan 3 Plant medicines 4 Dying 5 Wildlife 6 Beekeeping 7 Windbreak. 8 Education and Research 9 Recreation 10 Cultural / Spiritual 11 Merchantable Timber 96 Other: ……………………………………………………………………… | | |
| MIN CROWN COVER (7171) | 01 02 03 04 05 06 07 08 09 0100 | | |
| MAX CROWN COVER (7172) | 01 02 03 04 05 06 07 08 09 0100 | | |
| LAND FEATURE ISSUES (718) | 0 Not existing 1 Over grazing 2 Water pollution 3 Fire 4 Erosion 5 Landslide 6 Drought 7 Waterlogging 8 Flooding 9 Pests/Insect/Fungus 10 Cyclone/tidal Surges damage 11 Illicit felling 12 Leaf collection 13 Storm damage 14 Siltation 96 Other:……………………………………………………………….. | | |
| FIRE (7181) | 0 No fire 1 Recent fire 2 Old fire | | |
| EROSION (7182) | 1 No 2 General 3 Sheet 4 Rill 5 Gully 6 River | | |
| IMPACT (7183) | LAND FEATURE ISSUE… | LAND FEATURE ISSUE … | LAND FEATURE ISSUE … |
| *Slightly disturbed* | | | |
| *Moderately disturbed* | | | |
| *Heavily disturbed:* | | | |
| 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] | ARTIFICIAL-ITY[7](724) | OBJECT % OF COVER (725) | GROWTH FORM / AGE[8] (726) | MANAGE-MENT[9] (727) | TREATMENT[10] (728) | ROTATION[11] (729) | CROP (72101) | CULTIVATION STATE[12] (72102) | WATER SUPPLY[13] (72103) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
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**84 NON-VEGETATED DETAILS**

| OBJECT ID (721) | NON-VEGETATED OBJECT TYPE (7211[14]) | NON-VEG % COVER (7212) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**85 WATER BODY DETAILS**

| WATER BODY (7213)[15] | WATER SALINITY[16] (7214) | WATER % COVER (7215) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

LAND FEATURE NOTES (7216)

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[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

| 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 | | |
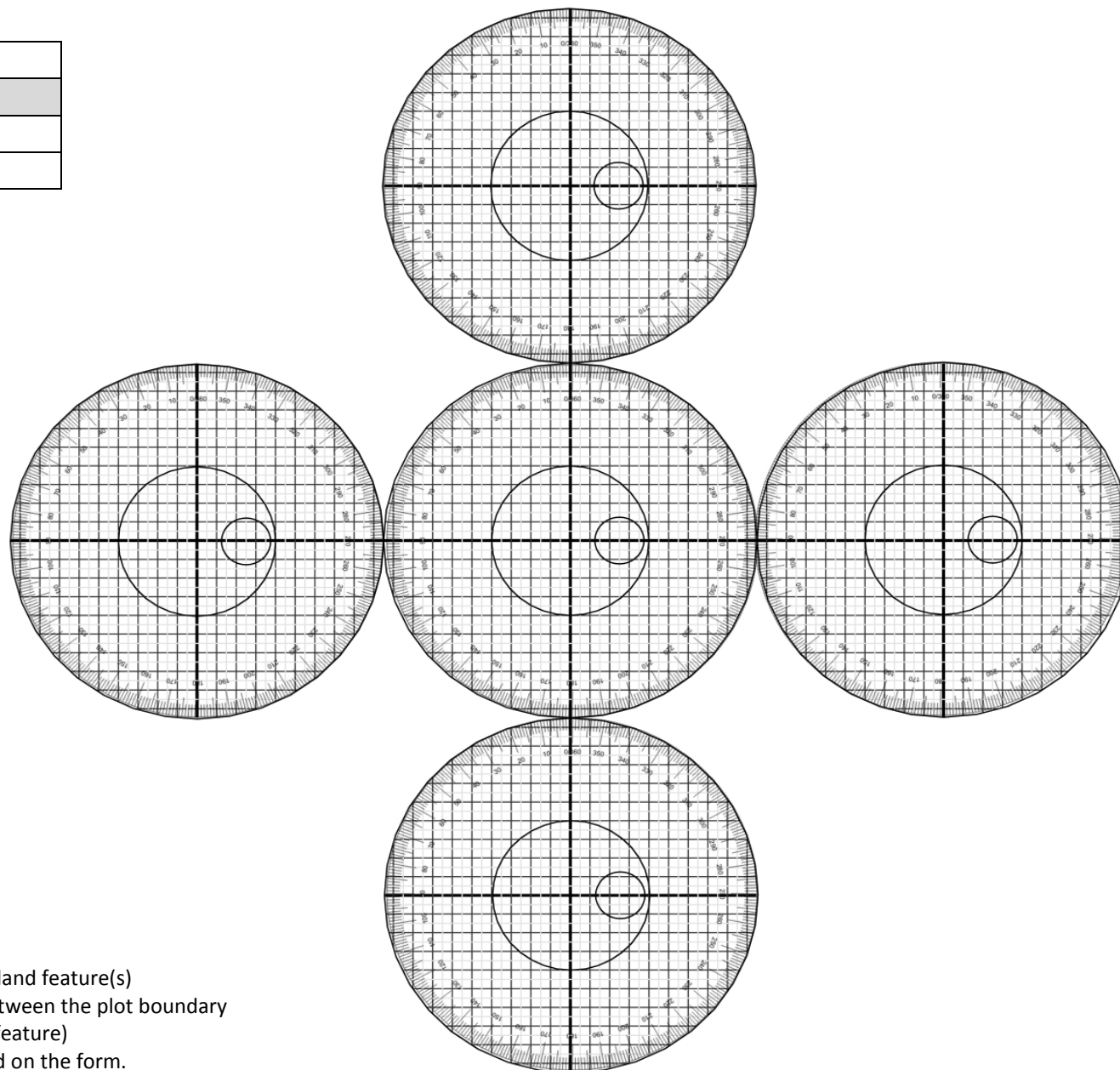
Indicate on the form the part of the subplot covered the land feature(s)

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)

● WOs ⊙ and RP ⊠ (if possible) locations to be indicated on the form.



102

| PLOT NUMBER (611) | | SUBPLOT NUMBER (811) | |
|---|---|---|---|

**SUBPLOT DATA COLLECTION (8)**

**SUBPLOT DETAILS (81)**

| | 1 Center subplot<br>2 North subplot<br>3 East subplot<br>4 South subplot<br>5 West subplot |  |
|---|---|---|
| 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: ………………<br>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 PICTURE (838) | | | |
| WO NOTES (839) | | | |

| PLOT NUMBER (611) | |
|---|---|

**SEEDLING DETAILS (9)**

| SEEDLING RECORD NUMBER (91) | SPECIES (92) | SEEDLING COUNT (93) | | | | |
|---|---|---|---|---|---|---|
| | | SUPLOT 1 | SUPLOT 2 | SUPLOT 3 | SUPLOT 4 | SUPLOT 5 |
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| SUBPLOT NOTES (84) | | | | | | |

| PLOT NUMBER (611) | |
|---|---|

**DOWN WOODY MATERIAL (10)**

**COARSE WOOD DEBRIS (101)**

| SUBPLOT RECORD NUMBER (811) | CWD ID(1011) | TRANSECT BEARING (1012) | LAND FEATURE NUMBER (1013) | CWD SLOPE DISTANCE (1014) | DIAMETER AT POINT OF INTERSECTION (1015) | DECAY CLASS (1016) |
|---|---|---|---|---|---|---|
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SUBPLOT NOTES (84)

| PLOT NUMBER (611) | |
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**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) | |
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**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

| PLOT NUMBER (611) | |
|---|---|
| SUBPLOT NUMBER (811) | |

**TREE AND SAPLING (12)**

| TREE ID (121) | LAND FEATURE NUMBER (112) | TREE STATUS (123) | SPECIES (124) | BEARING (126) | HORIZ. DIST. (127) | DBH.(1281) | HEIGHT TO MEASUREMENT POINT(1282) | TOTAL LENGTH (129) | BOLE LENGTH(1210) | TREE LENGTH METHOD[21] (1211) | TREE DAMAGE[22] (1212) | DAMAGE SEVERITY[23] (1213) | YEAR CUT[24] (1214) | DECAY CLASS[25] (1215) | NOTES (1216)[26] |
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[21]1: Laser Range Finder TruePulse or other hypsometer | 2: Clinometer tape | 3: Estimate
[22]0: None observed | 1:Insect | 2:Disease | 3: Fire | 4: Animal | 5: Weather | 6:    Vegetation | 7:    Human | 8: Physical | 96: Other
[23]1: Low | 2: Moderate | 3: Severe
[24]1: < 1 year | 2: 1-5 years | 3: 5 - 10 years | 4: >10 years
[25]1: 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) | |
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**BAMBOO (13)**

| CLUMP ID (131) | LAND FEATURE NUMBER (132) | SPECIES (133) | BEARING (134) | HORIZONTAL DISTANCE (135) | LENGTH (136) | LENGTH METHOD[27] (137) | DIAM. (138) | STEM NUMBER (139) | NOTES (1310) |
|---|---|---|---|---|---|---|---|---|---|
| **SUBPLOT 1** | | | | | | | | | |
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| **SUBPLOT 2** | | | | | | | | | |
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| **SUBPLOT 3** | | | | | | | | | |
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| **SUBPLOT 4** | | | | | | | | | |
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| **SUBPLOT 5** | | | | | | | | | |
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[27] 1: Laser Range Finder TruePulse or other hypsometer | 2: Clinometer tape | 3: Estimate

| PLOT NUMBER (611) | SUBPLOT NUMBER (811) |
|---|---|

**UNKNOWN SPECIES DESCRIPTION (125)**

| SUBPLOT NUMBER (811) | TREE ID (121) | PLANT FORM[28] | BARK[29] | LATEX[30] | LEAF TYPE[31] | FLOWER COLOUR[32] | FRUIT TYPE[33] | FRUIT SHAPE[34] | FRUIT COLOUR [35] | PHOTO NUMBER/S |
|---|---|---|---|---|---|---|---|---|---|---|
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UNKNOWN SPECIED DESCRIPTION (12.5.2)

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[28] 1. Tree | 2. Shrub | 3.Liana | 96. Other

[29] 1. Exfoliating | 2. Fissured | 3. Furrowed | 4. Plated | 5. Shredy | 6.Smooth | 7. Winged | 96. Other

[30] 1. Absent | 2. Present | 3.White | 4.Yellow | 5.Red | 96.Other

[31] 1. Long | 2. Round | 3.Palmate | 4.Lobed | 5.Opposite | 6.Alternate | 7.Pinnate | 8.Bipinnate | 9.Tripinnate | 96. Other

[32] 1. White | 2. Green | 3.Red | 4.Yellow | 5.Pink | 6.Violet | 7.Blue | 8.Purple | 9.Orange | 96. Other

[33] 1. Capsule | 2. Pod | 3.Berry | 4.Drupe | 5.Nut | 6.Pome | 7.Samara | 8.Silicula | 9.Caryopsis | 10.Follicle | 96. Other

[34] 1. Round |2. Cylindric | 3.Flat| 4.Ovoid | 5.Obovoid | 96 Other

[35] 1. White | 2. Green | 3.Red | 4.Yellow | 5.Pink | 6.Violet | 7.Blue | 8.Purple | 9.Orange | 96. Other

## 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 | Chittagomg 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 | Doivision Office | Barisal Coastal Forest Division |
| 158 | Non Forest | Sylhet Forest Divison | Sylhet | Division Office | Sylhet Forest Divison |
| 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 Divisiion, 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 | Gaurnadi 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 |
| 67 | Joypurhat | 117 | Kaliakoir | 167 | Sylhet SFNTC | 217 | Ukhia | 267 | Nursey  (USF) | 317 | Bhabaniganj |

| Code | Range | Code | Range | Code | Range | Code | Range | Code | Range | Code | Range |
|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|
| | SFNTC | | | | | | | | | | |
| 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 | Naikkhingchari | 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 |
| 85 | Sharsha SFNTC | 135 | Rasulpur | 185 | Hathazari SFNTC | 235 | Poli | 285 | Seed & Nursery , Khagrachari | 335 | Harhazari SFNTC |
| 86 | Magura HQ | 136 | Santoshpur | 186 | Raujan SFNTC | 236 | Boangchari | 286 | Ultachari | 336 | Rangunia SFNTC |

| Code | Range | Code | Range | Code | Range | Code | Range | Code | Range | Code | Range |
|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|
| | 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 | Araihazar 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 | 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 | Avoynagar 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 | Satkhamair |
| 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 | Daualatpur 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 | Gabtali 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 | Panchbibi 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 Afforeststion Division | 01828813575 | - |
| 2 | Mr. Md. Tariqul Islam | Q2 | Forest Guard, Sundarban East Forest Dvision, 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) | | |

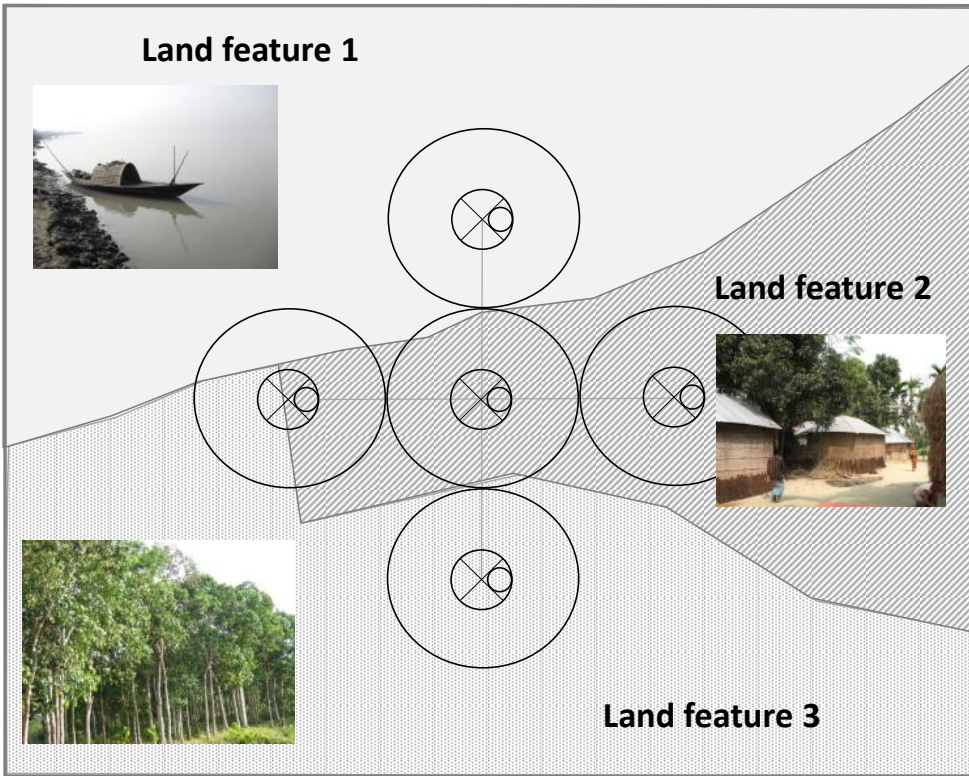| | | | | | |
|---|---|---|---|---|---|
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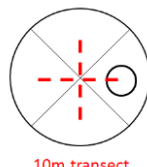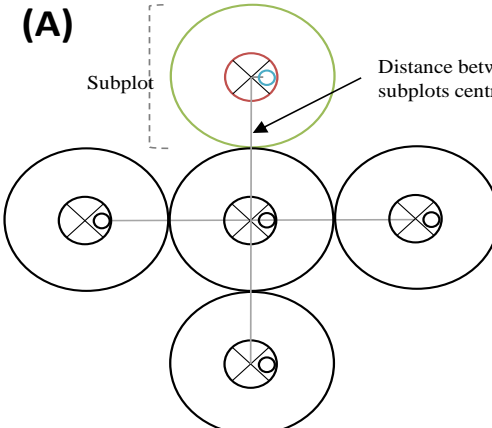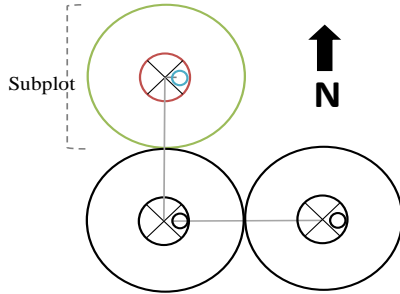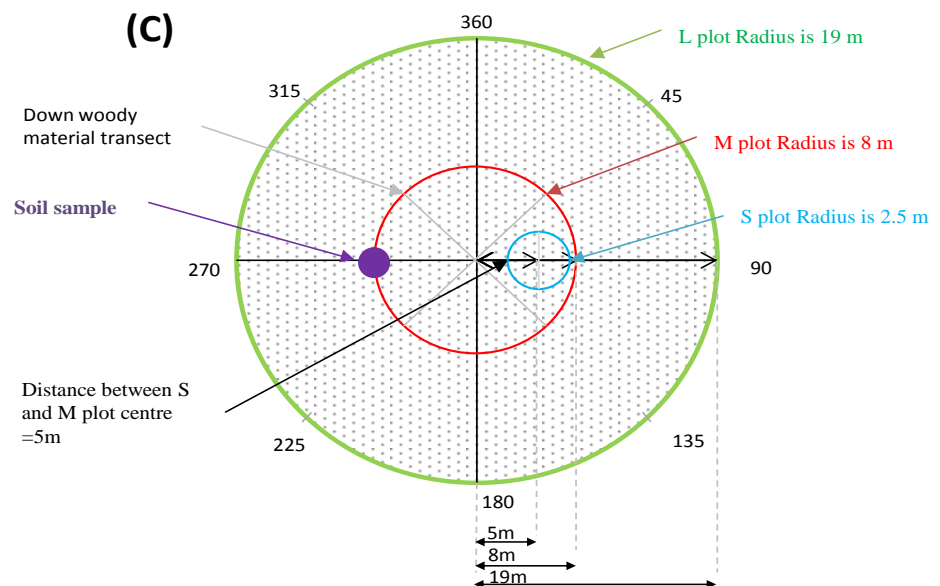| 12 | Mr. Masud Rana | T12 | Forester/Khagrachari Forest Division, Khagrachari | 01532682152 | - |
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**APPENDIX 12.** CHECK LIST FOR RECORDING INFORMATION ON THE PLOT
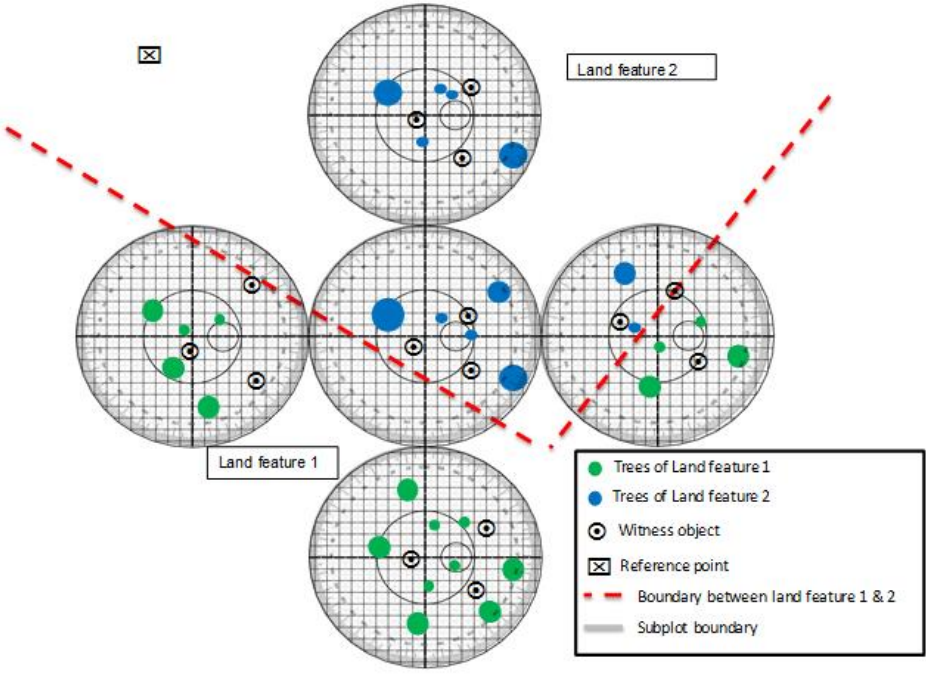
## Recommended work distribution for team members

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  | 4 and 7 |
| 7 | **Identify one (1) Reference point and record the following details:**<br>• Bearing RP to centre,<br>• HD,<br>• GPS coordinate<br>• If tree take DBH and species name<br>• Spray paint, metal tag at 2 meter<br>• Picture x 1 | 6.4 |

| | | | |
|---|---|---|---|
| | • Note | | |
| 8 | **Record Subplot information including:**<br>• Plot status<br>• SUBPLOT SLOPE (%)<br>• SLOPE ASPECT BEARING<br>• LEAF COVER - along two 10 m transect<br>• LAND FEATURE CLASS and area | M Plot<br><br>10m transect | 8 |
| 9 | **Record the leaf cover percentage using the densitometer**<br>10 m transects in north-south and east west direction either side of the plot centre | | |
| 10 | **Layout the plot:**<br>• 3 WO (make a triangle with 3 tree with the center )<br>• OBJECT TYPE<br>• IF TREE THEN<br>• SPECIES<br>• DBH<br>• BEARING<br>• SLOPE DISTANCE<br>• TREE TAG<br>• PAINT MARK AT THE POINT OF SLOPE DISTANCE MEASURED<br>• PICTURE<br>• NOTE | | 8 |
| 11 | **Record trees at the appropriate distance from plot centre respecting the L, M and S plot diameters**<br><br> | | 1.4 |

| | NESTED PLOT DIMENSIONS | THRESHOLDS FOR MEASUREMENT | WHERE TO MEASURE | |
|---|---|---|---|---|
| | **L PLOT** (19-meter radius) | All live and dea d 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 (*Ceriops decandra*) 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* | |

Take measurement for L plot including:
- Tree status
- Species
- Bearing
- HD
- DBH/ height to dia measurement
- Tree length
- Bole length (every 5th tree)
- Tree damage & decay class

| 12 | **Record data for Seedlings including:**<br>• Species name<br>• DBH<br>• Bearing from S plot centre (check the table for more information) | 9 |
|---|---|---|
| 13 | **Record details of coarse and fine wood debris along 4 transects (45, 135, 225, 315 degree)** | 10 |

| 14 | **If bamboo clump available collect the following information:**<br>• Bearing<br>• HD (Horizontal Density)<br>• Length<br>• DBH<br>• Stem number<br>• Bamboo note | 13 |
|----|---|---|
| 15 | **Record information for Soil:**<br>Collect soil samples from subplot 1, 2, 3 (figure 2, page 68)<br><br>• Soil texture sample<br>• Soil bulk density<br>• Take picture of the soil core, record soil depth of humus<br>• Label: plot no/subplot no/depth/sample type/Land Feature. | 11 |
| 16 | **Record information for Litter:**<br>1 m x 1 m plot, north from where the soil core is collected<br>Collect the dead leaves, flowers, fruits, seeds and bark fragments (excluding woody particles) | 11.4 |

| | | |
|---|---|---|
| 17 | **Complete the Land Feature Proportioning sketch** | 8.2.2 |
| |  | |
| 18 | **Undertake a final equipment check** | Appendix 4 |

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