

**FOREST AND NATURE CONSERVATION CODE OF BEST
MANAGEMENT PRACTICES OF BHUTAN**

**VOLUME II: NATIONAL FOREST RESOURCES
ASSESSMENT**



Department of Forests and Park Services

DEDICATION

A tribute to our benevolent Druk Gyalpo, His Majesty Jigme Khesar Namgyel Wangchuck, for His Selfless Service and Leadership to the People and Country





MINISTER

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ROYAL GOVERNMENT OF BHUTAN
Ministry of Agriculture and Forests
Tashichhodzong
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MESSAGE



I applaud the Department of Forest and Park Services for coming up with the Forest and Nature Conservation Code of Best Management Practices of Bhutan which is an updated version of the erstwhile Forest Management Code of Bhutan, 2004. The erstwhile code only covered sustainable management of Forest Management Units. However, with the shift of forest management paradigm to include other important aspects such as climate change, wetland and watershed management, biodiversity conservation & monitoring, agroforestry, payment for ecosystem services etc., a more comprehensive guideline has become imperative.

The revised *Code* broadens the scope of applicability covering wide range of contemporary forestry practices providing detailed guidelines on the technical aspects of forest resources management and biodiversity conservation.

The revision of the *Code* is timely and will play a significant role towards sustainable management of our forest resources especially in light of the global climate change and its anticipated impacts on our fragile mountain ecosystems. The *Code* will also take into account the application of advanced technologies in forest management and biodiversity conservation and will provide strong emphasis on monitoring and evaluation of forest and forestry programs which has always been our weakness.

The revised *Code* will also become handy to our colleagues in the field as it will serve as the single source of scientific guideline for all forestry management regimes in the country.

With the publication of this *Code*, Bhutan joins many countries who manage their forest through such technical guidelines. Our country now establishes a robust technical guideline for management of all forest resources in the country and I am confident that it will fulfill our aspiration of bringing all forest resources under sustainable management fulfilling the objectives of our National Forest Policy and the Constitutional mandate of maintaining 60% of forest cover all times to come.

I would like to commend the efforts and hard work of our colleagues in the Department of Forest and Park Services, particularly those who were involved in the revision of this *Code* and I hope this code will be useful to wide range of stakeholders outside of the Department as well.

Tashi Delek!

Yeshi Penjor



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SECRETARY

MESSAGE



I commend the Department of Forest and Park Services in bringing out the revised Forest and Nature Conservation Code of Best Management Practices of Bhutan which presents a comprehensive technical guideline for sustainable management of forest resources and biodiversity conservation in the country.

The intricate combination of several programs and activities on sustainable forest management and biodiversity conservation is fundamental to sustainable development, from their vital role as climate regulator, carbon sequestration and the vital ecosystem services they provide. Sustainable management of these forest resources are therefore essential if these benefits for the environment and societies are to be maintained for future generations. Such long-term feats can be achieved only if we are able to manage the huge forest base resources holistically.

Such holistic achievement can only be possible through a science based technical guideline - the *Code*. Its implementation will also ensure that the forests in Bhutan are managed through the integration of good science, research, technology and decades of forest management experiences.

The code also provides consistent and transparent approach to planning and implementation of sustainable forest management plans, conservation plans and activities at all levels and across all other cross-cutting management regimes. The *Code* now provides the deep nexus in making appropriate science-based decisions on several forestry and conservation issues.

I would like to congratulate the Department and in particular the technical working group members for coming up with this code which is a milestone in our effort towards sustainable forest management and biodiversity conservation.

I urge all relevant stakeholders, government and non-government, besides the colleagues of the Department of Forest and Park Services to actively use and implement the Code in managing our forest resources for the benefit of present and future generations.

Tashi Delek!

A blue ink signature of Rinzin Dorji.

Rinzin Dorji



DIRECTOR

དཔལ་ལྷན་འབྲུག་གཞུང་། སྐོམ་ནས་དང་ནགས་ཚལ་སྐྱོན་ལག། ནགས་ཚལ་དང་སྤྱིང་ཀ་ཞབས་ཏྲོག་ལས་ཁུངས།

ROYAL GOVERNMENT OF BHUTAN
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FOREWORD



Forests have always played a key role in the livelihood of Bhutanese and is intrinsically intertwined with the social, culture and tradition of our country. In view of its pivotal role not only on socio economic development but also on climate regulatory function through several means and vital ecosystem services, sustainable forest resources management has always played a key role in sustaining our natural forest resources. Bhutan is one of the few countries in the world that enshrines forest and environmental conservation aspects in its Constitution. Article 5 of the Constitution of the Kingdom of Bhutan reflects commitment to ensure that, in order to conserve the country's natural resources and to prevent degradation of the ecosystem, a minimum of sixty percent of Bhutan's total land shall be maintained under forest cover for all time. Bhutan also committed to remain carbon neutral at the 15th Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in 2009 in Copenhagen, Denmark. In addition, the Intended Nationally Determined Contribution (INDC) submitted in September 2015 towards finalization of Paris Agreement further re-iterated Bhutan's pledge to remain carbon neutral. Today with over 71% of the total land of Bhutan under forest cover (2,717,161 ha), forests form an important and indispensable national asset sequestering around 8.5 million tonnes of carbon,, generating continuous water flow to sustain our hydro power systems, providing timber and firewood resources to Bhutanese citizens etc.. Out of the total forest area (2,717,161 ha) about 33.29% (904,423.78 ha) fall within the Protect Area Systems (National Parks, Wildlife Sanctuaries and Strict Nature Reserve) and about 19.96% (542,346.32 ha) is managed as Forest Management Units, Community Forests and Local Forest Management Areas. Therefore, in order to fulfill our international commitment to remain carbon neutral and constitutional mandate of maintaining 60% forest cover for all times to come besides harnessing other benefits such as social, cultural, economic and ecosystem services, it is imperative that the Department possesses a *Code* outlining science based management of the overall forests and biodiversity resources which will enhance the productive and ecological functions of our forest ecosystems. This *Code* has been developed through integration of good science, research, technology and decades of forest management experiences. It gives me a great pleasure in congratulating the entire Technical Working Group involved in the preparation of this *Code*. This *Code* will definitely strengthen the sustainable forest resources management and biodiversity conservation practices in Bhutan for eons to benefit the present and future generations.

Tashi Delek!

Lobzang Dorji

INTRODUCTION

The assessment of resources (forest and biodiversity) is fundamental to provide essential data and information on forest and wildlife managers and decision makers to ensure appropriate prescriptions for sustainable management of forests and biodiversity. This Volume of the Code of Best Management Practices- Forest and Nature Conservation of Bhutan 2021 (hereafter referred to as the “Code”) describes the main method of resource assessment for Bhutan at the national level, namely for; (1) National Forest Inventory (NFI); (2) Forest Resource Potential Assessment (FRPA); (3) National Wildlife Survey; and (4) National Wetland Inventory (NWI).

NFI is a systematic collection of information on forest resources based on robust sampling design to gather information about growing stock of forests (increment, age, size, species, forest health and condition) for developing dynamic forest policies & programs, and to facilitate sound decisions for scientific management of forest. The forests play a critical role in providing non-wood goods and services such as wildlife habitat, recreational opportunities, climate regulation, carbon sequestration, hydrological recharge and nutrient cycling. Therefore, NFI constitutes an important exercise to understand the state of forest health and condition over time.

Similarly, Wildlife assessment gives knowledge on presence, distribution and population growth patterns of wild animals which is crucial for planning and evaluating wildlife status in the country. National wildlife survey has been carried out only for a few umbrella species which have provided understanding on population status, trends, viability, quality of habitat, conservation threats, and research needs for these animals. Therefore, such national surveys play a great role in understanding the overall wildlife ecology, diversity and their conservation status in the country.

The National Wetland Inventory is required in order to understand the types and number of wetland and their distribution within the country. This information is critical for the management and use of wetlands for conservation. This is also required to fulfill our commitments under the Ramsar Convention on Wetlands.

The forest resource assessments guide the forest managers in managing different forest resources with appropriate interventions as defined in the Volumes III- VI of this *Code*. All data generated from various forests resource assessment shall be stored in both digital and hard copies and deposited with the central data repository, UWICER and Forest Information and Management Section at Forest Resources Management Division (FRMD). The back up data shall be stored in respective functional divisions. The data shall be shared as per the data management and sharing Protocol of the Department.

Definition

Biodiversity refers to the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Blind check refers to a kind of check in which Quality Control team collect data of all variables from randomly or systematically selected plots in the absence of inventory crew and with no access to data collected by the crew.

Cardinal Directions refers to the four directions of North, East, South and West.

Cold check refers to a kind of check in which Quality Control team collect data from randomly or systematically selected plots in absence of inventory crew to validate with the data collected by crew.

Ecosystem refers to a community of living organisms in conjunction with the non-living components of their environment, interacting as a system.

Forests means land with trees spanning more than 0.5 ha with trees higher than 5 meters and a canopy cover of more than 10%. It doesn't include land that is predominantly under agricultural or urban land use.

Forest carbon stock refers to the amount of carbon that has been sequestered from the atmosphere and stored within the forest ecosystem, mainly within living biomass and soil, and to a lesser extent also in dead wood and litter.

Forest resource means the various types of vegetation normally growing on forestland, the associated harvested products and residue, including but not limited to shrubs, grass, logs, saplings, seedlings, trees and woody debris.

Hot check refers to the process of inspecting and assessing the quality of data collection wherein the Quality Control team visit randomly/systematically selected sample plots at an early stage to observe and correct any errors in the data collection processes.

Ramsar Convention or the Convention on Wetlands refers the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources which was adopted in the Iranian city of Ramsar in 1971.

Systematic sampling refers to a type of probability sampling method in which sample members from a larger population are selected according to a random starting point but with a fixed, periodic interval. This interval, called the sampling interval, is calculated by dividing the population size by the desired sample size. PS

Umbrella species refers to species selected for making conservation-related decisions, typically because protecting these species indirectly protects many other species that make up the ecological community of its habitat.

Vulnerability refers to the degree to which an ecosystem is sensitive to and unable to adapt to or moderate the consequences of climate change and other pressures/hazards on its ecological character.

Wetlands refers to flowing water in river, stream and spring with associated riverine wetland and riparian zone; still water, lake, pond and well and basin-type wetlands encompassing area of constant soil saturation or inundation with distinct vegetative and faunal community; and with area of swamp, marsh, fen, peatland, water body, with water that is static or flowing.

Wildlife refers to the animals and other living things that live in the wild.

Witness trees refers to those trees identified in each inventory plot to describe the location of plot center for future re-establishment of the plot center.

ABBREVIATIONS AND ACRONYMS

AAC	Annual Allowable Cut
BD	Bulk Density
BT FEC	Bhutan Trust Fund for Environment Conservation
CC	Carbon Content
CF	Community Forests
CP	Cluster Point
CWD	Coarse woody debris
DFO	Divisional Forest Offices
DoFPS	Department of Forests and Park Services
EC	Electrical Conductivity
FMU	Forest Management Units
FNCRR	Forests and Nature Conservation Rules and Regulations of Bhutan
FRMD	Forest Resources Management Division
FRPA	Forest Resources Potential Assessment
FWD	Fine Woody Debris
GI	Galvanized Iron
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
ICBN	International Code of Botanical Nomenclature
MCA	Multi-criteria analysis
MoAF	Ministry of Agriculture and Forests
MRV	Measuring, Reporting and Verification
NBC	National Biodiversity Centre
NCD	Nature Conservation Division
NEC	National Environment Commission,
NFI	National Forest Inventory
NFMS	National Forest Monitoring System
NSSC	National Soil Service Centre
NWI	National Wetland Inventory
PA	Protected Area
PC	Plot center
QAQC	Quality Assurance and Quality Control
RP	Reference point
RS	Remote Sensing
RSPN	Royal Society for Protection of Nature
SECR	Spatially Explicit Capture Recapture
SPAL	Soil and Plant Analytical Laboratory
TDS	Total Dissolved Solids
WMD	Watershed Management Division
WT	Witness Trees

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1. National Forest Inventory

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1. National Forest Inventory

1.1 Background

National Forest Inventory (NFI) is the procedure for obtaining information on the quantity and condition of the forest resource, associated vegetation and components and many of the characteristics of the land area on which the forest is located (Hush et al. 2003). Forest inventory forms the foundation of forest planning and forest policy (Kohl, 2016). There is a long history of forest inventories in the world wherein the traditional forest inventories were focused on timber production while modern forest inventories support a holistic view of forest ecosystems addressing not only timber production but the multiple functions of forests as well as the need to understand the functioning mechanisms of forest ecosystems (Lund 1998; Corona et al. 2003; Köhl et al. 2006; Corona and Marchetti 2007, Tomppo, 2010).

The forest inventories in Bhutan were mostly restricted to smaller area such as management inventory for Forest Management Units (FMU) and Community Forest (CF) management and there was no formal nationwide forest inventory until recently. The pre-investment survey of forest, which was conducted between 1974-1981 mainly focused on assessment of timber resources for development of forest industries and developing volume equations. The first NFI of Bhutan was conducted between 2012-2015. NFI involves the collection of a large range of variables on forest ecosystem, biophysical and socio-economic conditions. These information are important for planning, designing and implementation of national policies and strategies for conservation and sustainable use of forest resources. It will further help to understand the relationship between forest resources and users.

NFI is a very resource-intensive and time-consuming exercise and the use of remote sensing (RS) technologies offers rapid, reliable, and replicable data collection and processing. Therefore, integration of NFI and RS is very important to reduce cost but without compromising the quality of the data and precision of estimates. The integration of the NFI and RS shall help in monitoring forest cover for all time, carbon sequestration capacity and ensuring that our forest cover doesn't fall below 60% of the total geographical area as mandated by the Constitution of the Kingdom of Bhutan. NFI is also a requisite exercise of Measuring, Reporting, and Verification (MRV) component of National Forest Monitoring System (NFMS) of REDD+ program along with satellite land monitoring system. This section of the *Code* provides objectives, methods, roles & responsibilities and application of the NFI data.

1.2 Objectives

NFI provides information on the state and trends of forest resources, their goods and services, and other related variables that support forest management and utilization. The main objectives of NFI are to:

- Assess qualitative and quantitative status of Bhutan's overall forest resources in terms of the extent of area, growing stock and forest structures;
- Assess the broad and holistic view of land cover and land use;
- Assess the forest ecosystem health and vitality including the presence and absence of forest disturbance;
- Assess presence and absence of key biodiversity species, including forest growth and distribution of forest ecosystem;
- Assess the total forest carbon stock;
- Aide in formulating plans to incorporate national policies and strategies for sustainable use and conservation of forestry ecosystems in line with international conventions; and
- Monitor the forest ecosystem changes occurring over time.

The NFI shall continuously provide updated information about the state of forests to enable the Department to adopt appropriate scientific management regimes. This also helps in monitoring the state of our forests resources while simultaneously meeting the demand for both present and future generations. Further, this shall help in monitoring the changes in the growth and carbon stocks of forests as well as fulfilling our commitment to remain carbon neutral. It will also ensure that our forest cover does not fall below a minimum of 60 % of the total geographical area.

1.3 Responsibility

The Forest Resources Management Division (FRMD) shall technically guide coordination and implementation of NFI, while the field offices (Protected Area and Divisional Forest Offices) shall be entrusted with responsibilities of collecting data from the NFI plots. All field offices will use the standard inventory designs and data collection forms. The roles and responsibilities of the field offices are divided into four levels, namely Chief Forestry Officer (CFO), Data Manager, Crew Leader and Field Crews;

Office	Roles and Responsibilities
Chief Forestry Officer (principal coordinator of NFI field work)	<ul style="list-style-type: none"> ● Be a link between FRMD and field crews ● Constitute inventory crews/teams as recommended by FRMD to collect data from plots falling within his/her jurisdiction or allocated to concerned field divisions and parks ● Identify and appoint data manager for data management ● Identify and appoint crew leader who has the capability to lead the team ● Monitor the field work and ensure the timely completion ● Ensure transfer of data from Collect Mobile (inventory crews) to their respective Collect database ● Ensure timely cleansing of data in Collect database by Data Managers ● Ensure timely transfer of data at various levels ● Monitor the progress of the Inventory field work and ensure strict compliance to the data collection methodology and quality standards ● Ensure that the Inventory Crews observe safety guidelines during field work. ● Mobilize the fund (travel) for field work ● Plan and execute the field work based on the proposed work calendar in this document ● Collect inventory equipment and field gears from FRMD and distribute to the field crews ● Ensure that the field equipment and other government properties issued are used efficiently, well maintained and taken care off ● Coordinate and conduct consultation meetings with local government leaders and communities to garner their support for NFI field work ● Ensure delivery of above-ground understorey and soil carbon sample to FRMD. ● Ensure complete the work on time.
Data manager	<ul style="list-style-type: none"> ● Allocate the NFI plots to NFI crews under his or her jurisdiction ● Import the data into “Collect” database as and when received from the field crew ● Verify the data collected from each plot are properly imported into Collect Database ● Liaise with Crew Leader to ensure that the data collected are not lost ● Store and maintain data backup for each data received from inventory crew in raw form as well as collect format ● Cleanse the data received from inventory crews and submit a copy of raw and cleansed data to FRMD ● Ensure timely data collection and upload into Collect ● Check the data quality ● Ensure complete collection and compilation of data ● Remind crew leader to submit the data on a regular basis ● Deliver above-ground understorey and soil carbon sample to CFO. ● Complete the work on time.
Crew Leader	<ul style="list-style-type: none"> ● Plan and execute field work under the guidance of CFO ● Lead the field crew for execution of field work ● Coordinate and complete the field work on time ● Submit the data collected to data manager on a regular basis and maintain a copy of data submitted ● Mobilize support from the community and local leaders as may be required for field work ● Inform and update CFO of their whereabouts on a regular basis

	<ul style="list-style-type: none"> • Ensure safety and well-being of his/her crew members • Ensure that the field equipment and other government properties issued are efficiently used, well maintained and taken care off • Ensure the highest quality of data • Ensure proper division of responsibilities among crew members • Liaise with CFO in case of emergency situations during the field work • Ensure personal safety and safety of other crew members at all times • Maintain discipline of the highest standard expected of a civil servant and paramilitary agency • Complete the work on time.
Crew member	<ul style="list-style-type: none"> • Be duty bound to obey the instructions of the crew leader • Cooperate and support the crew leader and other crew members • Maintain discipline of the highest standard expected of a civil servant and paramilitary agency • Dutifully carryout whatever work that s/he is assigned by crew leader • Ensure that the field equipment and other government properties issued are well maintained and taken care off • Work as a team • Complete the work on time.

The details of activities and modality for implementation shall be as defined in the implementation modality, developed and agreed between field offices and FRMD. This modality shall be subject to periodic review to fulfil the emerging needs of the time.

1.4 Output

The NFI shall broadly provide updated information on the state of forests including National Forest Inventory and Carbon stock report.

1.5 Methodology

1.5.1 Sampling Design

The NFI shall use a systematic sampling design with sample plots laid systematically at 4 km by 4 km grid spread across the country regardless of land use and land cover classes. Each sample plot consists of a cluster of 3 plots, laid at L-shaped plots at 50 m apart transect and referred to as Elbow, North and East plots, as depicted on Figure 1.1.

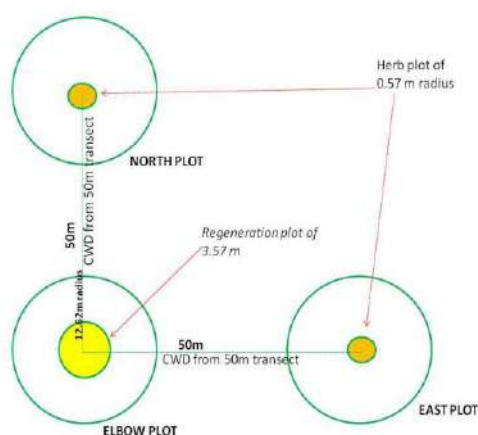


Figure 1.1 NFI Sample Plot

1.5.2 Quality Assurance and Quality Control (QAQC)

It is good practice to implement quality assurance and quality control for collection of scientifically sound and reliable data by adopting standard data collection methods, verification and checking for all possible errors.

Therefore, NFI field crews shall be trained on interpretation and application of field protocols, proper use of field equipment and data recording to minimize the data measurement and recording error. The data managers will verify each record of data submitted by field crews and ensure that all data are checked for completeness, errors and are ready for analysis.

The following QAQC measures will be put in place at various stages of the data collection and analysis.

1. Independent crews shall be formed to perform Quality Assurance and Quality Control (QAQC) and; visit and/or re-measure at least 5-10% of the plots measured by the original crews.
2. QAQC shall be conducted by FRMD and the plots shall be selected randomly from the total accessible/measured plots using randomization tools and approaches. The QAQC team shall perform both hot and cold checks and sometimes, blind checks.
3. The hot checks are inspections conducted as part of the training process by QAQC staff to provide immediate feedback to crew about their performance, both during the training and/or during the field work on their assigned plots.
4. Cold checks are inspections or remeasurements of plots that have been measured by field crews by the QAQC team in absence of the original field crew but with the data collected by crews as reference. The data collected by the original field crews are then compared with the data collected by the QAQC team from the same plot, and then errors shall be corrected accordingly to improve the quality of data.
5. Depending on the need, blind checks can also be performed. The blind checks are the remeasurement of the plots measured by the original crew but without the presence of original crew and also without the access to copy of data collected by the original crew. Unlike the two previous checks (hot and cold), the data collected by the crew shall not be corrected, rather this data shall be maintained separately as a means of assessing uncertainty in measurement.

FRMD will also continuously improve the inventory process by controlling, identifying, and documenting errors and source of the variability that could be detrimental to the quality of inventory results.

1.5.3 Preparation for field work

1.5.3.1 Planning and Preparation - General preparedness

It will be the responsibility of FRMD to coordinate and oversee the overall activities of NFI. Unlike the first NFI, in the second NFI, the FRMD will guide the field offices and provide technical support to field crews. It will be a joint effort of FRMD and field offices. Therefore, FRMD will provide overall guidance in terms of informing the field offices on timeline to complete the field work and also help the field offices in sourcing funds for the field works. FRMD will identify and assign total number of plots falling within jurisdiction of each field offices, which is worked out in Implementation Modality of NFI of Bhutan. Accordingly, the field office will have to prepare work plan and execute the field work in consultation with FRMD within the given timeframe. Safety of the crew should also be the top consideration while planning and implementing the field work.

First and foremost, the Crew Leader must acquire relevant topo maps (if needed) and shapefiles of the target areas. The Crew Leaders must select (in consultation with crew members) their camping sites in such a manner that maximum number of sample plots can be covered from that particular camp site so chosen.

Identify all possible approach points such as roads and footpaths to target plots. Also locate potential water sources, streams and rivers and mark them on the map for easy reference in the field. Refer Box 1.1 to find out your location topo map using GPS coordinates.

Then draw a travel itinerary or day-wise program, indicating the base-camp sites, the plots to be reached from each camp and the routes to be taken. This travel itinerary must be submitted to the respective field offices and then to FRMD. It is very important that both the field offices and FRMD are informed of the start dates and expected date of return.

The Crew Leaders must identify (in consultation with crew members) their camping sites in such a manner that maximum number of sample plots can be covered from the camp site so chosen. The Crew Leader must also ensure that his crew members are fully equipped with camp and field equipment, field gears, stores and rations, and any other necessary items which might be required in the field.

Additionally, the Crew Leader is entrusted with the responsibility to ensure that any confidential documents or maps being provided to the team should be kept under his personal custody. He must ensure that these items are not passed on or shown to any un-authorized person.

Some of the other important component of preparation like logistic arrangements, safety measures and survival and field equipment are discussed separately as sub-topics in the subsequent sections.

Logistic Arrangements

Logistic arrangement forms an important aspect of NFI field work. While it is the responsibility of FRMD to provide overall guidance and oversee NFI field work, it is the responsibility of the field offices and NFI crew to arrange porters and ponies required during camp shifting, besides arrangement of transportation for mobility. FRMD will not be responsible for day-day activities of field crews. Nonetheless, the day-day activity and work plan of crew should be shared with FRMD to provide overall guidance and facilitate smooth coordination and implementation.

FRMD and respective field office will arrange to provide tents, camping equipment and necessary field gears as far as possible while crews shall manage food items and rations for themselves at their own cost.

Safety Measures

Safety of the Crew must be ensured at all times and most of the preparation and planning components discussed earlier should be observed diligently for personal safety and to avoid wasteful journeys. The Inventory Crew must observe following safety measures at all times.

- The NFI Crew, specifically the Crew Leader will always report to Field Chief Forestry Officer and perhaps the FRMD contact point too, of their whereabouts during the field work.
- For facilitating communication, the Crew will carry personal cell phones. Change in phone numbers must be conveyed to respective field chief and to FRMD for record and access whenever necessary.
- For the purpose of NFI, the NFI Crew will observe the command of the crew leaders and perform the assigned responsibilities.
- The NFI Crew will walk in groups at all time while they are in the field and be observant of any hazards
- While moving into the field from the base camp, each individual must carry the following items of survival kit to prepare for any emergency situation:
 - i. Water bottle and water
 - ii. Match box or lighter
 - iii. Headlamp

- iv. Knife
- v. Survival kit
- vi. First aid kits
- vii. Any other item that will help surviving during emergency situation.

It is to be noted that though it is the responsibility of the Crew Leaders to ensure that their crew members maintain decorum in the camp, every individual is expected to conduct themselves in a manner appropriate of a civil servant.

Inspection of equipment

It is very important that the NFI crew inspects and checks the equipment for faults beforehand. The first inspection should be done prior to moving to the field. Should they find any faults, they must rectify and correct the equipment or have it replaced before moving to field.

The crew must ensure that their equipment which require power supply are fully charged (especially Tablet, GPS, Hypsometer & metal detector) to avoid any possible disruption of works in the field. Charging of equipment should be done preferably a day—before or the night before visiting the plot. All extra batteries should be fully charged. Final inspection of equipment should be done in the morning ensuring that all the necessary equipments are carried and all the equipment are in working conditions.

Failure to check and rectify faulty equipment will lead to undesirable disruption of work, which could be avoided.

The Crew Leader must ensure that the equipments are properly stored away from excessive heat (from sun, fire etc.), rain, water and other liquid items and from damage by trampling or crushing.

Box 1.1 Finding a location on map and slope correction

Locating Your Position on a Map.

Although for NFI field work, GPS will be used to navigate to the plots, it is a mustknow for every NFI crew members to know how to read map and locate their own position on the map. For map reading, two simple fundamentals are involved;

1. Converting minutes (graticules) of topo maps into distance units (cm)
2. Plotting the minutes of GPS onto the map by converting minutes into distance units (cm)

Steps for locating your position in map:

1. Switch on the GPS to find out your location coordinates i.e latitude and longitude of your current position in GPS.
2. Take out the relevant topo map of the locality.
3. Measure the length (cm) between two 5 minutes graticule of latitude and then longitude.

Eg: For Longitude (E): 5 min=16.5 cm

For Latitude (N): 5 min=18.6 cm

4. Divide length by 5 to calculate the distance of one minute

One minute For Longitude (E):

$$16.5/5=3.3 \text{ cm}$$

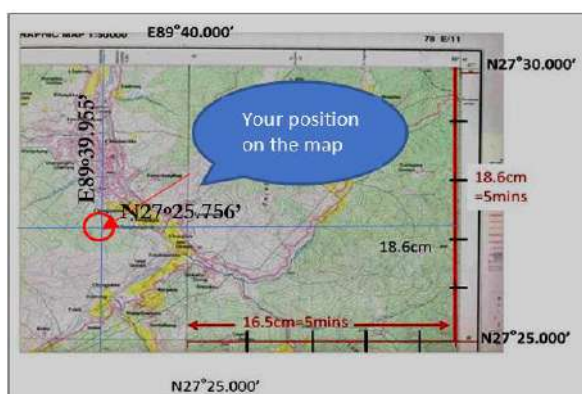
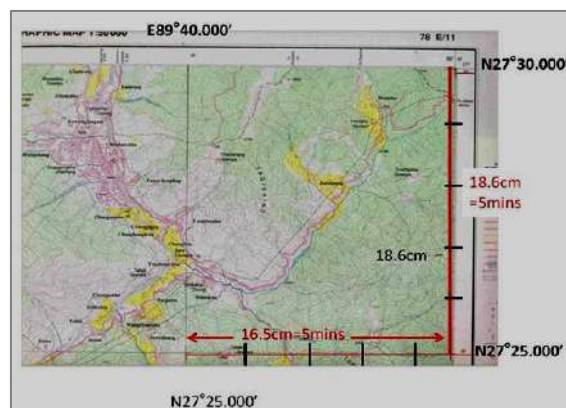
For Latitude (N):

$$18.6/5=3.7 \text{ cm}$$

5. If the GPS reads your position as **N27°25.756'** and **E89°39.955'**, to plot this position on the map:

For latitude $N27°25.756' = 0.756 \times 3.7 = 2.79 = 2.8 \text{ cm}$

For longitude $E89°39.955' = 0.955 \times 3.3 = 3.15 = 3.2 \text{ cm}$



After obtaining the distances,

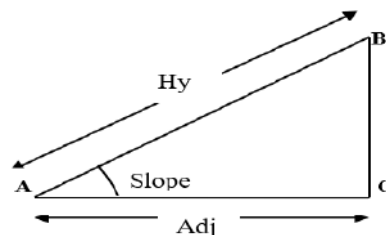
- Measure 2.8 cm from N27°25.000' graticule towards North and mark a point on the map.
- Then draw a line parallel to N27°25.000' graticule passes through this point
- Then measure 3.2 cm from E89°40.000' graticule towards West and draw a line parallel to E89°40.000' passing through this point.

6. The point of intersection of above two lines is your position on map as shown on the right.

Slope Correction for horizontal distances on slope

Slope distances are always greater than horizontal distances, which means for laying the 50m transect from Elbow to North and Elbow to East on a sloping ground, the distances have to be corrected for slope (gradient).

The relation between slope (in degrees) and the horizontal distance is;



$$\text{Cosine of Slope} = \frac{\text{Adjacent (Adj)}}{\text{Hypotenuse (Hy)}} = \frac{\text{Horizontal Distance}}{\text{Slope Distance}}$$

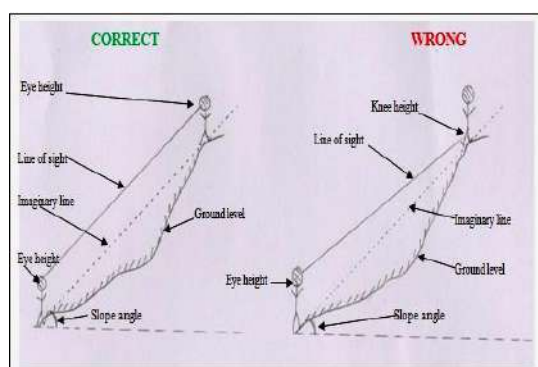
But, before applying Cosine function, the degrees of slope have to be converted to radians and to convert degrees to radians, simply multiply the degrees (of slope) by factor $\pi/180$. This has been applied to develop the slope correction table for slope in degrees since the clinometers (DP6Global) to be used for NFI provides slope reading in degrees and not as "slope percent".

To get slope distance, divide the Horizontal Distance (HD) by Cosine value of the slope (in radians).

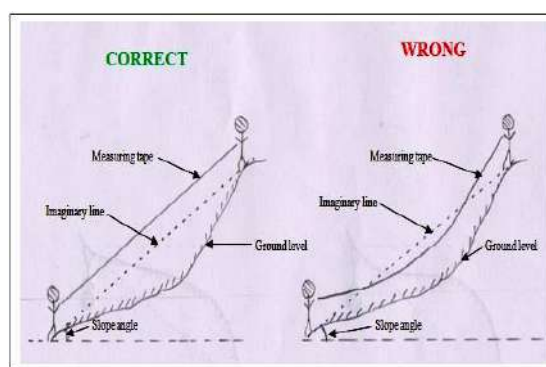
For instance, if an area has a slope of 20° and the horizontal distance that we require is 12.62m, then the Slope Distance (SD) we have to travel is 13.43m. This can be obtained from slope correction table. To read SD from slope correction table, take the reading/value under particular HD column that corresponds to particular slope (in degrees).

Slope (in Degrees)	Correction Factor	Horizontal Distance				
		3.57	10	12.62	20	50
1	0.9998	3.57	10.00	12.62	20.00	50.01
2	0.9994	3.57	10.01	12.63	20.01	50.03
3	0.9986	3.57	10.01	12.64	20.03	50.07
4	0.9976	3.58	10.02	12.65	20.05	50.12
5	0.9962	3.58	10.04	12.67	20.08	50.19
6	0.9945	3.59	10.06	12.69	20.11	50.28
7	0.9926	3.60	10.08	12.71	20.15	50.38
8	0.9903	3.61	10.10	12.74	20.20	50.49
9	0.9877	3.61	10.12	12.78	20.25	50.62
10	0.9848	3.63	10.15	12.81	20.31	50.77
11	0.9816	3.64	10.19	12.86	20.37	50.93
12	0.9782	3.65	10.22	12.90	20.45	51.12
13	0.9744	3.66	10.26	12.95	20.53	51.31
14	0.9703	3.68	10.31	13.01	20.61	51.53
15	0.9660	3.70	10.35	13.06	20.70	51.76
16	0.9613	3.71	10.40	13.13	20.81	52.01
17	0.9563	3.73	10.46	13.20	20.91	52.28
18	0.9511	3.75	10.51	13.27	21.03	52.57
19	0.9456	3.78	10.58	13.35	21.15	52.88
20	0.9398	3.80	10.64	13.43	21.28	53.21
21	0.9336	3.82	10.71	13.52	21.42	53.55

Although reading slope value on a clinometer is fairly easy, it is very important to ensure that clinometers and measuring tapes are held correctly as illustrated below.



Aiming at "eye-height" for correct slope measurement



The measuring tape shall be straight and parallel to the slope, without sagging or twisting measurement

Note: In the absence of slope correction table, use the slope correction formula (cosine of slope) to calculate the slope correction.

1.5.3.2 Navigating to Cluster Plots

With general preparation for field work completed and having decided on which Cluster Plots to be inventoried, the crew will use GPS to navigate to the targeted Cluster Plots. Each Cluster Plot will have a unique pre-assigned Plot ID (eg. CP0001) and coordinates (Latitude and longitude) using which crew can navigate and locate the cluster plots. FRMD or crew leader will have uploaded these coordinates in to the GPS and will be provided to crews, who in turn will use the GPS to navigate to the Cluster Plots for field works. The crews are also encouraged to use supplementary applications such as SW Maps & Collect Mobile to navigate to the plot.

Crew must navigate to the Elbow Plot first, complete all the necessary data collection in Elbow, and then move to North Plot. For moving to North Plot, use compass for direction and traverse 50 m towards North with slope correction.

Upon completing the North Plot, go back to Elbow Plot and then traverse towards East Plot, as done for North plot. If the transect between the Elbow and any of the two Plots (North and East) cannot be laid because of rocky cliff or water bodies, GPS may be used to navigate to these plots. In such cases, Coarse Woody Debris data cannot be collected.

1.5.3.3 Relocating, monumenting, referencing and witnessing of Plot Center (PC)

There are two parts to locating the plot centre. The NFI crew will use the plot coordinates provided and uploaded in GPS to relocate the PC and establish the centre of plot by driving down Iron stake. After establishing the plot centre, take photograph of plot with SW Maps application and save by cluster plot name and plot type (e.g., if you take five photos in elbow plot of cluster plot 0001, then the photos should be named as CP0001_L1, CP0001_L2, CP0001_L3, CP0001_L4 and CP0001_L5). Relocating the plot centres of those plots which were accessed during first inventory is described below.

Relocating the PC

Unlike establishing PC during the first inventory and also for those inaccessible plots described above, relocating plot centres of accessible plots during the second and subsequent inventories shall be a bit tricky and challenging. There may be cases of poor referencing and witnessing of the PC as well as use of different equipments which will affect relocating the plots. The NFI crew shall use GPS to navigate to the plot and nearest point of PC which the GPS shall alert by giving 'beep' sound indicating that the crew has reached PC. Once in the plot, the crew shall then use metal detector to find the Galvanized Iron (GI) pipe used to monument plot centre during the first NFI.

The crew shall also be provided with tree information that includes tree number, diameter, height, distance from PC and azimuth from the PC to aid relocating the PC, besides reference point (RP) information from the first NFI.

The crew must try their best to relocate the PC. After relocating the PC, the crew shall then install PC tag (Stainless steel stake with circular aluminium tag) provided to them.

Establishing PC for Replacement Plots

If the crew fails to relocate the PC and find the GI pipe despite repeated attempts and the best efforts, the crew will re-establish the plot and PC using stainless steel stake. The failure to relocate the PC will be owing to various reasons such as faulty establishment of PC by previous crew, limited or poor satellite signals resulting in faulty readings by GPS, loss of GI pipe either through natural forces such erosion, landslide or through anthropogenic forces such as development works or purposely being removed by humans, etc.

However, the crew will establish the new PC (replacement plot) within 5 meters radius from the PC, since the crew will be provided with expected coordinates of the PC. Their GPS or Data logger will show the

distance from the PC. Before establishing the replacement plot, the crew may try to relocate N or E plots and use back bearing to relocate L plot. It is encouraged to spent atleast one hour to try and relocate the last inventory plot center.

Referencing the PC

Referencing of the plot is done to relocate the plots in future. Referencing the plot will be done with Reference structure or feature. The reference structure or feature is going to be useful mainly for tree-less plots with no trees. It can be any permanent structure or feature which can help in re-locating the plot and plot centre in future.

For plots with trees, the reference and witness tree forms can be same, which means the same trees chosen as witness trees can be reference structure/feature for the plot. Each plot should have a minimum of 3 reference structure, to allow triangulation methods to relocate the plot. However, exceptions can be applied under unavoidable circumstance.

Witnessing the PC

After relocating the PC for those plots accessed previously and laying replacement plots for those that could not be located and establishing PC for new plots (which were not accessed in the first NFI), the NFI crew shall establish Witness Trees (WT) for each PC. Witnessing of PC shall be done by fixing a square aluminum tags at the base on to the witness trees.

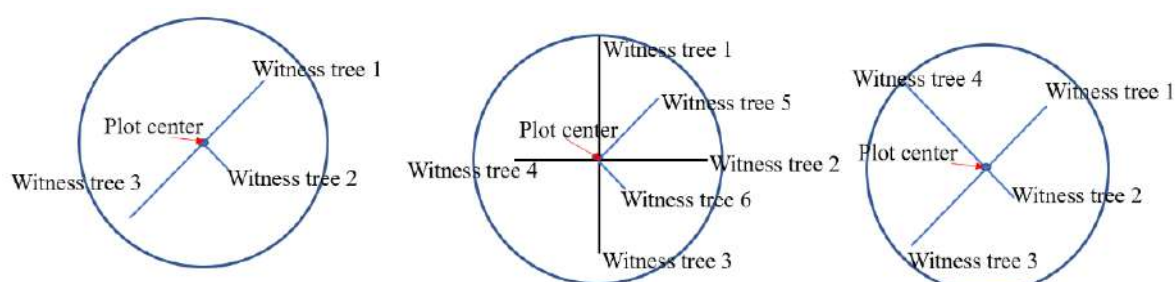


Figure 1.2 Configuration of witness tree

A minimum of 3 trees within the plot shall be chosen as witness tree, such that they are located around the PC and that they are not located in linear position about the PC. Preferably, when these 3 WT are triangulated, it should approximately form a right-angled triangle around the PC. After choosing the WT (live tree and not dead), the WTs are tagged with witness tags. The face of the witness tags should point towards the PC. For plots with less than three trees, all trees should be recorded as witness tree.

The witness trees should be easily seen from the plot center and be roughly within the plot radius. Choose witness tree 1 that is easily identifiable on the ground and as close as possible to the plot center. Then select witness tree 2 with a trajectory to plot center which is as close to 90 degrees from the witness tree 1, witness tree 3 with a trajectory to plot center which is close 90 degrees from the witness tree 2 and follows the same pattern. The witness trees are roughly at right angle to each other, which will help for relocation of plot center by triangulation in future inventories as depicted in Figure 1.2.

1.5.3.4 Establishing Plot

After monumenting the PC with Iron Stake, the crew will establish a circular plot of 12.62 m radius around the PC. The edge of the circular plot may be identified using the Hypsometer. The crew leader will stand at the PC and (using the hypsometer or measuring tape) determine the edge of 12.62 m radius circle boundary. The plot boundary should be marked by moving in a clockwise manner.

Where the vegetation is too dense to use hypsometer to determine the edge or boundary of the circular plot, measuring tape will be used to determine the boundary of the circular plot. If measuring tapes are used, then slope correction must be done for the distance measured.

Within Elbow Plot, establish a subplot having 3.57 m radius with Elbow PC as the PC for this sub-plot. This subplot is called regeneration plot. After establishing regeneration plot, the regeneration data will be collected prior to collection of other data to avoid trampling of regeneration data by careful observation while collecting other data. Likewise, a subplot of radius 0.57 m will be established within North and East plot, after establishing PC for North and East, called herb plot. Herb data will be collected prior to collecting other data in North and East plots for the same reason, as for regeneration data. The plot design is shown in Figure 1.1.

1.5.4 Field Data Collection and Protocols

The NFI field data collection shall be carried out by the field staff who are identified as NFI crew under the management guidance of field offices and technical guidance of FRMD. The data shall be collected from NFI cluster plots, based on standard protocols. The step-wise order and standard protocols for collecting data from the plots and subplots are detailed below;

1.5.4.1 Order of Collecting and Recording Data

After establishing plot, take a good photograph of plot. The Crew then start collecting data for Regeneration first. After completing collection of regeneration data, the crew will collect other data parameters in the elbow plot.

Data collection will start with Elbow plot, prior to that of North and East plots. The data recording will be done on the Android based Tablet, which will have the electronic field forms loaded on to it through Collect Mobile application.

In case, the Android Tablet fails to function, the crew will record the measurements or data on the paper data form with a pencil. The crew leader will ensure that writing is clear, neat and legible. Over-writing will be avoided at any cost. Instead, the data recorder should cancel any wrong entry with single strike line and corrected entry written at the side. Data manager will manually enter data collected in paper forms into Collect database.

The Inventory crews are to follow the following order of data collection and recording in the Plot of any cluster:

NOTE: In case, the Tablet fails to function, the crew shall record the measurements or data on the paper data form with a pencil. The crew leader shall ensure that writing is clear, neat and legible. Over-writing shall be avoided at any cost. Instead, the data recorder shall cancel any wrong entry with single strike line and corrected entry written at the side. Data managers shall manually enter data which are collected in paper form.

The Inventory crews are to follow the following order of data collection and recording in the Plot of any cluster:

1. Once the PC is located and established, identify the Reference Point (RP) and complete the 'Reference Point' form.
2. Once the PC is located and established, identify the Witness Trees (WT) and complete the 'Witness Trees' form.

3. In the Elbow plot, start the data recording 'Regeneration data' first and in North and East, start with 'Herb data' form.
4. Then fill in and complete Cluster Plot form. If the Elbow Plot is inaccessible, Cluster Plot form will be filled in North Plot, otherwise in East Plot. Likewise, for regeneration data form.
5. After that, fill in the Plot Description' form
6. While Plot Description Form is being completed, rest of the crew can start establishing the plot and measuring and recording the Tree data on a notepad.
7. Then fill in the Tree Data Form.
8. Upon completing the 'Tree data' form, complete the 'Sapling Data' form followed by 'Shrub Data' Form.
9. Then collect data on Wildlife (mammal, birds and reptiles) within the 25 m radius.
10. After completing the data collection from Elbow Plot, traverse to North plot (50 m away from the Elbow Plot Center). The 50 m transect should be slope corrected horizontal distance. On this 50 m transect to North Plot, collect and record data for Coarse Woody Debris (CWD). CWD shall be collected for 50 m transect to East Plot as well.
11. In the elbow plot, collect the data for fine woody debris (FWD) from 4 m transect at the outer edge of transect to North and East Plot.
12. Upon completing or parallel to these data collection, two individuals will collect data on aboveground understorey carbon which entails destructively sampling and collecting shrub and herb samples; and soil samples from carbon plot. Stepwise guidance and protocol for aboveground data collection is described in the subsequent chapters.

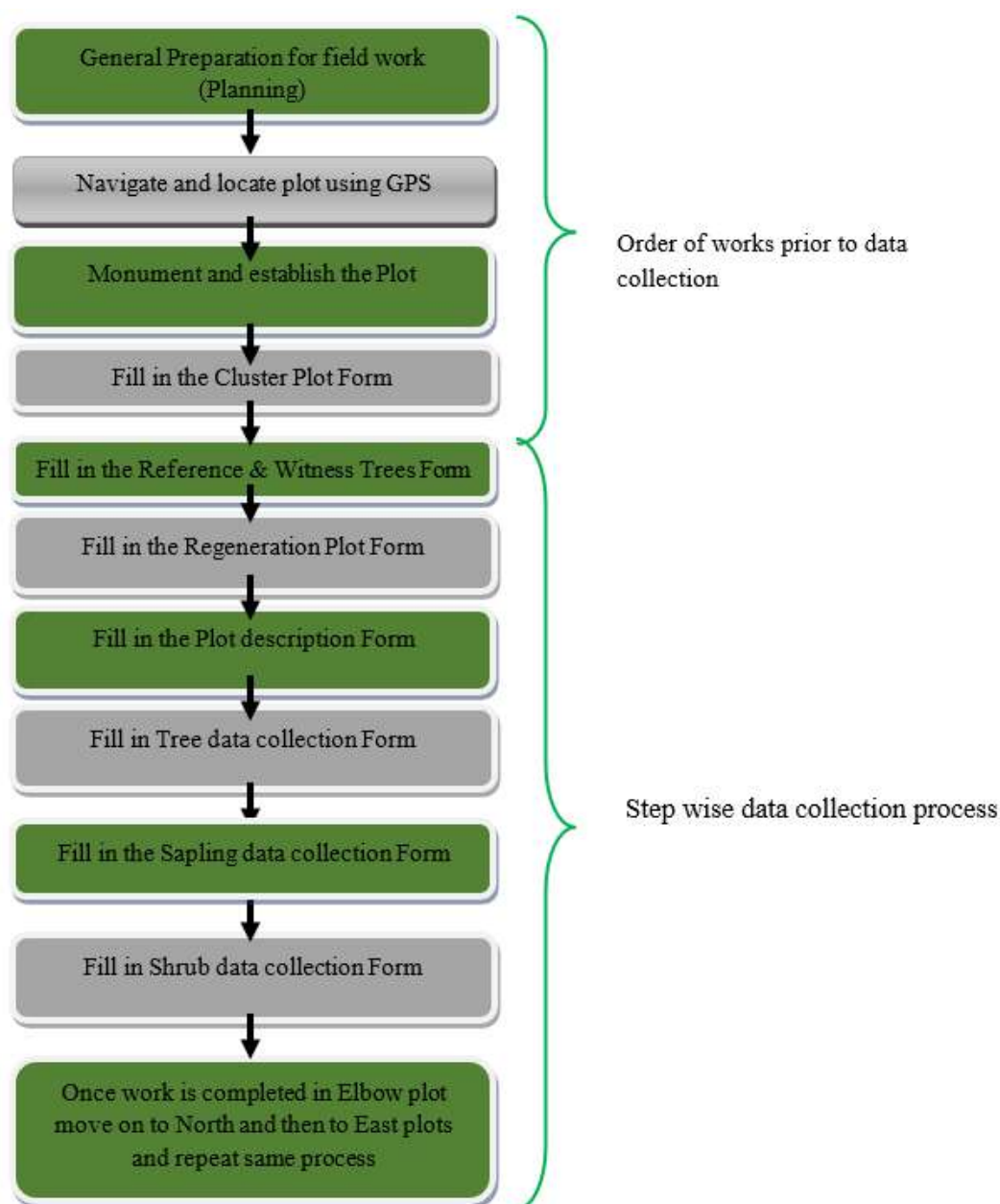


Figure 1.3 Flow chart illustrating the process of NFI field work

Note: In North and East plots, no Regeneration plot shall be laid. However, Herb data shall be collected in these two plots with 0.57 m radius circular plot (1 m²).

There are 18 data forms that need to be completed. Each of these data forms are assigned with form numbers. Form numbers shall not be visible on the electronic data form. Refer Table 1.1 for list of data collection forms used in NFI.

Table 1.1 List of data collection forms

Sl. No	Form	Form Number
1.	Cluster Plot Form	F1/18
2.	Reference Point	F2/18
3	Witness Trees Form	F3/18
4.	Regeneration Form	F4/18
5.	Plot Description Form	F5/18
6.	Tree Data Form	F6/18
7.	Sapling Data Form	F7/18
8.	Shrub Data Form	F8/18
9.	Herb Data Form	F9/18
10.	Mammal Data Form	F10/18
11	Bird Data Form	F11/18
12	Reptile Data Form	F12/18
13	Coarse Woody Debris	F13/18
14	Fine Woody Debris	F14/18
15	Shrub Sampling Form	F15/18
16	Herb Sampling Form	F16/18
17	Litter Sampling Form	F17/18
18	Soil Sampling Form	F18/18

1.5.4.2 Guidelines for Data Collection and Recording

1.5.4.2.1 Cluster Plot

Once the crew is in the plot, the Cluster plot information shall be collected from the Elbow plot. If Elbow plot is not accessible, the Cluster plot form shall be completed in North plot, otherwise East plot. Fill the form No. **F1/F18** for Cluster plot using information provided in Table 1.2.

Table 1.2 Collecting and recording Cluster plot (CP) data

SN	Data Item	Definition/Description	Instructions
1.	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001.	1. Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if data logger does not function in the field.</i>
2.	Date	Refers to date of day on which data is collected	Record the date by clicking on calendar icon next to the fill date.
3	Time	Refers to time of day when data for Cluster Plot is collected	Record the time by clicking on time icon next to the fill time.
4	Expected Distance	Refers to the distance between expected and current location of the CP	The distance will be automatically generated once location is recorded by clicking 'START GPS'. Repeat the process atleast three times before final record.
5	Location	Refers to the location of plot	1. Record the location by clicking on 'START GPS' and then after recording it, click on 'STOP GPS'. 2. Repeat atleast three times for final recording of plot location.

6	Enumerated	Refers to whether or not the cluster plot is enumerated	Record it by clicking ‘Yes’ if it is enumerated, ‘No’ if it is not. Note all accessible plots are enumerated.
7	Weather	Refers to the state of atmospheric conditions at that particular time when NFI crew carries out field work.	Based weather conditions prevailing at that particular moment, mention whether it is; a. Sunny b. Rainy c. Cloudy d. Wind Select from the dropdown menu.
8	Altitude	Refers to the elevation from mean sea level at which the cluster plot is located. It is measured in meter.	Use the GPS to obtain altitude reading. Record altitude in meter, as it appears on GPS.
9	Crew Leader Name	Refers to name of the Crew Leader of NFI crew carrying out field work	Choose appropriately from the list as it appears on electronic form or write down in the paper form if paper field form is used. <i>Note: Names of all crew leaders will be provided as drop-down list in electronic form.</i>
10	Crew ID	Refers to a unique identity number assigned to each Crew	Choose and record appropriate Crew ID from the drop-down list.
11	Office Name	Refers to the name of the field office collecting the data from the cluster plot	Choose from the list of office names from the drop-down menu.
12	Dzongkhag	Refers to name of the Dzongkhag within which the Cluster Plot is located.	Choose and record appropriate name of the dzongkhag from the drop-down list on electronic field form or write down on the paper field form if it is used. <i>Note: Dzongkhag names will be provided as drop-down list in the electronic field form.</i>
13	Gewog	Refers to name of the gewog within which the Cluster Plot is located.	Choose and record appropriate gewog name from drop-down list on electronic form or write down gewog name on paper field form if it is used. <i>Note: Gewog names will be provided as drop-down list on electronic field form.</i>
14	Region	Refers to region under which the CP falls. 20 Dzongkhags are placed under 3 different regions	The region field will automatically populate once the dzongkhag is selected.
15	Accessible	Refers to if the CP was accessible or not.	Select ‘Yes’ if the CP was accessible, ‘No’ if it was not accessible.
16	CP Description	Refers to any additional plot description that Crew provides, which may be useful for future inventories	Crew may provide additional information which may aid future inventories.
17	Remarks	Any other additional information that crew might want to give.	1. Crew can provide an additional information relevant to the cluster plot, if any. 2. If elbow plot is not accessible, indicate here. 3. Nearest GPS coordinate may be recorded by manual typing.

Note: Don't start the GPS in Collect Mobile any point in time after completing data collection. Doing so will result in error at the time of data export.



NATIONAL FOREST INVENTORY FIELD FORM
Cluster Plot Form

F1/18

Department of Forests and Park Services
Forest Resources Management Division

1. CP No

2. Date / /

3. Time /

4. Weather Sunny ☐ Rainy ☐ Cloudy ☐ Windy ☐ Snowing ☐

5. Location Y= X=

6. Enumerated Yes ☐ No ☐

7. Altitude (m)

8. Crew Leader Name

9. Crew ID:

8. Office Name:

9. Gewog

10. Dzongkhag

11. Accessible a. Yes ☐ b. No ☐

12. CP Description:

13. CP Remark.

1.5.4.2.2 Collecting and Recording Reference Point Form

Once you are in the plot, it is very important to provide the reference point for each plot. Referencing of the plot is done to relocate the plots in future using permanent structure(s) or feature.

For plots with trees, the reference and witness tree forms can be same, which means the same trees chosen as witness trees can be reference structure/feature for the plot. Each plot shall have a minimum of 3 reference structure, to allow triangulation methods to relocate the plot. The form No. F2/F18 shall be used for collection and recording of reference point information with the help of instruction provided in Table 1.3.

Table 1.3: Collecting and recording Reference Point Form

SN	Data Item	Description/Definition	Instructions
1.	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	1. Select correct CP No. from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2.	Plot type	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot	Select correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3.	Reference structure	Refers to structure/feature that is chosen as a Reference Point for the PC. Take a picture of reference structure and submit	1. After selecting the Reference Point, type the name of the reference point, such as rock, stream, footpath or tree, etc. 2. Short description of reference point is required.
4	Horizontal Distance to PC	This is the horizontal distance measured between the PC and the Witness Tree.	1. Measure the horizontal distance using either the Hypsometer or the measuring tape (with slope correction), as convenient. 2. Record the horizontal distance in meters (m).
6	Slope Distance to Plot Centre	This refers to the slope distance between PC and Witness Tree	Measure the slope distance using measuring tape or hypsometer and record the distance in meters (m).
7	Azimuth of RP	The angle from North at which the Reference Point (RP) is located, as measured from the PC.	1. Measure the azimuth of RP using compass by standing at the center of the plot. 2. Record the azimuth in degrees.
8	Location	Refers to the location of the reference structure	Record the coordinate of the reference structure
9	Remarks		Record if no suitable RP are available

Table 1.4: Slope correction factor

Slope Correction Table					
Slope (in Degrees)	Horizontal Distance(m)				
	3.57	10	12.62	20	50
	Slope Distance(m)				
1	3.57	10.00	12.62	20.00	50.01
2	3.57	10.01	12.63	20.01	50.03
3	3.57	10.01	12.64	20.03	50.07
4	3.58	10.02	12.65	20.05	50.12
5	3.58	10.04	12.67	20.08	50.19
6	3.59	10.06	12.69	20.11	50.28
7	3.60	10.08	12.71	20.15	50.38
8	3.61	10.10	12.74	20.20	50.49
9	3.61	10.12	12.78	20.25	50.62
10	3.63	10.15	12.81	20.31	50.77
11	3.64	10.19	12.86	20.37	50.93
12	3.65	10.22	12.90	20.45	51.12
13	3.66	10.26	12.95	20.53	51.31
14	3.68	10.31	13.01	20.61	51.53
15	3.70	10.35	13.06	20.70	51.76
16	3.71	10.40	13.13	20.81	52.01
17	3.73	10.46	13.20	20.91	52.28
18	3.75	10.51	13.27	21.03	52.57
19	3.78	10.58	13.35	21.15	52.88
20	3.80	10.64	13.43	21.28	53.21
21	3.82	10.71	13.52	21.42	53.55
22	3.85	10.78	13.61	21.57	53.92
23	3.88	10.86	13.71	21.73	54.31
24	3.91	10.95	13.81	21.89	54.73
25	3.94	11.03	13.92	22.07	55.16
26	3.97	11.12	14.04	22.25	55.62
27	4.01	11.22	14.16	22.44	56.11
28	4.04	11.32	14.29	22.65	56.62
29	4.08	11.43	14.43	22.86	57.16
30	4.12	11.55	14.57	23.09	57.73
31	4.16	11.66	14.72	23.33	58.32
32	4.21	11.79	14.88	23.58	58.95
33	4.26	11.92	15.04	23.84	59.61
34	4.31	12.06	15.22	24.12	60.30
35	4.36	12.21	15.40	24.41	61.03
36	4.41	12.36	15.60	24.72	61.79
37	4.47	12.52	15.80	25.04	62.59
38	4.53	12.69	16.01	25.37	63.43
39	4.59	12.86	16.23	25.73	64.32
40	4.66	13.05	16.47	26.10	65.25
41	4.73	13.25	16.72	26.49	66.23
42	4.80	13.45	16.98	26.90	67.26
43	4.88	13.67	17.25	27.34	68.34
44	4.96	13.90	17.54	27.79	69.48
45	5.05	14.14	17.84	28.27	70.68
46	5.14	14.39	18.16	28.78	71.95
47	5.23	14.66	18.50	29.31	73.28
48	5.33	14.94	18.85	29.88	74.69
49	5.44	15.23	19.23	30.47	76.17

Forest and Nature Conservation Code of Best Management Practices of Bhutan

50	5.55	15.55	19.62	31.10	77.75
51	5.67	15.88	20.04	31.76	79.41
52	5.80	16.23	20.49	32.47	81.17
53	5.93	16.61	20.96	33.21	83.03
54	6.07	17.00	21.46	34.00	85.01
55	6.22	17.42	21.99	34.84	87.11
56	6.38	17.87	22.55	35.74	89.35
57	6.55	18.35	23.15	36.69	91.73
58	6.73	18.86	23.80	37.71	94.28
59	6.93	19.40	24.48	38.80	97.00
60	7.13	19.98	25.22	39.96	99.91
61	7.36	20.61	26.01	41.21	103.03
62	7.60	21.28	26.85	42.56	106.39
63	7.86	22.00	27.77	44.01	110.01
64	8.13	22.79	28.76	45.57	113.93
65	8.44	23.63	29.82	47.27	118.16
66	8.77	24.55	30.99	49.11	122.77
67	9.12	25.56	32.25	51.11	127.79
68	9.52	26.65	33.64	53.31	133.27
69	9.95	27.86	35.16	55.72	139.30
70	10.42	29.19	36.84	58.38	145.94
71	10.95	30.66	38.69	61.32	153.30
72	11.53	32.30	40.76	64.59	161.49
73	12.18	34.13	43.07	68.26	170.65
74	12.92	36.20	45.68	72.39	180.98
75	13.76	38.54	48.64	77.08	192.71
76	14.72	41.22	52.03	82.45	206.12
77	15.82	44.32	55.94	88.65	221.62
78	17.12	47.94	60.50	95.88	239.71
79	18.64	52.22	65.90	104.44	261.10
80	20.48	57.36	72.39	114.71	286.79
90	4483.08	12557.66	15847.77	25115.32	62788.30



NATIONAL FOREST INVENTORY FIELD FORM
Reference Point Form

F2/18

Department of Forests and Park Services
Forest Resources Management Division

1. CP No
2. Plot Name Elbow North East

3. References

Sl. No.	Reference Type (Tree or Permanent feature)	Location		Reference Name	Horizontal Distance (m)	Slope distance (m)	Azimuth	DBH (cm)	Description of reference	Remark
		Northing	Easting							
1										
2										
3										
4										
5										

1.5.4.2.3 Collecting and Recording Witness Trees

Identifying and assigning a tree as witness tree is important for each plot (Elbow, North and East). This enables the crews in relocating the plot center in future. Minimum of three trees shall be identified as witness trees in each plot. However, if the plot has less than three trees, all available trees may be recorded as witness trees and for those plots with no trees, it should be recorded in the remarks stating that there are no trees in the plot. Ideally, the witness trees should form a triangle (Figure 1.2) around the plot.

The form No. F3/F18 shall be used for collection and recording of information of **witness tree** with the help of instruction provided in Table 1.5.

Table 1.5: Collection and recording witness tree (WT) data

SN	Data Item	Description/Definition	Instructions
1.	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	1. Select correct CP No. from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2.	Plot Type	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot	Select correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3.	Witness Tree (1, 2 &3)	Refers to tree that is chosen as a witness for the PC	After selecting the Witness Tree, drive the Witness Tag (Square aluminum tag) at the base of the tree (about 30 cm from the ground). The Witness Tag should point /face towards the PC.
4.	Species/ Scientific name	Refers to scientific or botanical name of the chosen Witness Tree. (For eg., <i>Pinus wallichiana</i>)	Provide botanical name of the Witness Tree by choosing it from the drop-down list.
5	dbh	Refers to the diameter at breast height (dbh) of the chosen Witness Tree	Measure the diameter at breast height (dbh) of the chosen witness tree using diameter tape and record the reading in centimeter (cm)
6.	Horizontal Distance to PC	This is the horizontal distance measured between the PC and the Witness Tree.	1. Measure the horizontal distance using either the Hypsometer or the measuring tape, as convenient. 2. Record the horizontal distance in meters (m).
7	Slope Distance to Plot Centre	This refers to the slope distance between PC and Witness Tree	Measure the slope distance using measuring tape and record the distance in meters (m).
8	Azimuth of WT	The angle from North at which the Witness Tree (WT) is located, as measured from the PC.	1. Measure the azimuth of WT using compass by standing at the center of the plot. 2. Record the azimuth in degrees.

Note: As mentioned in 1.1.4.3, there shall be a minimum of 3 Witness Trees (WTs) per Plot. Instruction and guidance on selecting WTs are provided in the same section above. The crew shall fill in 3 electronic WT forms on tablet if 3 WTs are selected, 4 times if 4 WTs are selected.



NATIONAL FOREST INVENTORY FIELD FORM
Witness Trees' Form

F3/18

Department of Forests and Park Services
Forest Resources Management Division

1. CP No
2. Plot Name Elbow North East
3. Trees or shrub present Yes No

Sl. No.	Name of Witness tree	Location		Local or common name	DBH (cm)	Horizontal Distance	Slope distance (m)	Azimuth	Description of Witness tree	Remark
		Northing	Easting							
1										
2										
3										
4										
5										

1.5.4.2.4 Collecting and Recording Regeneration Data

Regeneration data shall be collected only from the Elbow Plot, where 3.57 m radius circular plot shall be laid around the PC. All tree species with diameter at breast height (DBH) less than 5 cm and located within 3.57 cm subplot shall be enumerated and recorded in the regeneration data form.

The form No. F4/F18 shall be used for collection and recording of **regeneration** information with the help of instruction provided in *Table 1.6*. Refer *Table 1.19* for tree species list and species code.

Table 1.6: Collecting and recording regeneration data

SN	Parameters	Description/ Definition	Instructions or how to fill in Data Dictionary
1.	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	1. Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Date	Refers to date on which data was collected	1. Record the date by clicking on calendar icon next to it on Android tablet. 2. If paper form is used, record the date accordingly.
3.	Species /Scientific Name	Refers to scientific or botanical name which conforms to the <i>International Code of Botanical Nomenclature (ICBN)</i>	Choose appropriate botanical name as it appears against it as drop-down list.
4.	Common Name/ Local Name	“Common name” refers to the commonly used name of that tree species in English or local dialect. “Local name” means name of tree in local dialect. For NFI, the local names in following dialects will be used; Dzongkha (Dz), Tshanglha Kha (Ts), Lhotsham kha (Lh), Bumthangp (Bum), Khengkha (Kh), Trongsap (Tr) and Kurtoep (Kr).	1. The Crew may note either the common name or the local name, or both, of the tree. 2. In case of local name, Crew must specify dialect in which the local name has been given. (For <i>Quercus griffithii</i> , it is Baenangshing in Tshanglha Kha , therefore, local name must be written as Baenangshing (Ts) , Ts indicates it is in Tshanglha Kha)
6.	Number of established regenerations	Established seedlings are plants having height more than 2 m.	Count the number of plants having DBH less than 5 cm and of height more than 2 m within 3.57 m sub-plot and record the number/counts.
7.	Number of un-established regeneration	Un-established regeneration refers to plants which are less than 2 m height and are more than one year old.	Count the number of plants having DBH less than 5 cm and of height less than 2 m within 3.57 m sub-plot and record the number/counts.
8.	Number of recruits	Recruits are very small plants having 2-4 leaves but are current years seedling	Count the number of recruits and record the number
9.	Remarks		The Crew leader or the data recorder may add any additional information that may help in assessing regeneration status in the plot

NOTE: If the plants cannot be identified by either Scientific name or local name or common name, then the plant shall be recorded as “UNKNOWN 1,2,3,4.....” for that plot. A photo of the plant (with clear dorsal and ventral side of leaves with leaf margins) may be taken and in bracket record the photograph number.

While naming the unknown species follow the following naming protocol - Cluster Plot No_Plot type (L, N, E) Unknown1, 2,3...., e.g First unknown plant found in East Plot of Cluster Plot 0947 shall be named as CP0947_E_Unknown1.)). Same protocol shall be followed for unknown species of shalltrees, shrubs, herbs and saplings. The photo of the plant shall consist of shoot, leaf (dorsal & ventral side with clear leaf margins), flowers and whole plant where possible to aid identification.



NATIONAL FOREST INVENTORY FIELD FORM
Regeneration Form (Within $r < 3.57$ m)

F4/18

Department of Forests and Park Services
 Forest Resources Management Division

1. CP No

2. Date / /

SN	Scientific name	Local Name	No of Established	No of Un-established	No of Recruits	Remarks

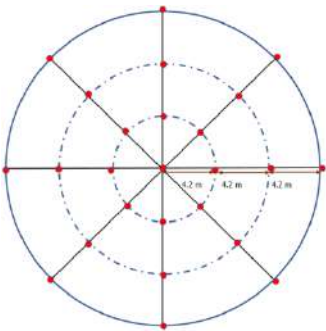
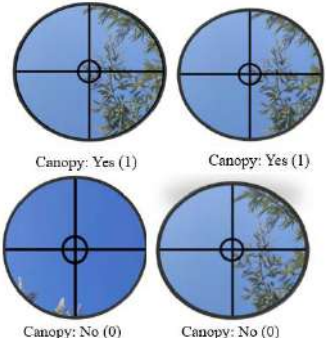
1.5.4.2.5 Collection and Recording of Plot Forms

This form is designed to capture topographical information, vegetation types, land use and land cover, forest types, etc. Follow the steps and description provided in *Table 1.7* for recording the **plot information** in Form F5/F18.

Table 1.7: Collecting and recording of plot data

SN	Data Item	Description/Definition	Instructions
1	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	1. Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot name	Refers to one of the three plots (Elbow, East or North Plot) of Cluster Plot.	Select correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3	Topographic position	Refers to the position of the plot in reference to the topography and the slope. Topographic position will be classified as: 1. Ridge top : when plot is located on a ridge top 2. Upper hill side : when the plot is located in the upper one-third of the hill 2. Middle hill side : when the plot is located on the middle one third of the hill 3. Lower hill side : when the plot is located in the lower one third of the hill 4. Flat land : when the plot is on valley beds or vast stretch of flat area. 5. River bed : when the plot falls on a river (dry or otherwise) 6. River banks : when the plot falls on the banks of river or stream. 7. Gorge/ravine : when the plot falls on very steep ravines.	1. Classify the position of the plot topographically by referring the definitions provided. 2. Record the appropriate topographic position by selecting from the drop-down list in the data dictionary (if electronic field form is used). 3. In case of paper field form, tick the appropriate topographic position.
4	Aspect	Refers to the direction of the slope and is classified as: 1. Northern : When the slope is facing North 2. North-Eastern : When the slope is facing North East 3. Eastern : When the slope is facing East 4. South-eastern : When the slope is facing South-East 5. Southern : When the slope is facing South 6. South-western : When the slope is facing South -West	1. Use a compass to determine the direction to which the slope is facing. 2. Record appropriate aspect by selecting from the drop-down list on the data dictionary in the electronic field form and tick appropriate aspect from check list in the paper field form.

		<p>7. North-western: When the slope is facing North West</p> <p>8. No aspect: When the plot falls on a flat area</p>	
5	Slope up	<p>Slope Up describes the gradient, inclination of the up-hill slope from the PC.</p> <p>Note: Slope reading for our purpose will be done in degrees.</p>	<ol style="list-style-type: none"> 1. For measuring the Slope up, walk one of the crew members towards the steepest part of the up-hill side and position the member on the edge of the 12.62 m plot. 2. Take a clinometer reading to his eye height from the PC. 3. Record the reading accordingly.
6	Slope down	<p>Slope down describes the gradient, inclination of the down-hill slope from the PC.</p>	<ol style="list-style-type: none"> 1. For measuring the Slope down, walk one of the crew members towards the steepest part of the down-hill side and position the member on the edge of the 12.62 m plot. 2. Take a clinometer reading to his eye height from the PC. 3. Record the reading accordingly
7	Stand height	<p>Refers to an arithmetic mean of the height of five tallest trees in the plot.</p> <p>If number of records are less than 5, record average height of these trees as stand height.</p>	<ol style="list-style-type: none"> 1. Identify five tallest trees having DBH above 10 cm located within 12.62 m radius plot. 2. Measure the heights of the identified trees using Hypsometer or clinometers. 3. Start from North and move in clockwise direction to measure heights all five identified trees located within the plot. 4. Once the measurement of height is completed for all five trees, add the height and divide the sum by 5. The result is the <i>stand height</i>. 5. Record the result to the nearest one decimal place.

8	Canopy closure	<p>Refers to the cover percent of tree canopy.</p>  <p><i>Figure: Points for measurement on circular plot</i></p>  <p><i>Figure: Tally and non-tally of canopy by looking through the densitometer</i></p> <p>If more than 50% of the black circle in the densitometer is covered it is '1' for canopy measurement.</p>	<ol style="list-style-type: none"> 1. Divide the plot into eight sections using or with imaginary lines running through North-South intersecting with East-West line, North Eastern – South Western intersecting North Western – South Eastern. 2. Using the Crown Densitometer, estimate the canopy cover percent from the following 25 positions: <ul style="list-style-type: none"> -Plot centre, -From the plot centre measure about 4.2 m on each line and take three measurement from all 8 directions from plot centre. <p>Looking at the canopy cover with a GRS Densitometer, at each 4.2 m distance from plot center, record '1' if more than 50% of inner black circle is covered by canopy and '0' if no canopy is observed in 50% of the black circle (Figure 5).</p> <p>The canopy cover is calculated</p> $\text{Canopy cover} = \frac{\text{Total 1s}}{25} \times 100$ <p>Record the canopy closure in percentage.</p>
	Canopy Tally	Refers to number of points where more than 50% of the black circle in the densitometer is covered by canopy and are recorded as 'Yes' or '1'.	Total number of "Yes" or "1" observations
	Canopy Non-tally	Refers to number of points where less than 50% of the black circle in the densitometer is covered by canopy and are recorded as 'No' or '0'.	Total number of "No" or "0" observations
9	Land Ownership	<p>Refers to the ownership status of the land on which the plot is located. This is classified into the following categories:</p> <ol style="list-style-type: none"> 1.State Reserved Forest Land (SRFL) 2.SRFL-Protected area 3.SRFL-FMU 4. SRFL-Community Forests 5. SRFL-Leased 6. Private 7. Thromde 8. Institutional 9. Don't Know 	Refer the legal definition for assessing the Land ownership status of the plot and record accordingly.

10	Land Ownership note	Refers to any other information related to land ownership.	Mention any additional relevant information on land ownership, as deemed fit.														
11	Land Cover Type	<div>Refers to class of land cover as classified in the Land Cover classification of IPCC 2006 and LUPP,1995, Land Use Land Map 2010, 2016 and are classified under the following categories:</div> <table><tr><td>Category</td><td>Sub-Category</td></tr><tr><td>Forest</td><td><div>1. Coniferous forests</div><div>2. Broadleaf forests</div><div>3. Coniferous plantation</div><div>4. Broadleaf plantation</div></td></tr><tr><td>Grassland</td><td><div>1. Meadow</div><div>2. Grassland</div><div>3. Scrub - shrubs non-rhododendrons</div><div>4. Shrubs- Rhodendron</div></td></tr><tr><td>Cropland</td><td><div>1. Chuzhing</div><div>2. Kamzhing</div><div>3. Mixed agriculture</div><div>4. Apple orchard</div><div>5. Citrus orchard</div><div>6. Areca nut</div><div>7. Cardamom Plantation</div><div>8. Other horticulture</div></td></tr><tr><td>Settlement</td><td><div>1. Urban</div><div>2. Rural</div><div>3. Industrial</div><div>4. Roads</div></td></tr><tr><td>Wetland</td><td><div>1. Lake</div><div>2. Reservoir</div><div>3. Marshy area</div><div>4. River</div></td></tr><tr><td>Other land</td><td><div>1. Impervious surface</div><div>2. Snow/glacier</div><div>3. Rocky outcrop</div><div>4. Scree</div><div>5. Landslide</div><div>6. Gully</div><div>7. Ravine</div><div>8. Moraines</div></td></tr></table>	Category	Sub-Category	Forest	<div>1. Coniferous forests</div> <div>2. Broadleaf forests</div> <div>3. Coniferous plantation</div> <div>4. Broadleaf plantation</div>	Grassland	<div>1. Meadow</div> <div>2. Grassland</div> <div>3. Scrub - shrubs non-rhododendrons</div> <div>4. Shrubs- Rhodendron</div>	Cropland	<div>1. Chuzhing</div> <div>2. Kamzhing</div> <div>3. Mixed agriculture</div> <div>4. Apple orchard</div> <div>5. Citrus orchard</div> <div>6. Areca nut</div> <div>7. Cardamom Plantation</div> <div>8. Other horticulture</div>	Settlement	<div>1. Urban</div> <div>2. Rural</div> <div>3. Industrial</div> <div>4. Roads</div>	Wetland	<div>1. Lake</div> <div>2. Reservoir</div> <div>3. Marshy area</div> <div>4. River</div>	Other land	<div>1. Impervious surface</div> <div>2. Snow/glacier</div> <div>3. Rocky outcrop</div> <div>4. Scree</div> <div>5. Landslide</div> <div>6. Gully</div> <div>7. Ravine</div> <div>8. Moraines</div>	<div>Use the technical definition provided in Table 1.8 for identifying the Land cover classification. Then record appropriate land cover class accordingly in the data dictionary or electronic field forms.</div> <div>Land Cover Classification Code as provided in the Table 1.9 may be used, if paper field forms have to be used.</div>
Category	Sub-Category																
Forest	<div>1. Coniferous forests</div> <div>2. Broadleaf forests</div> <div>3. Coniferous plantation</div> <div>4. Broadleaf plantation</div>																
Grassland	<div>1. Meadow</div> <div>2. Grassland</div> <div>3. Scrub - shrubs non-rhododendrons</div> <div>4. Shrubs- Rhodendron</div>																
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12	Vegetation composition	<div>Refers to the dominating composition of vegetation and often described by dominating tree species.</div> <div>The Vegetation Composition types are provided in Table 1.10 and appropriate type should be selected or typed</div>	<div>1. Study the vegetation within 25 m radius of the plot for majority species.</div> <div>2. Run through the Vegetation Composition list and select the most appropriate type</div> <div>3. Record accordingly</div>														
13	Forest type	Refers to Forest type as classified in the Flora of Bhutan. The characteristic feature of	Select the appropriate forest type from the drop-down list in case of														

Forest and Nature Conservation Code of Best Management Practices of Bhutan

		different forest types is provided in Table 1.11.	electronic field form and in case of paper field forms, record the Forest type Code as provided in the Table 1.11.
14	Forest Stand Structure	Refers to or defined as the “physical and temporal distribution of trees in a stand (Oliver and Larson, 1990). It basically refers to the horizontal and vertical distribution of components of a stand (Helms 1998), while for NFI, the vertical distribution (even aged and un-even aged) of the stand shall be recorded.	Select from the drop-down list; a) even aged forest b) uneven aged forest. a) An evenaged forest is has one or two distinct age or size classes of trees; thus, one or two layers of tree crowns b) An unevenaged forest has three or more distinct age or size classes, thus three or more layers of trees
15	Stand Development Stage	The stand development stage is characterized by changes in stand structure and species composition and maybe classified as (Oliver and Larson,1990). 1. Open 2. Stand Initiation 3. Stand Exclusion 4. Stand re-initiation 5. Old growth	1. Refer to identify the stand structure 2. Study the stand structure within 12.62 m and then record appropriately from the drop-down list for electronic forms and tick appropriately for paper forms.
16	Main Understorey type	Refers to the dominant understorey type growing within the plot. The understorey type is categorized as: 1. Moss 2. Grass 3. Herbs 4. Bamboos 5. Shrubs	1. Observe the understorey type within the plot. 2. Record the appropriate undergrowth type from the drop-down list for electronic form and tick appropriately for paper forms
17	Understorey cover percent	Refers to the area of plot (in percentage) covered by dominant understory type.	1. Observe the understorey cover within the plot and make ocularly professional calculation. 2. Record the cover percent of the dominant understorey type in percentage.
Forest Resources			
18	Non-Wood Forest Produce (NWFP)	Non-Wood Forest Produce (NWFP) for the purpose of NFI will refer to only the living plant species whose plant parts (flowers, seeds, bulbs, roots, fruits, leaves, barks, any other vegetative part or the whole plant) or its produce such as resin, katha, kutch has medicinal properties or is edible or has some utility to people as tangible goods, or has economic value. NWFP may include trees, shrubs, herbs, bamboos, grasses, creepers, reeds, orchids, canes and fungi.	1. Observe and record the NWFPs found in the 12.62 m radius plot. 2. NWFP may be recorded by its botanical name, common name or local name or by any two nomenclatures. 3. List of NWFP should not be limited to the list provided. 4. Use field references, field guides and local knowledge to identify NWFPs.

		(This working definition is guided by Forest and Nature Conservation Rules of Bhutan, 2006 definition of NWFP) Options for listing five NWFPs are provided in the data forms along with the cover percent of each, within the 12.62 m radius of plot.	Refer Table 1.12 for Traded NWFPs and Table 1.23 for Herbs.
19	Cover Percent	Refers to the cover percent of the NWFP found within the plot.	1. Observe ocularly within plot and make expert judgement of percent area of plot covered by that NWFP. 2. Record the cover percent of the identified NWFP.
20	Bamboo	Refers to evergreen perennial flowering plants of grass family Poaceae.	1. Observe ocularly for presence or absence of bamboo within the plot and 25 m around the PC. 2. If bamboos are present within the 12.62 m radius plot, record as “Yes”, otherwise “No”.
21	Scientific Name	Refers to scientific or botanical name which conforms to the <i>International Code of Botanical Nomenclature (ICBN)</i> . Refer Table 1.15 for list of Bamboos.	1. Observe within the plot and record the botanical name of the bamboo. 2. The botanical names of the bamboos found in Bhutan are provided as drop-down list in the electronic field form. 3. If paper field form is used, record appropriately from the list of Bamboo provided.
22	Bamboo cover percent	Refers to the cover percent of the bamboo in the plot	1. Observe ocularly within plot and make expert judgement of percent area of plot covered by that bamboo. 2. Record the cover percent of the identified bamboo.
23	Bamboo Regeneration	Refer to status of bamboo regeneration within the 12.62 m radius plot, which is categorized as: 1. None 2. <10% 3. 10-20% 4. 20-50% 5. >50%	Assess the plot for bamboo regeneration and accordingly record the appropriate category.
24	Cane	Refers to perennial grasses with flexible and woody stalks for the purpose of NFI.	1. Observe ocularly for presence or absence of cane within the plot and 25 m around the PC. 2. If cane is present, record as “Yes” otherwise “No”.
25	Cane Cover Percent	Refers to percent area of 12.62 m radius plot covered by cane.	1. Observe ocularly within plot and make expert judgement of percent area of plot covered by Cane. 2. Record the observation in percentage.

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26	Daphne	Refers to recording the presence or absence of Daphne within the plots.	<ol style="list-style-type: none"> 1. Observe ocularly for presence or absence of Daphne within the plot and 25 m around the PC. 2. If Daphne is present, record as “Yes”, otherwise “No”.
27	Daphne Cover percent	Refers to percent area of the 12.62 m radius plot covered by Daphne.	<ol style="list-style-type: none"> 1. Observe ocularly within plot and make expert judgement of percent area of plot covered by Daphne. 2. Record the observation in percentage.
28	Snag	Refers to dead standing tree within the 12.62 m radius plot. Such trees will not have any living part at or above the DBH.	Look for snag within the plot, record “Yes” if snag is present in the plot, otherwise “No”.
29	Snag count	Refers to the number of snag present in the plot.	Count the number of snag and record the count of snag accordingly in electronic form or record on paper form.
30	Fallen trees	Refers to the number of dead fallen trees (of more than 1.37 m length and diameter of more than 10 cm at the midpoint) within the 12.62 m radius plot	<ol style="list-style-type: none"> 1. Look for fallen trees within the plot. 2. Record “Yes”, if it is present, otherwise “No”
31	Fallen trees count	Refers to total number/count of fallen trees found in the plot.	Count the number of fallen trees and record accordingly on electronic form or paper form.
Disturbance			
32	Forest Fire	Refers to presence or absence of evidence of forest fire	<ol style="list-style-type: none"> 1. Observe within plot for evidence of forest fire. 2. Record “Yes” if evidence is present, otherwise “No”.
33	Intensity of forest fire	Refers to the severity of forest fire damage and will be classified in one of the following categories: <ol style="list-style-type: none"> 1. Heavy: Where more than 50% of the area/crop is affected by fire 2. Moderate: Where 10-50% of the area/crop is affected by fire 3. Light: Where less than 10% of the area/crop is affected by fire 4. No Fire 	<ol style="list-style-type: none"> 1. Observe the area ocularly within the plot and 25 m around the PC and assess the severity of damage as per description of each category 2. Then record the category accordingly from the drop-down list in the electronic form or tick appropriately for the paper form.
34	Type of forest fire	Refers to type of forest fire and is classified as one of the following categories: <ol style="list-style-type: none"> 1. Underground fire: fire spreading under the surface through roots or any other underground means. 2. Surface fire: Fire spreading through ground cover, vegetation and litters without reaching the tree canopies 3. Crown fire: Fire spreading through the canopies of woody vegetation 	<ol style="list-style-type: none"> 1. Classify the type of forest fire that had affected the area, as per definition provided 2. Then record the appropriate category from the drop-down list in the electronic form or tick appropriately for paper forms.

		<p>4. Not Sure/not known: If the nature of forest fire cannot be ascertained</p> <p>5. Not applicable: When no fire incidence is evident</p>	
35	Grazing	Refers to presence or absence of evidence of grazing.	<p>1. Observe ocularly for evidence of presence or absence of grazing within the plot and 25 m around the PC.</p> <p>2. Then record as;</p> <p>a. Yes: When there are signs of grazing, presence of livestock or sighting of cattle or dung, etc.</p> <p>b. No: When there is no evidence of grazing.</p> <p>c. Not sure: When you are not sure</p>
36	Intensity of grazing	<p>Refers to the severity of grazing and will be classified as:</p> <ol style="list-style-type: none"> 1. Low 2. Moderate 3. Severe 4. No grazing 	<p>1. Observe ocularly for evidence of severity of grazing within the plot and 50 m around the PC.</p> <p>2. Then make expert judgement and record the extent of grazing class from the drop-down list for electronic form or tick appropriately on the paper form.</p>
37	Timber extraction	Refers to evidence of timber being extracted from the plot.	<p>1. Observe for evidence of timber extraction within the plot and 25 m around PC.</p> <p>2. Record as “Yes” if there is evidence of extraction, otherwise “No”.</p>
38	Type of Timber Extraction	<p>Refers to type of timber extraction in the plot and will be categorized in one of the following:</p> <ol style="list-style-type: none"> 1. Clear felling: Felling of all trees in the area 2. Selective felling: Felling of trees selectively/few trees felled 3. Group felling: Felling of trees in group/patch 4. No felling 	<p>1. Observe and record the observation by selecting the type of timber extraction appropriately from drop-down list for electronic form or tick appropriate type of timber extraction on the paper form</p>
39	Mining	Refers to evidence of presence or absence of mining in the plot	<p>1. Observe ocularly in the plot for evidence of presence or absence of mining in the plot and 25 m around the PC.</p> <p>2. Record “Yes” if there is presence of mining, otherwise “No”.</p>
40	Type of Mining	<p>Refers to type of mining and will be categorized as:</p> <ol style="list-style-type: none"> 1. Yes, Surface collection 2. Yes, quarry 3. None 	<p>Observe ocularly within plot and 50 m around the PC; and record your observation as;</p> <ol style="list-style-type: none"> a. Yes, surface collection b. Yes, quarry

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41	Transmission lines	Refers to the transmission wires running over-head and/or existence of transmission poles.	If the transmission line runs over the plot or presence of electric poles within plot or boundary, then it will be recorded as “Yes”, otherwise “No”.
42	Garbage	Refers to presence or absence of garbage and will be categorized as: 1. Food wrappers 2. PET bottles 3. Construction wastes 4. All of above 5. None	1. Observe within the plot for evidence of any garbage/wastes. 2. Record the observation under any one of the relevant categories by selecting from the drop-down list for electronic form or tick appropriately on the paper form
Forest Health			
43	Pest and disease	Refers to presence or absence of evidence of pest and diseases	Observe ocularly with plot and around 25 m from the PC and record “Yes” if evidence of disease and pests is observed, otherwise “No”.
44	Mistletoe	Mistletoe is an obligate hemiparasitic plant that grows attached to and penetrating within branches of trees. Can be identified on trees by the presence of “witches’ broom”	If mistletoes are observed on the plot itself or within 25 m from the PC, record as “Yes, mistletoe”, otherwise as “No”
45	Dieback Fir	Fir dieback is a condition observed in Fir, where the following symptoms are observed: 1. Top-dying/shedding of needles 2. Thinning crown	If fir dieback is observed on the plot itself or within 25 m from the PC, record as “Yes”, otherwise “No”.
46	Bark Beetle	Refers to occurrence of Bark Beetle infection in the forest stand. The visible symptoms of bark beetle infections are: 1. Discoloration of needles from green to yellow and eventually from red to brown 2. Tiny holes in the bark of the infected trees	If you observe the symptoms of Bark Beetle infection in the area, record as “Yes”, else “No”.
47	Others	Refers to any other information not captured.	If other pests and diseases are observed, record as observed.
Litter, Humus and Fuel bed			
48	Litter Depth Value	Refers to the depth of litter on the forest floor, measured in centimeters. Litter can be defined as the surface layer of the forest floor consisting of freshly fallen leaves, needles, twigs, stems, bark, and fruits. The decomposition would have just begun in this layer.	1. Measure the Litter depth at three random points in the plot, using a measuring scale. 2. Record the average value to the nearest decimal in centimeters.
49	Humus depth Value	Humus is the layer just below the litter and comprises of highly decomposed organic matter. There will be no discernible plant parts.	1. Measure the Humus depth at three random points in the plot, using a measuring scale. 2. Record the average value to the nearest decimal in centimeters.

50.	Fuel bed Depth Value	The accumulated mass of dead, woody material on the surface of the forest floor. It begins at the top of the duff/humus layer, and includes litter, fine and coarse wood debris and dead woody shrubs.	1. Measure the fuel depth at three random points in the plot. 2. Record the average value to the nearest decimal in centimeters.
51	Litter Cover percent	Refers to the coverage of the litter measured as a percentage of the total area of the plot.	Record the cover percent of litter in the 12.62 m radius plot.
52.	Bare soil cover percent	The extent of plot area that is not covered by litter and is indicated as the percentage of total area.	Record the bare soil cover percent in the 12.62 m radius plot.
Soil			
43.	Stoniness	Refers to cover percent of stones in the 12.62 m radius plot area. The stoniness of the plot area may be classified as: 1. None 2. Rare, <10 percent 3. Few, 10-20 percent 4. Common, 20-30 percent 5. Many, 30-60 percent 6. Abundant, >60 percent	1. Walk around the plot and assess the area for stoniness. 2. Record your observations by selecting the most appropriate category from the drop-down list on the electronic form or tick appropriately on paper form
54.	Soil drainage	The drainage capacity of the soil is observed and classified as under: 1. Poorly drained: Water removed slowly; soil remains wet with water table near the surface for considerable part of the time. 2. Imperfectly drained: Water removed slowly; soil remains wet for significant part of the year; mottles present within 75 cm of the soil. 3. Moderately drained: Water removed somewhat slowly and soil remains wet for small part of the time. Mottles observed below 75cm. 4. Well drained: Water removed rapidly. No mottles	1. Observe ocularly in the plot. 2. Select and record the most appropriate soil drainage category based on the definition provided.
55	Top soil moisture	Refers to the moisture content of the top soil at the time of data collection and classified as: 1. Dry 2. Slightly moist 3. Moist 4. Wet 5. Water-logged.	Select and record the most appropriate category of top soil moisture from the drop-down list on electronic form or tick appropriately on the paper form.
56	Top soil colour	Refers to the colour of the soil and classified as: 1. Blackish 2. Reddish 3. Yellowish 4. Brownish 5. Others	Select and record the most appropriate top soil color from the drop-down list on electronic form or tick appropriately on paper form.

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57	Top soil texture	Refers to assessment of the soil texture, which will be classified as: <ol style="list-style-type: none"> 1. Sand 2. Sandy loam 3. Loam 4. Silty Loam 5. Silt 6. Clay loam 7. Clay 	<ol style="list-style-type: none"> 1. Feel the soil particles and assess the texture as instructed in the field guide provided in Table 1.14 2. Record your observation.
58	Gully Evidence	Gullies are vast gaps, crevices created by erosion of soil on hillside by running waters.	If gullies are observed within the plot or 25 m around the plot, record as 'Yes', otherwise, 'No' from the drop-down list on electronic form or tick appropriately on paper form.
59	Erosion Evidence	Evidence of any form of displacement of the upper layer of soil by water, air or any external forces.	Check for evidence of erosion and record "Yes" if it is present, otherwise "No" from the drop-down list on electronic form or tick appropriately on paper form
Water Bodies			
60	Stream	Stream refers to any flow of water in a channel or bed, as a brook, rivulet or small river.	If there is a stream within the plot or 25 m around the plot, record as "Yes", otherwise "No".
61	River	A large natural stream of water following in a channel to a sea, a lake or to another river.	If there is a river within the plot or 25 m around the plot, record as "Yes", otherwise "No".
62	Wetland/ Marshy area	Refers to any inundated /waterlogged area or areas with ponds.	If the plot area or area within 25 m radius from the PC, shows waterlogged/swampy conditions, then record as "Yes" else "No"
63	Lakes	A lake is a body of relatively still fresh or salt water of considerable size, localized in a basin, which is surrounded by land apart from a river, stream, or other form of moving water that serves to feed or drain lake. (Source: en.wikipedia.org/wiki/Lake). Lakes can be Alpine lake, Sub-alpine lakes, Glacier lakes, Supra Glacial lake, Supra snow lake or Tsho.	If there is lake (irrespective of the category) within the plot or within 25 m radius from the PC, record as "Yes" else "No".
64	Glacier	A glacier is a large persistent body of ice that forms where the accumulation of snow exceeds its ablation (melting and sublimation) over many years, often centuries. (At least 0.1 km ² in area and 50 m thick). (Source: http://en.wikipedia.org/wiki/Glacier) This will be relevant for Cluster plots falling in the high altitudes only.	If there is glacier within the plot or 25 m around the PC, record "Yes", otherwise "No" from the drop-down list on electronic form or tick appropriately on paper form.
Site Value			
65	Natural Trail facility	Refers to any approach path (footpath, road) to the plot, within the plot or within 25 m radius from the PC.	Record observation appropriately "Yes" or "No" from the drop-down

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			list on electronic form or tick on the paper form.
66.	Scenic	Refers to aesthetic value of the site.	Record “Yes” or “No” based on your own observation/ judgment from the drop-down list on electronic form or tick appropriately on paper form
67.	Visitor Evidence	Any evidence of human visiting the area in and around 25 m of the plot. For this, consult with the local guide accompanying the crew.	Observe and record observation as: 1. Yes, Local 2. Yes, Foreigner 3. Yes, Religious 4. None evident
68	Site value	Refers to any value attached to the location by people and will be classified as: 1. Yes, cultural 2. Yes, historical 3. Yes, religious 4. None	Observe and record the appropriate category from the drop-down list on electronic form or tick on the paper form, as; 1. Yes, Cultural 1. Yes, Historical 2. Yes, Religious 3. None
69.	Site name	Name of the site	Record the name of the site, if it has one.
70	Remarks	Any other useful remarks or information related to site that crews want to provide.	For e.g., if there is marshy land under the forest area, the area shall be classified as forest. However, it shall be mentioned in the “Remarks”, that the forest land falls on the marshy land

Table 1.8: Major land cover definitions and land cover code

Major land category	Definition	Code
Forest land	Land with tree or woody vegetation spanning more than 0.5 hectares with tree higher than 5 meter in height and a canopy cover of more than 10 percent. Do not include land that is predominantly under agriculture or urban landuse or orchards	FL
Cropland	All arable and tillage land, and agro-forestry systems where vegetation falls below the thresholds used for the forest land category.	CL
Grassland	All rangelands and pasture land that is not considered as cropland. It also includes systems with vegetation that fall below the threshold used in the forest land category and are not expected to exceed, without human intervention, the threshold used in the forest land category.	GL
Wetlands	All land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories.	WL
Settlements	All developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories.	SL
Other land	Any land that is not included as part of above five land categories, such as bare soil, rock, ice, and all unmanaged land areas is considered a other land	OL

Table 1.9: Land Use and land cover classes and code

Sl. No	Land Use Type	Definition	Code
1	Coniferous forests	Forest in which more than 75 percent of tree cover consists of coniferous (Fir, Spruce, Pine) species.	FC
2	Broadleaf forests	Forest in which more than 75 percent of tree cover consists of broadleaf and hardwood species.	FB
3	Coniferous plantation	Plantations of more than 75 percent coniferous species	FPc
4	Broadleaf plantation	Plantations of more than 75 percent broadleaf species	FPb
5	Scrub (rhododendron) forests	Forest areas characterized by less than 10 percent tree cover; or where vegetations are stunted or dwarfed. Mainly dominated by rhododendron species.	FSR
6	Scrub (non-rhododendron) forests	Areas characterized by less than 10 percent tree cover; or where vegetations are stunted or dwarfed. Dominated by species other than rhododendron.	FSnR
7	Meadow	Open areas of predominantly grassy vegetation cover and herbaceous plants.	MDW
8	Chuzhing	Irrigated, bench terraced and land cultivated mainly for rice	AW
9	Kamzhing	Rainfed, cultivated land which may be terraced or unterraced.	AD
10	Apple orchard	Self explanatory	HOa
11	Citrus orchard	Self explanatory	Hoc
12	Areca nut	Self explanatory	HPa
13	Cardamom Plantation	Self explanatory	HPc
14	Other horticulture		HPo
15	Urban	Towns and areas of habitation (near houses but besides roads or other concrete surfaces).	UR
16	Rural	Areas of habitation in villages (near houses, footpaths, or areas which are not forest, or meadows or agricultural fields)	RU
17	Road	National Highways, Dzongkhag Roads, Thromde Roads, Farm Roads, Access Roads, Forest Roads.	RO
18	Industrial Area	Area identified or earmarked for production of industrial goods and services.	Ia
19	Impervious surface	Man-made surfaces like roads, concretes, pavements	IMP
20	Snow/glacier	Only those areas which appear to remain permanently under snow or glacier should be identified as one.	OS
21	Rocky outcrop	Areas of rocky outcrop and rocky barren lands, sometimes associated with sparse trees/scrub cover	OR
22	Scree	Scree , or talus , is accumulation of broken rock fragments at the base of crags , mountain cliffs , or valley shoulders .	OScr
23	Lake	A lake is a body of relatively still fresh or salt water of considerable size, localized in a basin , which is surrounded by	Olk

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		land apart from a river, stream, or other form of moving water that serves to feed or drain the lake. (Source: en.wikipedia.org/wiki/Lake). Lakes can be Alpine lake, Sub-alpine lakes, Glacier lakes, Supra Glacial lake, Supra snow lake or Tsho.	
24	Reservoir	Any water body held within man-made structure.	Ores
25	River	Refers to perennial flow of water and the river beds.	Orv
26	Marshy area	Poorly drained or waterlogged areas of permanent swamp or marsh	OM
27	Landslide	Areas in which there is clear evidence of erosion	OL
28	Gully	Gullies are vast gaps, crevices created by erosion of soil on hillside by running waters.	OG
29	Moraines	Refers to a mass of rocks and sediments carried don and deposited by a glacier typically as ridges at its edges or extremity	OU
Note: The Land Use Classes have been derived from the LUPP, 1995 definitions of Land Use/Land Cover Classes and categories. Additional Land use Classes have been added based on the field experiences.			

Table 1.10 Vegetation composition and vegetation composition code

CODE	VEGETATION COMPOSITION
Ac	Acer sp.
Ac-Be	Acer sp./Betula sp.
Ac-Oc	Acer sp./Populus ciliate
Ac-Qs	Acer sp./Quercus semecarpifolia
Al	Alnusnepalensis
Be	Betula sp.
Bk	Temporarily unstocked/Blank
Bl	Low bamboo
Bl(Nc)	Low bamboo with sparse Mixed coniferous
Bl(Nf)	Low bamboo with sparse tree cover
Bt	Tall bamboo
Ch	Schimawallichii, Chilaune
Cu	Agriculture/Cultivation
Cy	Cypress sp.
Ex	Exbucklandia populnea
Fi	Fir
Fi(Be)	Fir with minor Betula sp.
Fi(He)	Fir with minor Hemlock
Fi-Ac	Fir/Acer sp.
Fi-Ar	Fir/Prunus sp.
Fi-Be	Fir/Betula sp.
Fi-He	Fir/Hemlock
Fi-Ju	Fir/Juniper sp.
Fi-La	Fir/Larch
Fi-Rh	Fir/Rhododendron sp.
Fi-Sp	Fir/Spruce
Ga	Alpine grassland
Ga(Fi)	Alpine Grassland with sparse Fir
Ga(Ju)	Alpine Grassland with sparse Juniper sp.

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Ga(Sp)	Alpine Grassland with sparse Spruce
Gr	Grassland
Gr(Nf)	Grassland with sparse tree cover
Gr(Pb)	Grassland with sparse Blue Pine
Gr(Pc)	Grassland with sparse Chir Pine
Gr(Sp)	Grassland with sparse Spruce
He	Hemlock
He(Be)	Hemlock with minor Betula sp.
He(Fi)	Hemlock with minor Fir
He(Pb)	Hemlock with minor Blue Pine
He(Sp)	Hemlock with minor Spruce
He-Ac	Hemlock/Acer sp.
He-Ar	Hemlock/Prunus sp.
He-Be	Hemlock/Betula sp.
He-La	Hemlock/Larch
He-Nb	Hemlock/broadleaved
He-Pb	Hemlock/Blue Pine
He-Qs	Hemlock/Quercus semecarpifolia
Ju	Juniper sp.
Ka	Castanopsis sp., Katus
Ka-Qu	Castanopsis sp./Quercus sp.
La	Larch
La-Qs	Larch/Quercus semecarpifolia
Ma	Macaranga sp.
Nb	Mixed broadleaved
Nc	Mixed coniferous
Nc-Nb	Mixed coniferous/Mixed broadleaved
Oc	Populus ciliate
Oc-Nc	Populus ciliata/Mixed coniferous
Oc-Qs	Populus ciliata/Quercus semecarpifolia
Or	Populus rotundifolia
Pb	Blue Pine
Pb-He	Blue Pine/Hemlock
Pb-He(Sp)	Blue Pine/Hemlock with minor Spruce
Pb-Nb	Blue Pine/Mixed broadleaved
Pb-Oc	Blue Pine/Populus ciliate
Pb-Or	Blue Pine/Populus rotundifolia
Pb-Qg	Blue Pine/Quercus griffithii
Pb-Qs	Blue Pine/Quercus semecarpifolia
Pb-Qu	Blue Pine/Quercus sp.
Pb-Rh	Blue Pine/Rhododendron sp.
Pc	Chir Pine
Pc-Nb	Chir Pine/Mixed broadleaved
Pl	Forest plantation
Qg	Quercus griffithii
Qg-Nc	Quercus griffithii/Mixed coniferous
Qg-Qs	Quercus griffithii/semecarpifolia
Qg-Rh	Quercus griffithii/Rhododendron sp.
Qn	Quercus lanata
Qs	Quercus semecarpifolia
Qs-Nc	Quercus semecarpifolia/Mixed coniferous
Qu	Quercus sp.
Qu-Nc	Quercus sp./Mixed coniferous
Rh	Rhododendron sp.

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Ro	Rocky outcrops and barren land
Ro(Nf)	Barren land with sparse tree cover
Ro(Pb)	Barren land with sparse Blue Pine
Ro(Pc)	Barren land with sparse Chir Pine
Sa	Alpine shrubland
Sa(Fi)	Alpine shrubland with sparse Fir
Sc	Shrubland
Sc(Nf)	Shrubland with sparse tree cover
Sc(Pb)	Shrubland with sparse Blue pine
Sc(Pc)	Shrubland with sparse Chir Pine
Se	Settlements
Sp	Spruce
Sp-Ac	Spruce/Acer sp.
Sp-He	Spruce/Hemlock
Sp-Nb	Spruce/Mixed broadleaved
Sp-Oc	Spruce/Populus ciliate
Sp-Pb	Spruce/Blue Pine
Sp-Qs	Spruce/Quercus semecarpifolia
Wa	Lakes and rivers
Ye	Yew
Ye-Oc	Taxus baccata/Populus ciliate
Fi-He(Ju)	Fir/Hemlock with minor Juniper
Nb-He	Mixed broadleaf/Hemlock
Nb-Pb	Mixed broadleaf/Blue Pine
Nb-Pc	Mixed broadleaf/Chir Pine
Nb-Qu	Mixed broadleaf/Quercus sp.
He-Fi	Hemlock/Fir
He-Fi(Sp)	Hemlock/Fir with minor Spruce
He-Pb(Qu)	Hemlock/Blue Pine with minor Quercus sp.
Ju-He	Juniper/Hemlock
Pb-Pc	Blue Pine/Chir Pine
Pb-Pc(Qu)	Blue Pine/Chir Pine with minor Quercus sp
Qu-Nb	Quercus sp/Mixed broadleaf
Qu-Nb(He)	Quercus sp/Mixed brl with minor Hemlock
Qu-Nb(Pb)	Quercus sp/Mixed brl with minor Blue Pine
Pb-Sp	Blue Pine/Spruce
Nc-He	Mixed coniferous/Hemlock
Nb-Nc	Mixed coniferous/Mixed broadleaf
He-Pb(Sp)	Hemlock/Blue Pine with minor Spruce
He-Sp	Hemlock/Spruce
He-Sp(Pb)	Hemlock/Spruce with minor Blue Pine
Sp-He(Pb)	Spruce/Hemlock with minor Blue Pine
Dp	Daphniphyllum sp.
Nb-Dp	Mixed broadleaf/Daphniphyllum sp.
Qu-Pc	Quercus sp./Chir Pine
Qg-Pb	Quercus griffithii/Blue Pine
Fi(Ju)	Fir with minor Juniper
He-Be(Fi)	Hemlock/Betula sp. with minor Fir
Pb-Sp(Qu)	Blue Pine/Spruce with minor Quercus sp.
Qu-He	Quercus sp./Hemlock
Ju-Fi	Juniperus sp./Fir
Qu-He(Sp)	Quercus sp./Hemlock with minor Spruce
Pb-Qu(Sp)	Blue Pine/Quercus sp. with minor Spruce
Pb(Sp)	Blue Pine with minor Spruce

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Sp-Pb(He)	Spruce/Blue Pine with minor Hemlock
Sp-Pb(Qu)	Spruce/Blue Pine with minor Quercus sp.
Qu-Sp	Quercus sp./Spruce
Qu-Sp(Be)	Quercus sp./Spruce with minor Betula sp.
Ju(Fi)	Juniperus sp. with minor Fir
He-Fi(Be)	Hemlock/Fir with minor Betula sp.
He-Sp(Fi)	Hemlock/Spruce with minor Fir
Sp(Fi)	Spruce with minor Fir
Pb-Sp(He)	Blue Pine/Spruce with minor Hemlock
He-Qu	Hemlock/Quercus sp.
He-Qu(Sp)	Hemlock/Quercus sp. with minor Spruce
Fi(Sp)	Fir with minor Spruce
Fi-Ju(He)	Fir/Juniperus sp. with minor Hemlock
Fi-Sp(He)	Fir/Spruce with minor Hemlock
Ju-Sp	Juniperus sp./Spruce
Pb(Qs)	Blue Pine with minor Quercus semecarpif.
Pb-He(Qs)	Blue Pine/Hemlock with minor Q. semecarpi
Op	Populus sp.
Pb-Op	Blue Pine/Populus sp.
Pb-Qs(Sp)	Blue Pine/Q. semec. with minor Spruce
Pb-Qs(He)	Blue Pine/Q. semec. with minor Hemlock
Pb-Sp(Qs)	Blue Pine/Spruce with minor Q. semec.
Qs-Pb	Quercus semecarpifolia/Blue Pine
Qs-Pb(Sp)	Q. semec./Blue Pine with minor Spruce
Qs-Sp	Quercus semecarpifolia/Spruce
Sp-Fi(Qs)	Spruce/Fir with minor Quercus semec.
Sp(Pb)	Spruce with minor Blue Pine
Sp-Fi	Spruce/Fir
Sp-Fi(He)	Spruce/Fir with minor Hemlock
Sp-He(Fi)	Spruce/Hemlock with minor Fir
Sp-He(Ju)	Spruce/Hemlock with minor Juniperus sp.
Sp-Ju	Spruce/Juniperus sp.
Sp-Ju(Fi)	Spruce/Juniperus sp. with minor Fir
Sp-Pb(Qs)	Spruce/Blue Pine with minor Q. semec.
Sp-Qs(He)	Spruce/Q. semec. with minor Hemlock
Sp-Qs(La)	Spruce/Q. semec. with minor Larch
Sp-Qs(Pb)	Spruce/Q. semec. with minor Blue Pine
He-Pb(Qs)	Hemlock/Blue Pine with minor Q. semec.
He-Qs(Sp)	Hemlock/Quercus semec. with minor Spruce
Qs-He	Quercus semecarpifolia/Hemlock
Qs-He(Sp)	Quercus semec./Hemlock with minor Spruce
Qs-Sp(Be)	Quercus semec./Spruce with minor Betula
He-Qs(Nb)	Hemlock/Q. semec. with minor Mixed brl.
He-Rh	Hemlock/Rhododendron sp.
Sp-Rh	Spruce/Rhododendron sp.
He-Qs(Rh)	Hemlock/Q. semec. with minor Rhododendron
Qs-He(Rh)	Q. semec./Hemlock with minor Rhododendron
He-Fi(Rh)	Hemlock/Fir with minor Rhododendron sp.
He-Sp(Qs)	Hemlock/Spruce with minor Q. semec.
He-Qs(Fi)	Hemlock/Quercus semec. with minor Fir
Pb-Sp(Fi)	Blue Pine/Spruce with minor Fir
He-Fi(Qs)	Hemlock/Fir with minor Quercus semec.
He-Rh(Nb)	Hemlock/Rhodo sp. with minor Mixed brl.
Rh-Fi	Rhododendron sp./Fir

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He-Rh(Qs)	Hemlock/Rhodo sp. with minor Q. semec.
He-Ju	Hemlock/Juniperus sp.
Be-Fi	Betula sp./Fir
Ju-Fi(Rh)	Juniperus sp./Fir with minor Rhodo. sp.
Ma-Nb	Macaranga/Mixed broadleaved
Nb-Ma	Mixed broadleaf/Macaranga sp.

Note: Vegetation composition (as per Land Use code combination in Forestry Services Division, Laumans, P. *Guidelines for Forest Management Inventory Field work*, 1994)

Table 1.11 Forest types of Bhutan

Sl. No	Forest Type	Code	Characteristics	Characteristic species
1	Subtropical Forest	STFr	<ul style="list-style-type: none"> Contain many tropical genera and species, forming dense jungle Scattered Sal trees in Sarpang areas Altitudinal range: 200-1000 m (-1200 m) 	<i>Acraocarpus fraxinifolius</i> , <i>Ailanthus grandis</i> , <i>Bombax ceiba</i> , <i>Cratevaregiliosa</i> , <i>Delliniapentgyna</i> , <i>Duanbanga grandiflora</i> , <i>Gmelina arborea</i> , <i>Leea asiatica</i> , <i>Musa</i> , <i>Pnadanus</i> , <i>Pterospermum acerifolium</i> , <i>Shorea robusta</i> , <i>Tetrameles nudiflora</i> , <i>Thunbergia</i>
2	Warm Broad-leaved Forest	WBFr	<ul style="list-style-type: none"> Type of Subtropical forest, but occurs at higher altitude with lower rainfall Contains mixture of Evergreen and deciduous broad-leaved species Many of the tropical genera e.g. <i>Duabanga</i>, <i>Pterospermum</i> and <i>Tetrameles</i> are absent Altitudinal range: 1000-2000 m (-2300 m) 	<i>Alangium chinensis</i> , <i>Altingia excels</i> , <i>Bischofia javanica</i> <i>Calicarpa arborea</i> , <i>Castanopsis indica</i> , <i>Cordia oblique</i> , <i>Dendrocalamus hookeri</i> , <i>Dichroa febrifuga</i> , <i>Engelhardia spicata</i> , <i>Eoudia fraxinifolia</i> , <i>Macaranga pustulata</i> , <i>Maesa</i> spp., <i>Mussaenda roxburghii</i> , <i>Pouzolzia sanguinea</i> , <i>Raphidophora aximeia</i> , <i>Schima wallichii</i> , <i>Wandlandia puberula</i>
3	Chirpine Forest	CPFr	<ul style="list-style-type: none"> Low-altitude xerophytic forest occurring in the deeper dry valleys of Bhutan Almost no other tree species occur in such forest other than <i>Chirpine</i> Altitudinal range: 900-1800 m (-2000 m) 	<i>Buddleja asiatica</i> , <i>B. bhutanica</i> , <i>Cycas pectinata</i> , <i>Cymbopogon flexuosus</i> , <i>Euphorbia royleana</i> , <i>Ficus oblignodon</i> , <i>Grewia sapida</i> , <i>Indigoferasua</i> , <i>Rhus paniculata</i> , <i>Zizyphus incurva</i>
4	Cool Broad-leaved Forest	CBFr	<ul style="list-style-type: none"> Found on moist exposed slopes Mixed forest in which oaks are LESS COMMON and other trees, both deciduous and evergreen, e.g. <i>Lauraceae</i>, <i>Exbucklandia</i> etc., are more abundant together with dense shrubs, climbers and epiphytes Altitudinal range: 2000-2900 m 	<i>Acer campbelli</i> , <i>A. sterculiaceum</i> , <i>Betula alonoides</i> , <i>Brassiopsis alpine</i> , <i>Chiritalachensis</i> , <i>Corylopsis himalayana</i> , <i>Elatostema monandrum</i> , <i>E. obtusum</i> , <i>Exbucklandia populnea</i> , <i>Ilex fragilis</i> , <i>Lecanthes peduncularis</i> , <i>Lindera neesiana</i> , <i>L. pulcherrima</i> , <i>Persea clarkeana</i> , <i>Pilea bracteosa</i> ,

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				<i>Rosa moschata</i> , <i>Rubuslineatus</i> , <i>Schisandra grandiflora</i> , <i>Symplocusdryiphila</i>
5	Evergreen Oak Forest	EOFr	<ul style="list-style-type: none"> • Characteristic feature of some parts of Central Bhutan (for e.g. Trongsa and hills above Mongar) • Composition varies according to altitude and rainfall • At lower levels, <i>Castanopsishystrix</i> and <i>C. tribuloides</i> are often dominant, higher up <i>Quercus lamellose</i> becomes commoner • With increasing dryness, more xerophytic <i>Quercus</i> species, e.g., <i>Q. lanata</i>, <i>Q. griffithii</i> and <i>Q. semicarpifolia</i> and <i>Pinus wallichiana</i> are seen • Not much shrub layer, whilst shady humid floors are dominated by small herbs • Altitudinal range: (1800-) 2000-2600 m 	<i>Acer campbelli</i> , <i>castanopsishystrix</i> , <i>C. tribuloides</i> , <i>Elatostemahookerianum</i> , <i>E. sessile</i> , <i>Galeolalindleyana</i> , <i>Juglans regia</i> , <i>Pileasymmeria</i> , <i>Quercus lamellose</i> , <i>Skimmiaarborescens</i> , <i>Symplocus lucida</i>
6	Blue Pine Forest	BPFr	<ul style="list-style-type: none"> • Temperate equivalent of Chirpine forest and occupies the dry valleys of Bhutan • Bluepine dominant with <i>Quercus species</i> in some places • Xerophytic shrubs occur and herbs mostly appear during the monsoon season • Altitudinal range: 2100-3000 (-3200) m 	<i>Berberis asiatica</i> , <i>Berchemiaedgeworthii</i> , <i>Cotoneaster griffithii</i> , <i>Eleagnus parviflora</i> , <i>Euonymus grandiflorus</i> , <i>Indigoferaheterantha</i> , <i>Jasminiumhumile</i> , <i>Prinsepiautilis</i> , <i>Lyonia ovalifolia</i> , <i>Quercus griffithii</i> , <i>Q. semicarpifolia</i> , <i>Rhododendron arboretum</i> , <i>Rosa sericea</i> , <i>Spirea canescens</i> , <i>Zanthoxylumarmatum</i>
7	Spruce Forest	SPFr	<ul style="list-style-type: none"> • Spruce forest with Hemlock and Fir forests occupy the montane cloud-forest zone of Bhutan • Often mixed with each other but separate forests can frequently be recognized • Spruce are found at lower altitude than Hemlock and Fir • Altitudinal range:2700-3100 (-3200) m 	<i>Acer cappadocicum</i> , <i>A.pectinatum</i> , <i>Berberis praecipua</i> , <i>Enkianthusdeflexus</i> , <i>Larix griffithiana</i> , <i>Lindera heterophylla</i> , <i>Osmanthus suavis</i> , <i>Piceabrachytyla</i> , <i>P. spinolosa</i> , <i>Salix daltiniana</i> , <i>Salvia campanulata</i> , <i>Taxus baccata</i>
8	Hemlock Forest	HMFr	<ul style="list-style-type: none"> • Appears at higher altitude than Spruce where <i>Tsuga dumosa</i> is dominant species mixed with Spruce and Fir • Shrubby and arborescent rhododendrons are frequent with dense growth of ferns, lichens and bryophytes 	<i>Arundinaria griffithiana</i> , <i>Betualutilis</i> , <i>Buddlejacolvilei</i> , <i>Daphne bholua</i> , <i>Gaultheria fragmentissima</i> , <i>Larix griffithiana</i> , <i>Litsea sericea</i> , <i>Maddeniahimalaica</i> , <i>Magnolia globosa</i> , <i>Pnax pseudo-ginseng</i> , <i>Rhododendron falconeri</i> , <i>R.hodgsonis</i> , <i>R. keysii</i> ,

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			<ul style="list-style-type: none"> • Altitudinal range: 2800-3100 m 	<i>Rubuscalophyllus, R.pentagonus, Sorbus thibetica, Tsuga dumosa, Viburnum mullaha</i>
9	Fir Forest	FIFr	<ul style="list-style-type: none"> • Occurs in the highest ridges of Bhutan below tree line, where huge tracts are covered by no other tree species than Fir (<i>Abiesdensa</i>) and some Hemlock and Birch in places. • Luxuriant undergrowth of Rhododendrons and other shrubs with many small herbs on mossy ground layer are found. • As tree lines are approached, the firs become stunted and are mixed with Junipers and smaller Rhododendron species • Altitudinal range: 3300-3800 m 	<i>Abiesdensa, Arundinaria maling, Betula utilis, Bryicarpumhimalaicum, Daphne bholua, Juniperuspseudosabina, Maddeniahimalaica, Primula denticulate, Prunus rufa, Rheum acuminatum, Rhododendron cinnabarinum, R. hodgsonii, Ribestikare, Rubusfragariodes, Skimmialaureola, Sorbus foliolosa, Viburnum nervosum</i>
10	Juniper-Rhododendron Scrub	JUSc	<ul style="list-style-type: none"> • Moist scrub vegetation occurring above treeline throughout Northern and Central Bhutan • Consists of scattered shrubs of <i>Junipers, Rhododendron</i> and <i>Potentilla arbuscula</i> but with rich herb layer appearing during the monsoon • Damp grassy meadow commonly found in this zone • Altitudinal range: 3700-4200 m 	<i>Gaultheria trichophylla, Juniperusrecurva, J. squamata, Morinanepalensis, Pedicularismegalantha, Phlomistibetica, Potentilla arbuscula, Primula sikkimensis, Rhodendronlepidotum, Thalictrum chelidonii, Trollius purnilus</i>
11	Dry Alpine Scrub	DASc	<ul style="list-style-type: none"> • More xerophytic vegetation found • Higher altitude than Juniper-Rhododendron Scrub • Altitudinal range: 4000-4600 m 	<i>Aconitum orochryseum, Astragalus acaulis, Chesneyanubigena, Cremanthodiumthomsonii, Ephedra gerardiana, Meconopsiscaldieriana, Rheum nobile, Rhododendron anthopogon, Salix lindleyana, Saussureagossypiphora, S. obvallata, Saxifraga moorcroftiana, Tanacetumgossypinum, Thermopsisbarbata</i>
12	Not sure	NS	<ul style="list-style-type: none"> • When the data collector is not sure or doesn't know, which category of Forest type to record the plot into, it may be recorded as "Not Sure" 	-

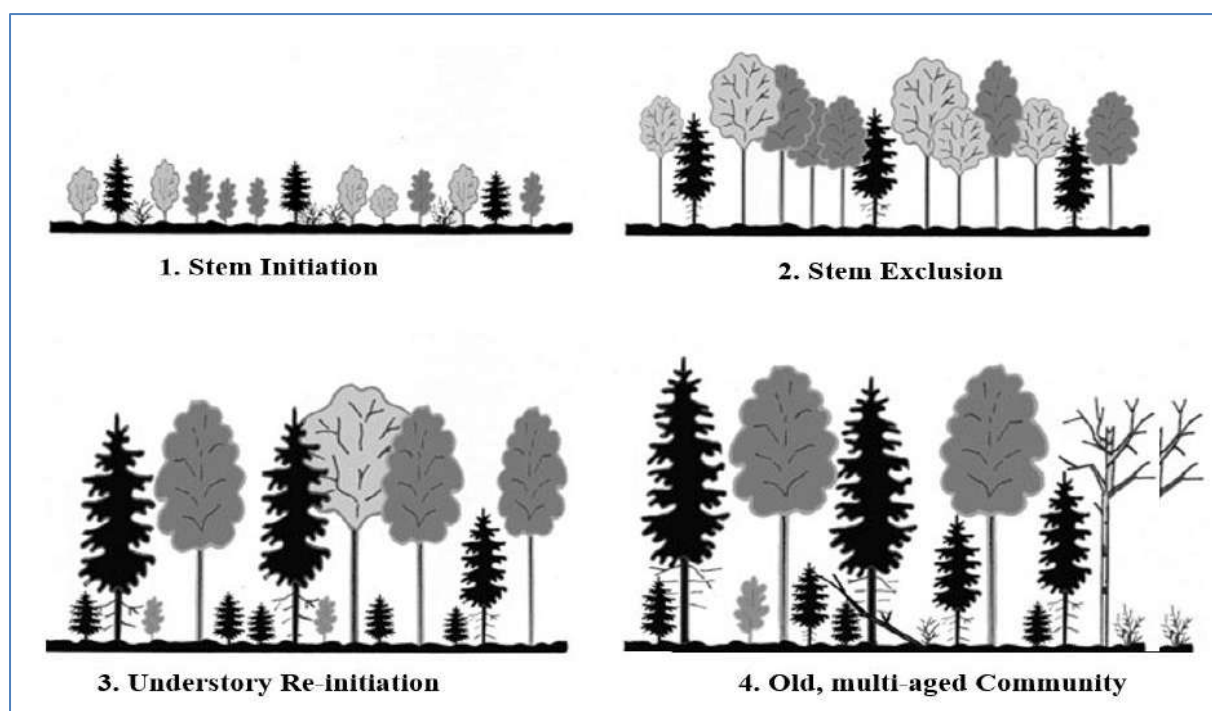


Figure 0.4 Forest stand development stages

Table 1.12 List of Non-Wood Forest Produce that can be collected and traded

Sl. No	Name		Part(s) used
	Scientific	Local	
1	<i>Aconitum laciniatum</i>	Bongkar (Dz), Maanchhen (Ts)	Root / tuber
2	<i>Aconitum orochryseum</i>	Bong nga (Ts), Bongkar Med)	
3	<i>Aconogonum tortusum</i>	Ngalachog(Dz)	Root
4	<i>Acorus calamus</i>	Chudar or chudala (Dz), bojo or bojho (Lh), bar-tsi (Ts)	Rhizome
5	<i>Artemisia spp.</i>	Khempa (Dz), Titey-pati (Lh)	Leaf, twig and stem
6	<i>Asphaltumpunjabinum</i> /A. <i>amomalutum</i>	Shilajit	Refine part / processed
7	<i>Bambusa clavata</i>	Chiley bans (Lh), Pagshing (Dz), Pagshi (Kh), Soo (Ts)	Culms, young shoots
8	<i>Bambusa nutans</i>	Jhushing (Dz), Mal bans (Lh), Jushi / Gren (Kh)	
9	<i>Borindagrossa</i>	Baa (Dz); Rhui (Bu &Kh) shee / shi (Ts)	Culms
10	<i>Cassia fistula</i>	Golden shower (Eng), Rajbriksha or Rajbrikshay (Lh), Donkasey or Donko shing (Ts), Donga (Med)	Pods and seeds
11	<i>Choerospondia axillaris</i>	Lapsi(Lh)	Fruits
12	<i>Ophiocordyceps sinensis</i>	Yar-tshaguenbub (Dz), yar-tsagumba (Lh)	Entire form
13	<i>Cymbopogon spp.</i>	Sorbhang (Ts), Lemon grass (Eng)	Upper parts
14	<i>Daphne spp.</i>	Dheynap (Dz), Kaga-tey, Kagati, Lokta in (Lh)	Bark
15	<i>Edgeworthia gardneri</i>	Dheykap (Dz), Argaylee (Lh)	
16	<i>Dendrocalamus hamiltonii</i>	Pagshi (Dz), Tama, choya or jungali bans (Lh), Leeshing, or gugsho (Ts), Soo (Kh)	Culm, young shoots
17	<i>Diplazium esculentum</i>	Nakey(Dz), Dhawai(Ts)	Young shoots
18	<i>Diploknema butyracea</i> (Syn. <i>Aesandrabutyraea</i> , <i>Bassia butyracea</i>)	Chiuri (Lh), Butter tree (En), Yegashi (Dz), Pin-shing (Ts)	Fruits

Table 1.13: List of Bamboos of Bhutan

Sl.No	Botanical name	Local name
1	<i>Ampelocalamus patellaris</i>	Dhemm or Shogodhong(Ts)
2	<i>Arundinaria racemosa</i>	Sui chung(Ts)
3	<i>Bambusaalamii</i>	Dhemm(Ts),Mugi bans(Lh)
4	<i>Bambusabalcooa</i>	Zhooshing(Dz),Soh(Ts),Dhanu bans(Lh)
5	<i>Bambusaclavata</i>	Pagshing (Dz), Pagshi (Kh), Soo (Ts),Chiley bans (Lh)
6	<i>Bambusa nutans(subsp. Cupalata)</i>	Jhushing (Dz), Mal bans (Lh), Jushi / Gren (Kh)
7	<i>Bambusatulda</i>	Juhu shing(Dz)
8	<i>Bambusa vulgaris</i>	Soh(Ts)
9	<i>Bambusa pallida</i>	
10	<i>Borindagrossa</i>	Baa (Dz); Rhui (Bu &Kh) shee / shi (Ts)
11	<i>Cephalostachyumlatifolium</i>	Jhi(Dz), Soh(Ts),Ghopi bans(Lh)
12	<i>Chimonobambuscallosa</i>	
13	<i>Dendrocalamusgiganteus</i>	Pagshi (Dz), Tama, Leeshing(Ts),
14	<i>Dendrocalamushamiltonii</i>	Pagshi (Dz), Leeshing, or gugsho (Ts), Tama, choya or jungali bans (Lh),Soo (Kh)
15	<i>Dendrocalamushookeri</i>	
16	<i>Drepanostachyummannulatum</i>	Him (Dz), Sheechung(Ts), Ban nigalo(Lh)
17	<i>Drepanostachyum intermedium</i>	Sheedaza(Ts), Titenigalo(Lh)
18	<i>Drepanostachyum khasianum</i>	Daohe(Dz), Tsongsuiza(Ts), Ban nigalo(Lh)
19	<i>Himalayacalamusfalconeri</i>	Soh zuima(Ts),Singhane(Lh)
20	<i>Himalayacalamushookerianus</i>	Soh shee(Ts), Padang or Parang(Lh)
21	<i>Melocannabaccifera</i>	Philim bans/Lahure bans (Lh)
22	<i>Neomicrocalamusandropogonifolius</i>	Reengshu (Ts), Langma (Lh)
23	<i>Pseudostachyum polymorphum</i>	Soh kurpee (Ts), Philim (Lh)
24	<i>Teinostachyumdulloo</i>	Tokhre bans (Lh)
25	<i>Thamnocalamusspathiflorus</i>	Hum (Dz), Ratonigalo (Lh)
26	<i>Yushania hirsute</i>	Hima (Dz), Suizachilo (Ts)
27	<i>Yushaniamaling</i>	Suiza (Ts), Maling (Lh)
28	<i>Yushaniamicrophylla</i>	Mingma (Dz), Suizadhoomba (Ts)
29	<i>Yushaniapantlingii</i>	Threyshee (Ts)
30	<i>Yushaniasagittifera</i>	Damo Dew-Yangka (Arrow bamboo)

Source: Bamboos of Bhutan, An Illustrated Guide-Chris Stapleton Royal Botanic Garden, Kew on behalf of The overseas Development Administration, London. (Local names derived from “Know the Plants of Bhutan-Vol II” by Ugyen Thinley)

Dorjee et al., 2020. *Yushaniasagittifera* (Poaceae: Bambusoideae), a new species discovery from Bhutan
Dorjee, S., Stapleton, C.M.A., Chopel, U., Phurpa., Tshering, D. and Samdrup, Tshering. (2020). *Bambusa pallida* (Poaceae: Bambusoideae), a new record for Bhutan. *J.Amer.Bamboo.Soc.* 30:1-5.

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Table 1.14 Rough guide for identifying soil texture in the field

Soil Texture	Feel to fingers and visual	Ball formation		Sticki-ness	Ribbon formation
		When dry	When moist		
Sand	Very gritty and individual grains visible, free flowing when dry	Does not form ball (falls apart when pressure is released)	Does not form ball (Ball crumbles when lightly touched)	Does not stain fingers	No ribbon formation
Sandy Loam	Moderately gritty (sand characteristic predominates)	Forms a ball which falls apart when lightly touched	Forms ball but easily broken	Stains the fingers	No ribbon formation
Loam	Neither very gritty nor very smooth	Forms ball but easily broken	Forms firm ball	Stains the fingers	No ribbon formation
Silt Loam	Smooth or slick "buttery" feel".	Forms ball but easily broken and has soft flour like feel	Forms firm ball	Stains the fingers	Slight tendency to ribbon with flaky surface
Silt	smooth feel	Forms firm ball	Forms firm ball		Slight tendency to ribbon with flaky surface
Clay Loam	Slightly gritty feel	Moderately hard ball	Forms firm ball which can be handled freely	Stains fingers	Ribbons on squeezing but ribbon breaks easily
Clay	Very smooth	Forms firm ball without breaking	Forms firm ball which can be handled freely and cannot be crushed with fingers when dry	Stains fingers	Squeezes out at right moisture into long ribbons

Table 1.15 Bamboos of Bhutan¹

Sl. No	Botanical name	Local name
1	<i>Ampelocalamus patellaris</i>	Dhemm or Shogodhong(Ts)
2	<i>Arundinaria racemosa</i>	Sui chung(Ts)
3	<i>Bambusaalamii</i>	Dhemm(Ts),Mugi bans(Lh)
4	<i>Bambusabalcooa</i>	Zhooshing(Dz),Soh(Ts),Dhanu bans(Lh)
5	<i>Bambusaclavata</i>	Pagshing (Dz), Pagshi (Kh), Soo (Ts),Chiley bans (Lh)
6	<i>Bambusanutans(subsp. Cupalata)</i>	Jhushing (Dz), Mal bans (Lh), Jushi / Gren (Kh)
7	<i>Bambusatulda</i>	Juhu shing(Dz)
8	<i>Bambusa vulgaris</i>	Soh(Ts)
9	<i>Borindagrossa</i>	Baa (Dz); Rhui (Bu &Kh) shee / shi (Ts)
10	<i>Cephalostachyumlatifolium</i>	Jhi(Dz), Soh(Ts),Ghopi bans(Lh)
11	<i>Chimonobambuscallosa</i>	
12	<i>Dendrocalamusgiganteus</i>	Pagshi (Dz), Tama, Leeshing(Ts),
13	<i>Dendrocalamushamiltonii</i>	Pagshi (Dz), Leeshing, or gugsho (Ts), Tama, choya or jungali bans (Lh),Soo (Kh)

¹Source: Bamboos of Bhutan, An Illustrated Guide-Chris Stapleton Royal Botanic Garden, Kew on behalf of The overseas Development Administration, London. (Local names derived from "Know the Plants of Bhutan-Vol II" by Ugyen Thinley)

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14	<i>Dendrocalamushookeri</i>	
15	<i>Drepanostachyummannulatum</i>	Him (Dz), Sheechung(Ts), Ban nigalo(Lh)
16	<i>Drepanostachyum intermedium</i>	Sheedaza(Ts), Titenigalo(Lh)
17	<i>Drepanostachyumkhasianum</i>	Daohe(Dz), Tsongsuiza(Ts), Ban nigalo(Lh)
18	<i>Himalayacalamusfalconeri</i>	Soh zuima(Ts),Singhane(Lh)
19	<i>Himalayacalamushookerianus</i>	Soh shee(Ts), Padang or Parang(Lh)
20	<i>Melocannabaccifera</i>	Philim bans/Lahure bans (Lh)
21	<i>Neomicrocalamusandropogonifolius</i>	Reengshu (Ts), Langma (Lh)
22	<i>Pseudostachyumpolymorphum</i>	Soh kurpee (Ts), Philim (Lh)
23	<i>Teinostachyumdulloo</i>	Tokhre bans (Lh)
24	<i>Thamnocalamusspathiflorus</i>	Hum (Dz), Ratonigalo (Lh)
25	<i>Yushania hirsute</i>	Hima (Dz), Suizachilo (Ts)
26	<i>Yushaniamaling</i>	Suiza (Ts), Maling (Lh)
27	<i>Yushaniamicrophylla</i>	Mingma (Dz), Suizadhoomba (Ts)
28	<i>Yushaniapantlingii</i>	Threyshee (Ts)

Table 1.16: List of Rhododendrons of Bhutan

Sl. No	Botanical name	Sl. No	Botanical name
1	<i>Rhododendron griffithianum</i>	24	<i>Rhododendron thomsonii</i>
2	<i>Rhododendron grande</i>	25	<i>Rhododendron edgeworthii</i>
3	<i>Rhododendron kesangiae</i>	26	<i>Rhododendron pendulum</i>
4	<i>Rhododendron falconeri</i>	27	<i>Rhododendron maddenii</i>
5	<i>Rhododendron hodgsonii</i>	28	<i>Rhododendron dalhousiae</i>
6	<i>Rhododendron campylocarpum</i>	29	<i>Rhododendron lindleyi</i>
7	<i>Rhododendron kendrickii</i>	30	<i>Rhododendron ciliatum</i>
8	<i>Rhododendron papillatum</i>	31	<i>Rhododendron triflorum</i>
9	<i>Rhododendron arboretum</i>	32	<i>Rhododendron nivale</i>
10	<i>Rhododendron niveum</i>	33	<i>Rhododendron vaccinioides</i>
11	<i>Rhododendron wightii</i>	34	<i>Rhododendron pumilum</i>
12	<i>Rhododendron bhutanense</i>	35	<i>Rhododendron cinnabarinum</i>
13	<i>Rhododendron lanatum</i>	36	<i>Rhododendron setosum</i>
14	<i>Rhododendron flinckii</i>	37	<i>Rhododendron keysii</i>
15	<i>Rhododendron tsariense</i>	38	<i>Rhododendron virgatum</i>
16	<i>Rhododendron campanulatum</i>	39	<i>Rhododendron leptocarpum</i>
17	<i>Rhododendron aeruginosum</i>	40	<i>Rhododendron camelliiflorum</i>
18	<i>Rhododendron wallichii</i>	41	<i>Rhododendron glaucophyllum</i>
19	<i>Rhododendron barbatum</i>	42	<i>Rhododendron lepidotum</i>
20	<i>Rhododendron argipeplum</i>	43	<i>Rhododendron baileyi</i>
21	<i>Rhododendron succothii</i>	44	<i>Rhododendron anthopogon</i>
22	<i>Rhododendron neriiflorum</i>	45	<i>Rhododendron pogonophyllum</i>
23	<i>Rhododendron fulgens</i>	46	<i>Rhododendron fragariflorum</i>



NATIONAL FOREST INVENTORY FIELD FORM
Plot Description Form

F5/18

Department of Forests and Park Services
Forest Resources Management Division

1. CP No

2. Plot Name Elbow ☐ North ☐ East ☐ (Tick the appropriate plot)

3. Date / /

4. Time / hrs

5. Location **Y** **X**

6. Topographic position (Tick appropriately)

i. Ridge top <input type="checkbox"/>	ii. Upper side hill <input type="checkbox"/>	iii. Middle side hill <input type="checkbox"/>	iv. Lower side hill <input type="checkbox"/>
v. Flat land <input type="checkbox"/>	vi. River bed <input type="checkbox"/>	vii. Gorge/Ravine <input type="checkbox"/>	

7. Aspect

i. Northern <input type="checkbox"/>	ii. North-eastern <input type="checkbox"/>	iii. Eastern <input type="checkbox"/>	iv. South-eastern <input type="checkbox"/>
v. Southern <input type="checkbox"/>	vi. South-western <input type="checkbox"/>	vii. Western <input type="checkbox"/>	viii. North-western <input type="checkbox"/>
ix. No aspect <input type="checkbox"/>			

8. Slope (Slope should be in degrees)

i. Slope up <input type="text"/>	ii. Slope down <input type="text"/>
----------------------------------	-------------------------------------

9. Stand description

i. Stand height m iia. Canopy tally iib. Canopy non-tally iic Canopy closure %

10. Land Ownership

i. SRFL ii. SRFL-PA iii. SRFL-FMU iv. SRFL-CF v. SRFL-Leased
vi. Private vii. Thromde viii. Thromde ix. Institutional x. Don't know

11. Land ownership certainty: Yes No

12. Land ownership note

13. Land Cover Type (Refer manual and enter appropriate land cover code)

14. Vegetation composition (Refer manual and enter appropriate vegetation composition code)

15. Forest type (Refer manual and enter appropriate forest type code)

16. Forest stand structure i. Even-aged stand ii. Uneven-aged stand

17. Forest stand development stage

i. Open ii. Stand initiation iii. Stand exclusion iv. Stand re-initiation
v. Old growth

18. Main understory type (Tick appropriately)

i. Moss ii. Grass iii. Herbs iv. Bamboo v. Shrubs vi. Others

19. Understory percent (%) :

20. Forest Resources

a. **Non-wood forest produce (NWFP)**

Sl. No.	Botanical Name	Common Name	Cover Percent
1			
2			
3			
4			
5			
6			

b. **Bamboo** a. Yes ☐ b. No ☐ (Tick against Yes, if the Bamboo is found, and No, if it is not found)

Sl. No.	Bamboo Botanical Name	Common Name	Cover Percent
1			
2			
3			
4			
5			

1. Bamboo regeneration

i. None ☐ ii. <10% ☐ iii. 10-20% ☐ iv. 20-50% ☐ v. > 50% ☐

c. **Cane** a. Yes ☐ b. No ☐ (Tick against Yes, if the Cane is found, and No, if it is not found)

Sl. No.	Cane Botanical Name	Common Name	Cover Percent
1			
2			
3			
4			
5			

d. **Daphne** a. Yes ☐ b. No ☐ (Tick against Yes, if the Daphne is found, and No, if it is not found)

1. Daphne cover percent

21. Snag a. Yes ☐ b. No ☐

22. Snag Count

23. Fallen Tree a. Yes ☐ b. No ☐

24. Fallen Tree Count

25. Disturbance

a. **Forest fire** a. Yes ☐ b. No ☐ (Tick against Yes, if there is evidence of fire, No if there is no evidence)

1. Intensity of forest fire

i. Heavy fire ☐ ii. Moderate fire ☐ iii. Light fire ☐ iv. No fire ☐

2. Type of forest fire

i. Ground fire ☐ ii. Surface fire ☐ iii. Crown fire ☐ iv. Not sure ☐ v. Not applicable ☐

b. **Grazing** a. Yes ☐ b. No ☐ (Tick against Yes, if there is evidence of grazing, No if there is no evidence)

1. Intensity of grazing

i. Low ☐ ii. Moderate ☐ iii. Severe ☐ iv. No grazing ☐

c. **Timber extraction** a. Yes ☐ b. No ☐ (Tick against Yes, if there is evidence of timber extraction, No if there is no evidence)

1. Type of timber extraction

i. Clear felling ☐ ii. Selective felling ☐ iii. Group felling ☐ iv. Others ☐ v. No felling ☐

d. **Mining** a. Yes ☐ b. No ☐ (Tick against Yes, if there is evidence of mining, No if there is no evidence)

1. Type of mining

i. Surface collection ☐ ii. Quarry ☐ iii. None ☐ iv. Don't know ☐

e. **Transmission line** a. Yes ☐ b. No ☐ (Tick against Yes, if there is transmission line, No if there is no evidence)

f. Garbage

i. Food wrappers ☐ ii. PET bottles ☐ iii. Construction wastes ☐ iv. All of above ☐ v. None ☐

26. Forest Health

a. Pest & Disease a. Yes ☐ b. No ☐

b. Mistletoe a. Yes ☐ b. No ☐

c. Dieback fir a. Yes ☐ b. No ☐

d. Bark beetle a. Yes ☐ b. No ☐

e. Others a. Yes ☐ b. No ☐

27. Litter, Humus and fuel bed

- a. Litter depth value (in cm)
- b. Humus depth value (in cm)
- c. Fuel bed depth value (in cm)
- d. Litter cover percent (in %)
- e. Bare soil cover percent (in %)

28. Soil

a. Stoniness

- i. None ii. Rare, < 10% iii. Few, 10-20% iv. Common, 20-30%
- v. Many, 20-30% vi. Abundant, >60%

b. Soil drainage

- i. Poorly drained ii. Moderately drained iii. Well drained

c. Top soil moisture

- i. Dry ii. Slightly moist iii. Moist iv. Wet v. Water-logged

d. Top soil colour

- i. Blackish ii. Reddish iii. Yellowish iv. Brownish v. Others

e. Top soil texture

- i. Sand ii. Sandy loam iii. Loam iv. Silt loam
- v. Silt vi. Clay loam vii. Clay

f. Gully evidence

- a. Yes b. No

g. Erosion evidence a. Yes ☐ b. No ☐

29. Water bodies

a. Stream a. Yes ☐ b. No ☐

b. River a. Yes ☐ b. No ☐

c. Wetland a. Yes ☐ b. No ☐

d. Lakes a. Yes ☐ b. No ☐

e. Glacier a. Yes ☐ b. No ☐

30. Site Value

a. Natural trail facility a. Yes ☐ b. No ☐

b. Scenic a. Yes ☐ b. No ☐

c. Visitor evidence
i. Yes, Local ☐ ii. Foreign Tourist ☐ iii. Yes, Both ☐ iv. Yes, Religious ☐ v. None evident ☐

d. Site Value
i. Yes, Cultural ☐ ii. Yes, historical ☐ iii. Yes, Religious ☐ iv. None ☐ v. None evident ☐

e. Site Name

f. Remarks:

1.5.4.2.6 Tree Data

Tree is a woody perennial with a single main stem, or, in the case of coppice, with several stems, having a more or less definite crown (FAO 2005). For NFI, any woody perennial that meet the definition of tree and has DBH of above 10 cm (both live and dead) falling within 12.62 m are considered as trees. Tree data is collected from all three plots of the cluster; Elbow, North and East plots. Follow the steps and description provided the *Table 1.17* to complete form F6/F18 with **tree data** and follow dbh measurement guidelines in *Box 1.2*, Tree species code and tree list in *Table 1.19*. Also use *Table 1.16* to record the species of Rhododendrons encountered. **Note:** *The same tree data collection Form is used for all three plots; Elbow, North and East.*

Table 1.17: Tree data collection

SN	Parameters	Description	Instructions or how to fill in Data Dictionary
1	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	1. Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. Note: <i>Paper Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot Name	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot	1. Choose appropriate plot name as it appears against it as drop-down list, on electronic form. 2. If paper forms have been used, tick the relevant plot from the three options provided.
3	Tree Location	Refers to the coordinate of the tree	Take a coordinate reading from the data logger/ Collect Mobile
4	Scientific Name	Refers to scientific or botanical name which conforms to the <i>International Code of Botanical Nomenclature (ICBN)</i> Tree names are provided in Table 1.19	1. Choose appropriate Botanical Name as it appears against it as drop-down list on electronic form. 2. If the name of the plant is not in the list, then provision for typing the botanical name is also provided. 3. If Paper forms have been used, record accordingly.
5	Common Name/ Local Name	“Common name” herein is referred to the commonly used name of a tree in English. "Local name" means name of tree in local dialect. For NFI, the Local Names in following dialects will be used; Dzongkha (Dz), Tshanglha kha (Ts), Lhotsham kha (Lh), Bumthangp (Bum), Khengkha (Kh), Mangdep kha (Mg) and Kurtoep kha (Kr).	1. The Crew may note either the common name or the local name of the plant. 2. In case of local name, specify dialect in which the local name has been given. (For <i>Quercus griffithii</i> , it is Baenangshing in Tshanglhakha , therefore, local name must be written as Baenangshing (Ts) , Ts indicates it is in Tshanglha kha)

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6	Tree tag No.	Refers to the pre-printed tree Tag no. assigned to a particular tree (ranges from 1 to 60000).	Type manually or select from the dropdown list
7	Witness Tree	Refers to whether or not this particular tree has been recorded as a Witness Tree (WT) for PC.	If this tree has been already recorded as WT, record as “Yes”, otherwise “No”.
8	Tree Distance Horizontal	Refers to the horizontal distance of the tree from the PC	<ol style="list-style-type: none"> 1. Measure the distance of the tree from the PC using Hypsometer. 2. In dense forest where use of Hypsometer may not be possible, measure the distance using measuring tape. 3. This distance must be recorded to one decimal place in meter (m)
9	Tree Distance Slope	Refers to the slope distance of the tree from the PC	<ol style="list-style-type: none"> 1. Measure the distance of the tree from the PC using Hypsometer. 2. In dense forest, where use of Hypsometer may not possible, measure the distance using measuring tape. 3. This distance must be recorded to one decimal place in meter (m)
10	Azimuth	Refers to the angle from North at which the tree is located, as measured from PC	<ol style="list-style-type: none"> 1. Measure the Azimuth of a tree using compass by standing at the center of the plot 2. Record the Azimuth in Degrees to one decimal place.
11	DBH	Refers to Diameter measured at Breast Height. It is defined as a method of dendrometric measurements wherein the diameter is measured at Breast Height which is 1.37 m height from the ground.	<ol style="list-style-type: none"> 1. Measure the DBH and record accordingly. 2. Record DBH in centimeter (cm) to one decimal place. <p><i>Note: Standard Rules for measuring DBH is given in Box 1.2 .</i></p>
12	Total Height	Refers to the height of a tree which is the length of tree from Ground till Tip.	<ol style="list-style-type: none"> 1. Measure the height of tree using Hypsometer. 2. Measure the height by standing on uphill side of the tree on a slope. 3. Record the height in meters (m) to once decimal place.
13	Bole Height	The distance between ground level and crown point (<i>the position of the first crown forming living or dead branch</i>) is defined as Bole Height.	<ol style="list-style-type: none"> 1. Measure the bole height using hypsometer. 2. Record the bole height in meter to one decimal place. <p><i>Note: The measurement should be taken by standing on uphill side of the tree on a slope.</i></p>

14	Crown Length	The vertical measurement of crown from the tip of the crown to the point, half way between lowest green branch forming green crown all around and the lowest green branch on the bole is Crown Length.	<ol style="list-style-type: none"> 1. Measure the crown length of tree using Hypsometer. 2. Record the crown length in meter to one decimal place. <p><i>Note: The measurement should be taken by standing on uphill side of the tree on a slope.</i></p>
15	Crown Position	<p>This refers to the position of crown of a tree in relation to the adjacent trees. It is categorized as;</p> <ol style="list-style-type: none"> a. Dominant Trees: Trees which form the upper most leaf canopy and have their leading shoots free. These trees are called best trees. b. Dominated Trees: Trees which do not form part of the upper most leaf canopy but leading shoots of which are definitely not over-topped by neighboring trees. Their height is about 3/4 of the tallest tree which falls within the plot. c. Suppressed Trees: Trees which reach only about 1/2 to 5/8 of the height of the best trees, with their shoots over-topped by the neighboring trees. d. Solitary Trees: Trees which stand scattered or stand individually. 	Observe ocularly and select the appropriate category of crown position of tree from the drop-down list on electronic form or tick appropriately on paper form.
16	Condition of Tree	<p>Refers to state of the tree. The condition of the tree will be categorized as:</p> <ol style="list-style-type: none"> 1. Healthy: Tree is free of disease or abnormality and damage. 2. Diseased: Tree is infected with pests and diseases. 3. Abnormal and Damaged: Tree is moribund, damaged or hollowed, etc. 4. Dead: Dead standing tree 	Observe and record the condition of tree by choosing the appropriate category from the drop-down option on the electronic form or tick appropriate category on paper form. .
17	Bark Thickness	Refers to thickness or amount of bark around a tree from outer surface till cambium/wood of a tree.	<ol style="list-style-type: none"> 1. Measure the Bark thickness using Bark gauge. 2. Measure the bark thickness at DBH. 3. Press Bark gauge against bark until wood is reached and read the scale to determine bark thickness. 4. Record the bark thickness in centimeter to one decimal place.

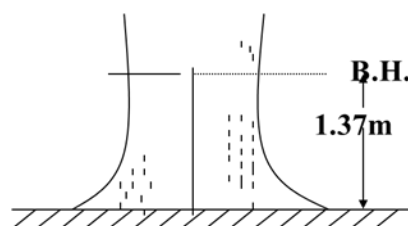
18	Core Taken	Refers to whether or not the tree is cored. Tree Cores will be used for estimating the age of the tree and; also, to study and understand the growth of trees. If selected for coring, two cores will be taken from one tree. Coring technique is provided separately. Only one tree per diameter class will be cored. However, if a plot has less than 5 trees, all trees may be cored.	<ol style="list-style-type: none"> 1. If the tree is selected for coring and the tree core is taken, record as “Yes” otherwise “No”. 2. Segregate the trees into diameter-class of 10 cm interval (eg.10-20, 20-30...) 3. Select one tree each from each diameter class for coring. 4. Core the tree using increment borer. 5. Bring the core back to laboratory for analysis. <p><i>Note: Use of increment borer is provided separately.</i></p>
19	Total rings of core 1	Refers to the number of rings in the core 1	Count the number of rings and record accordingly.
20	Length of core 1	Refers to length of the core 1 taken.	Measure the length of core with ruler and record the length in centimeter (cm).
21	Total rings of core 2	Refers to the number of rings in the core 2	Count the number of rings and record accordingly.
22	Length of core 2	Refers to length of the core 2 taken.	Measure the length of core with ruler and record the length in centimeter (cm).
23	Remarks	Any useful remarks related to this particular tree.	Crews may or may not provide remarks. e.g all tree recorded in the plot are less than 30cm diameter, 20m height and it's a pure stand

Note: Not all trees falling within the plots shall be cored. Only one tree per diameter class shall be cored and diameter classes shall be 10-20, 20-30 and so on.

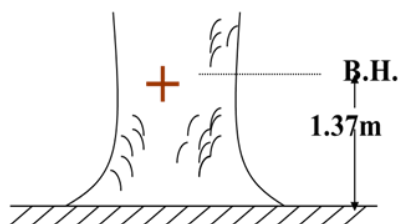
Box 1.2: Standard rules for measuring Tree DBH

Diameter at Breast Height (DBH) is the diameter of a tree measured at 1.37m above ground. The DBH over bark and under bark are abbreviated as DBH (O.B) and DBH (U.B) respectively. A few but very important rules one must follow while measuring DBH are;

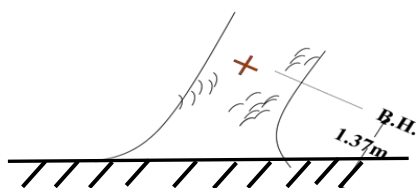
1. Loose bark/ creepers/mosses if found on the tree especially near breast height shall be removed before measuring the diameter.
2. Mark BH by means of measuring stick or white paint or a soft nail (e.g. aluminum) driven into the bark or a scribe mark.



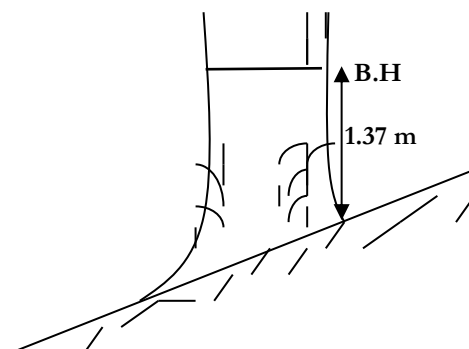
3. On a Flat ground and if the tree is straight, the DBH is taken as depicted in figure below;



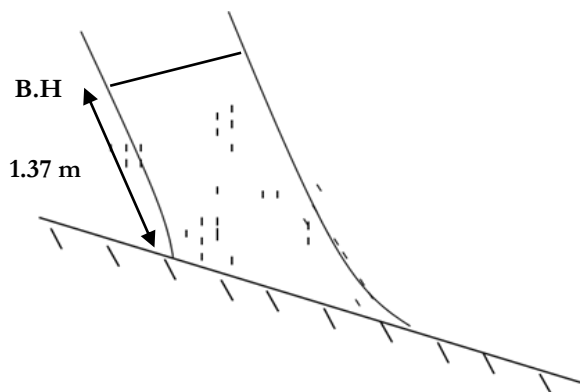
4. If the ground is flat and the tree is leaning, then measure DBH parallel to the tree stem and not vertically, on the side of the lean as shown below.



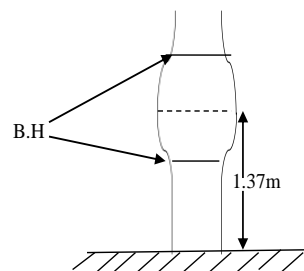
5. On a **sloping** ground with **straight tree**, the DBH is measured from the up- hill side as shown below.



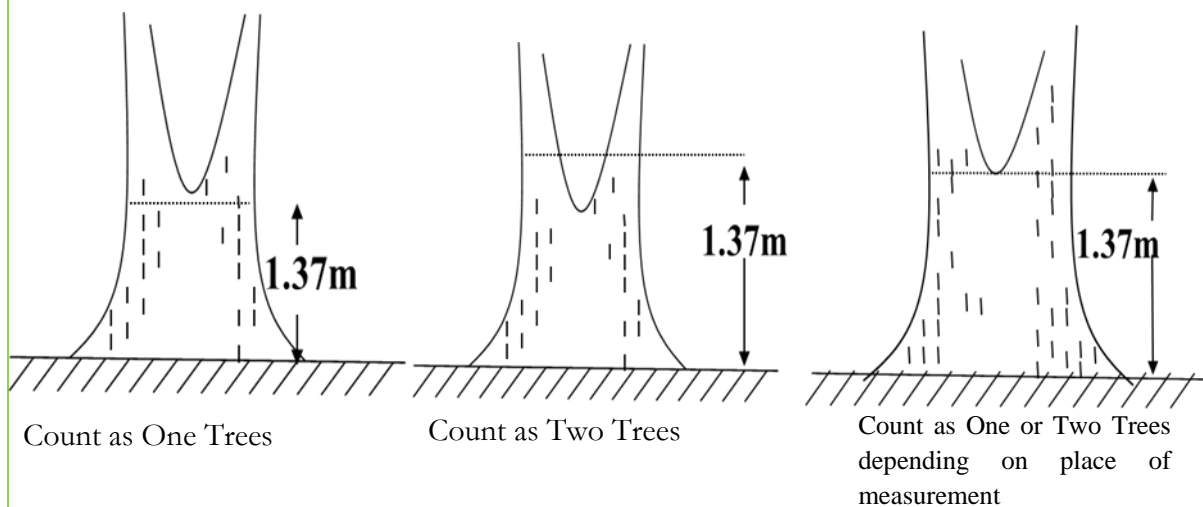
6. On a sloping ground with tree leaning against the direction of slope, measure DBH parallel the tree stem and not vertically, on the side of the lean as shown below.
7. On sloping ground with tree leaning towards uphill slope, measure DBH parallel to the tree stem and not vertically, on the side of the lean as shown below.



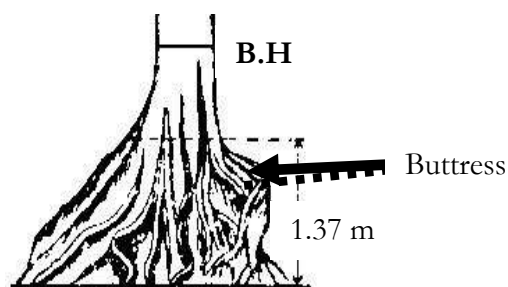
8. If the tree stem is abnormal at Breast Height level, DBH is measured not exactly at 1.37 m but measurement mark is slightly shifted up or down (*as little as possible*) to a more normal position of the stem as shown below.



9. If the stem is Forked, then



10. Tree stem has buttress at breast height level, then DBH is measured at the lowest point above which the abnormal formation is not likely to extend.





NATIONAL FOREST INVENTORY FIELD FORM Tree Data Form

F6/18

Department of Forests and Park Services
Forest Resources Management Division

1. CP No
2. Plot Name Elbow ☐ North ☐ East ☐ (Tick the appropriate plot)
3. Date / / 4. Time / hrs

Tree Data Form (>10 cm DBH)

SN	Location		Scientific name	Local name	Tree tag No	Witness Tree	Distance Horizontal (m)	Distance Slope (m)	Azimuth (degree)	DBH (cm)	Height (m)	Bole height (m)	Crown length (m)	Crown position	Condition of Tree		Bark thickness (cm)	Core Taken		Core 1		Core 2	
	Lat	Lon													Live	Dead		Yes	No	Ring No	Ring Length	Ring No	Ring Length

Crown position

SN	Crown position	code
1	Dominant	D1
2	Dominated	D2
3	Suppressed	S1
4	Solitary	S2

1.5.4.2.7 Sapling data

All tree species having DBH above 5 cm but less than 10 cm shall be classified as Sapling. Sapling data shall be collected from 12.62 m radius plot of all three plots (Elbow, North and East). The form F7/F18 shall be completed with **sapling data** and follow the steps and description provided the *Table 1.18* and follow dbh measurement guidelines in *Box 1.2*, Tree species code and tree list in *Table 1.19*. Also use *Table 1.16* to record the species of Rhododendrons encountered.

Table 1.18: Sapling Data Collection

SN	Data Items	Description	Instructions
1	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot Name	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot	Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
4	Scientific Name	Refers to scientific or botanical name which conforms to the <i>International Code of Botanical Nomenclature (ICBN)</i> . The list of trees are provided in Table 1.17.	1. Choose appropriate Botanical Name as it appears against it as drop-down list on electronic form. 2. If the name of the plant is not in the list, then provision for typing the botanical name is also provided. 3. If Paper forms have been used, record accordingly.
5	Common Name/ Local Name	“Common name” herein is referred to the commonly used name of a tree in English. "Local name" means name of tree in local dialect. For NFI, the Local Names in following dialects will be used; Dzongkha (Dz), Tshanglha kha (Ts), Lhotsham (Lh), Bumthangp (Bum), Khengkha (Kh), Trongsap (Tr) and Kurtoep (Kr).	1. The Crew may note either the common name or the local name of the plant. 2. In case of local name, Crew must specify dialect in which the local name has been given. (For <i>Quercus griffithii</i> , it is Baenangshing in Tshanglha kha , therefore, local name must be written as Baenangshing (Ts) , Ts indicates it is in Tshanglha kha).
6	Number of individuals	Refers to the number of saplings of that particular species found within a plot.	1. Count the number of saplings of one species and record the observation. <i>Note: If there are more than one species, open same electronic field form (electronic form) and fill it up as being done for first species.</i> 2. For paper field forms, write the species name and record the number accordingly.

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7	Sapling average diameter at breast height (dbh)	Refers to average diameter at breast height of the saplings recorded in that particular plot	<ol style="list-style-type: none">1. Measure diameter at breast height of all the saplings recorded in that particular plot and average them.2. Record the average diameter in centimeter to one decimal place.
8	Layer height	Refers to the average height of sapling in meters	Record the average height of the sapling in meters
9	Cover percent	Refers to the percentage of the plot area that is covered by sapling.	Ocularly estimate as to the extent of coverage of sapling within 12.62 m plot and record it in terms of percentage.
10	Remarks	Any useful remarks related to the sapling	Crews may or may not provide remarks.

F7/18

1. CP No

2. Plot Name Elbow North East (Tick the appropriate plot)

3. Date / / 4. Time / hrs

[illegible]

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Table 1.19: Tree species list and species code

Species code	Botanical Name	Family	Common Name			
			Dzongkha	English	Tshanglakha	Lhotshamkha
1	<i>Abies densa</i>	Pinaceae	Dhungshing	Fir	Waang shing	Gobresalla
2	<i>Acacia auriculiformis</i>	Leguminosae				Akasmoni
3	<i>Acacia catechu</i>	Leguminosae				Khair
4	<i>Acacia lenticularis</i>	Leguminosae				Kakur
5	<i>Acacia mearnsii</i>	Leguminosae		Black wattle		
6	<i>Acacia</i> spp.	Leguminosae				
7	<i>Acer campbellii</i>	Sapindaceae	Chalam	Maple	Sermaling shing/Busung Jashing	
8	<i>Acer laevigatum</i>	Sapindaceae				Putli
9	<i>Acer oblongum</i>	Sapindaceae				
10	<i>Acer</i> spp.	Sapindaceae				
11	<i>Acrocarpus fraxinifolius</i>	Leguminosae	Cha shing		Choktse shing	Mandalhy
12	<i>Actinodaphne obovata</i>	Lauraceae				
13	<i>Actinodaphne</i> spp.	Lauraceae				
14	<i>Acuba</i> spp.	Lauraceae				
15	<i>Adina cordifolia</i>	Rubiaceae				Haldu, Karan
16	<i>Aesculus assamica</i>	Sapindaceae		Horse chestnut		Satpati
17	<i>Agapetes saligna</i>	Ericaceae				
18	<i>Aglaia spectabilis</i>	Meliaceae				
19	<i>Agrostistachys borneensis</i>	Euphorbiaceae				
20	<i>Ailanthus excelsa</i>	Simaroubaceae				Maharukh
21	<i>Ailanthus grandis</i>	Simaroubaceae	Poeaka shing		Pokar shing	
22	<i>Ailanthus integrifolia</i>	Simaroubaceae				Gokul
23	<i>Ailanthus</i> spp.	Simaroubaceae				
24	<i>Alangium alpinum</i>	Cornaceae				Galasu
25	<i>Alangium chinense</i>	Cornaceae	Luma shing			
26	<i>Alangium</i> spp.	Cornaceae				
27	<i>Albizia falcataria</i>	Leguminosae				
28	<i>Albizia julibrissin</i>	Leguminosae				
29	<i>Albizia lebbeck</i>	Leguminosae				Kalosiris
30	<i>Albizia lucidior</i>	Leguminosae				
31	<i>Albizia odoratissima</i>	Leguminosae				Karkursiris
32	<i>Albizia procera</i>	Leguminosae				Setosiris
33	<i>Albizia</i> spp.	Leguminosae				
34	<i>Alcimandra cathcartii</i>	Magnoliaceae		Golden trumpet		Titechamp
35	<i>Alcimandra</i> spp.	Magnoliaceae				
36	<i>Alnus nepalensis</i>	Betulaceae	Gama	Alder		
37	<i>Alnus</i> spp.	Betulaceae				
38	<i>Alstonia neriifolia</i>	Apocynaceae				
39	<i>Alstonia scholaris</i>	Apocynaceae				
40	<i>Altingia excelsa</i>	Altingiaceae				Setikath, Jhikri, jutuli
41	<i>Amoora rohituka</i>	Meliaceae				Lahasune
42	<i>Amoora</i> spp.	Meliaceae				
43	<i>Amoora wallichii</i>	Meliaceae				Lali, Amari
44	<i>Anogeissus latifolia</i>	Combretaceae				
45	<i>Anthocephalus cadamba</i>	Rubiaceae				Kadam
46	<i>Aphanamixis polystachya</i>	Meliaceae			wagorey doroshing	

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47	<i>Aphanamixis spp.</i>	Meliaceae				
48	<i>Aquilaria malaccensis</i>	Thymelaeaceae	Aarnag	Eaglewood	Aarnag	Agoor/Agar
49	<i>Artocarpus chama</i>	Moraceae			Yitsu sing	Lathar
50	<i>Artocarpus heterophyllus</i>	Moraceae	Dam-zay shing		Drembling sey	Rukkathal
51	<i>Artocarpus hirsuta</i>	Moraceae			Aini koko	
52	<i>Artocarpus lacucha</i>	Moraceae				barrar, dewa
53	<i>Artocarpus spp.</i>	Moraceae				
54	<i>Aucuba himalaica</i>	Garryaceae				
55	<i>Azadirachta indica</i>	Meliaceae	Ja shing		Lhyra shing	Bakaina, Lhem
56	<i>Baccaurea ramiflora</i>	Phyllanthaceae				Kusum
57	<i>Baccauria spp.</i>	Phyllanthaceae				
58	<i>Barleria prionitis</i>	Acanthaceae				
59	<i>Bauhinia purpurea</i>	Leguminosae	Zibzibshing		Pegpeyposhing	
60	<i>Bauhinia sp.</i>	Leguminosae				
61	<i>Bauhinia variegata</i>	Leguminosae	Ruchashing		Ruchashing	Koiralo
62	<i>Beilschmiedia dalzellii</i>	Lauraceae				Tarshing
63	<i>Beilschmiedia gammieana</i>	Lauraceae			Golong shing	Tarshing
64	<i>Beilschmiedia roxburghiana</i>	Lauraceae				Thulotarshing
65	<i>Beilschmiedia sikkimensis</i>	Lauraceae				
66	<i>Beilschmiedia spp.</i>	Lauraceae				
67	<i>Benthamedia capitata</i>	Cornaceae	Phoetshe		Namenpa shing	Ramkatar
68	<i>Betula alnoides</i>	Betulaceae	Taap shing	Birch	Chaar shing	Saur
69	<i>Betula spp.</i>	Betulaceae		Birch		
70	<i>Betula utilis</i>	Betulaceae	La taap		Phuga chaar shing	Bhojpatra
71	<i>Bischofia javanica</i>	Phyllanthaceae	Goile shing	Black jack		Kanjai
72	<i>Boehmeria rugulosa</i>	Urticaceae			Dongtsong	Dar
73	<i>Bombax ceiba</i>	Malvaceae	Pemageyershing	Red Cotton Tree	Pemageyershing	Simal
74	<i>Brassaiopsis hainla</i>	Araliaceae				Chuletro
75	<i>Brassaiopsis hispida</i>	Araliaceae				Phutta
76	<i>Brassaiopsis mitis</i>	Araliaceae				Chuletro
77	<i>Brassaiopsis spp.</i>	Araliaceae				Chuletro
78	<i>Bridelia retusa</i>	Phyllanthaceae	Treta shing		Menchha shing	Gayo, Gaumbha, kuir, kulir
79	<i>Bridelia tomentosa</i>	Phyllanthaceae				Muse Gayo
80	<i>Callicarpa arborea</i>	Lamiaceae	Khalema		Jeesey shing	Guyelo
81	<i>Calophyllum polyanthum</i>	Clusiaceae				
82	<i>Camellia kissii</i>	Theaceae	Yangchen metog		Hinguwa	
83	<i>Canarium sikkimense</i>	Burseraceae		Hornbeam		Gokul Dhup
84	<i>Carpinus viminea</i>	Betulaceae	Rutoshing		lungshing	
85	<i>Caryota urens</i>	Arecaceae	Dung Dung kha			
86	<i>Cassia fistula</i>	Leguminosae	Chakap-Juma shing		Dongkashing	Rajbirse
87	<i>Cassia siamea</i>	Leguminosae	Minjuri			Minjuri
88	<i>Castanopsis hystrix</i>	Fagaceae	Sokey		Tshe shing	Katus
89	<i>Castanopsis indica</i>	Fagaceae	Sokey		Tshe shing	Aule Katus
90	<i>Castanopsis lanceifolia</i>	Fagaceae				Patle katus
91	<i>Castanopsis spp.</i>	Fagaceae				
92	<i>Castanopsis tribuloides</i>	Fagaceae	Sokey			Musrekatus
93	<i>Cedrela toona</i>	Meliaceae				Tooni

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94	<i>Celtis australis</i>	Cannabaceae	Phantang		Sok sokpa shing	Khari
95	<i>Choerospondias axillaris</i>	Anacardiaceae	Charra shing		Throong-chung shing	Lapshi
96	<i>Chukrasia tabularis</i>	Meliaceae	Chuzim			Halonre, Katli
97	<i>Cinnamomum bejolghota</i>	Lauraceae	Drongdo		Tespar shng chilloo	Bhhalesinkoli
98	<i>Cinnamomum glaucescens</i>	Lauraceae	Phagpa neng shing		Shingtsazim	Kawla or Malagiri
99	<i>Cinnamomum impressinervium</i>	Lauraceae				Sissi, Korsane
100	<i>Cinnamomum javanicum</i>	Lauraceae				Dalchini
101	<i>Cinnamomum spp.</i>	Lauraceae				
102	<i>Cinnamomum tamala</i>	Lauraceae				Tejpat
103	<i>Cordia grandis</i>	Boraginaceae				
104	<i>Cordia obliqua</i>	Boraginaceae				
105	<i>Coriaria nepalensis</i>	Coriariaceae	Limphu shing		Thabshing	
106	<i>Corylopsis himalayana</i>	Hamamelidaceae				
107	<i>Corylus ferox</i>	Betulaceae				
108	<i>Croton himalaicus</i>	Euphorbiaceae				
109	<i>Croton tiglium</i>	Euphorbiaceae	Lapcha			
110	<i>Cryptomeria japonica</i>	Cupressaceae	Ja tshen shing		Japan shoogpu	Dhupi
111	<i>Cupressus corneyana</i>	Cupressaceae	Tshenden shing			
112	<i>Cupressus spp.</i>	Cupressaceae				
113	<i>Cyathea spinulosa</i>	Cyatheaceae				
114	<i>Dalbergia latifolia</i>	Leguminosae		Rosewood		Satisal
115	<i>Dalbergia sericea</i>	Leguminosae	Pchang			Bandre siris
116	<i>Dalbergia sissoo</i>	Leguminosae	Jesengshing or Tshe-nen shing		Sissoo shing	Sissoo
117	<i>Daphniphyllum chartaceum</i>	Daphniphyllaceae	Juru shing		Awa shing	Chandan
118	<i>Daphniphyllum himalense</i>	Daphniphyllaceae				Chandan
119	<i>Delonix regia</i>	Leguminosae				Gul Mohar
120	<i>Desmodium oojenense</i>	Leguminosae				
121	<i>Dillenia indica</i>	Dilleniaceae				Panchphale
122	<i>Dillenia pentagyna</i>	Dilleniaceae				Tantri
123	<i>Diploknema butyracea</i>	Sapotaceae	Yeeka shing		Peen shing	
124	<i>Dipterocarpus macrocarpus</i>	Dipterocarpaceae			Hollong	
125	<i>Drimycarpus racemosus</i>	Anacardiaceae				
126	<i>Drypetes indica</i>	Putranjivaceae				
127	<i>Duabanga grandiflora</i>	Lythraceae	Patang shing		Bikaling shing	Lampate
128	<i>Echinocarpus decicarpus</i>	Elaeocarpaceae				Gobrel
129	<i>Elaeocarpus sikkimensis</i>	Elaeocarpaceae				Bhadrased
130	<i>Elaeocarpus sphaericus</i>	Elaeocarpaceae				Rhudrax
131	<i>Elaeocarpus varunua</i>	Elaeocarpaceae				Bhadrased
132	<i>Engelhardtia spicata</i>	Juglandaceae				Mauwa
133	<i>Enkianthus deflexus</i>	Ericaceae				
134	<i>Eriobotrya petiolata</i>	Rosaceae				Maya kath
135	<i>Eriobotrya bengalensis</i>	Rosaceae				Maya kath
136	<i>Erythrina arborescens</i>	Leguminosae	Chatshey shing		Karshing	
137	<i>Erythrina spp.</i>	Leguminosae				Phaledo
138	<i>Erythrina stricta</i>	Leguminosae				Phaledo
139	<i>Erythrina suberosa</i>	Leguminosae				Phaledo

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140	<i>Eucalyptus camaldulensis</i>	Myrtaceae	Tobdashin	Red gum		
141	<i>Eucalyptus globulus</i>	Myrtaceae	Tobdashin	Blue gum		
142	<i>Eucalyptus spp.</i>	Myrtaceae				
143	<i>Euphorbia spp.</i>	Euphorbiaceae				
144	<i>Eurya acuminata</i>	Pentaphylacaceae				
145	<i>Eurya cavinervis</i>	Pentaphylacaceae				
146	<i>Eurya cerasifolia</i>	Pentaphylacaceae				
147	<i>Eurya spp.</i>	Pentaphylacaceae				
148	<i>Evodia fraxinifolia</i>	Rutaceae				Khanakpa
149	<i>Exbucklandia populnea</i>	Hamamelidaceae	Chenjushing		Lem shing	
150	<i>Ficus auriculata</i>	Moraceae	Baku shing		Chongma	Lhbharo
151	<i>Ficus glaberrima</i>	Moraceae			Pangthang chongma	Karpoa
152	<i>Ficus hispida</i>	Moraceae	Koksa			Koksa
153	<i>Ficus lacor</i>	Moraceae				
154	<i>Ficus neriifolia</i>	Moraceae			Rui shing	
155	<i>Ficus semicordata</i>	Moraceae	Ridang shing		Barachongma	Khalhw
156	<i>Ficus spp.</i>	Moraceae				
157	<i>Ficus subincisa</i>	Moraceae			Gugai chongma	Looteykhaniun
158	<i>Fraxinus spp.</i>	Moraceae				
159	<i>Fraxinus xanthoxyloides</i>	Oleaceae				Lankuri
160	<i>Gamblea ciliata</i>	Araliaceae				
161	<i>Garcinia stipulata</i>	Clusiaceae				
162	<i>Garuga pinnata</i>	Burseraceae				Dur Lampate
163	<i>Glochidion assamicum</i>	Phyllanthaceae				
164	<i>Glochidion bhutanicum</i>	Phyllanthaceae			Kotokmo shing	
165	<i>Glochidion thomsonii</i>	Phyllanthaceae				
166	<i>Gmelina arborea</i>	Lamiaceae	Gamar shing		Kholomshing	Khamari
167	<i>Grevillea robusta</i>	Proteaceae		Silver oak		
168	<i>Grewia asiatica</i>	Malvaceae				
169	<i>Grewia optiva</i>	Malvaceae				
170	<i>Gynocardia odorata</i>	Achariaceae	Lentem			
171	<i>Helicia nilagirica</i>	Proteaceae				
172	<i>Heteropanax fragrans</i>	Araliaceae				
173	<i>Holoptelea integrifolia</i>	Ulmaceae				
174	<i>Hovenia acerba</i>	Rhamnaceae	Pumoo ruto		Froomtegepa shing	Bhogote
175	<i>Hovenia dulcis</i>	Rhamnaceae				Bange Kath
176	<i>Hymenodictyon excelsum</i>	Rubiaceae	Lalikaram			Lalikaram
177	<i>Illicium griffithii</i>	Schisandraceae	Dhom leeshi		Khaila tseenang	
178	<i>Itea macrophylla</i>	Iteaceae				
179	<i>Jambosa formosa</i>	Myrtaceae				Ambake
180	<i>Juglans regia</i>	Juglandaceae	Ta shing		Khey shing	Okhar
181	<i>Juniperus pseudosabina</i>	Cupressaceae	Shoop shing	Black juniper	Shoop shing	
182	<i>Juniperus recurva</i>	Cupressaceae	Shoop shing	Weeping Blue juniper	Shoop shing	
183	<i>Juniperus spp.</i>	Cupressaceae				
184	<i>Juniperus squamata</i>	Cupressaceae	Shoop shing		Shoogpo shing	
185	<i>Kydia calycina</i>	Malvaceae			Pichala or Chamaktangshing	Kuninde, pichala
186	<i>Lagerstroemia hirsuta</i>	Lythraceae	Dongka shng		Buram shing	Jarul
187	<i>Lagerstroemia parviflora</i>	Lythraceae	Dongka shng		Buram shing	Sidha/Buri Damera
188	<i>Larix griffithii</i>	Pinaceae	Zashing	Larch		
189	<i>Leucaena leucocephala</i>	Leguminosae				

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190	<i>Lindera pulcherrima</i>	Lauraceae			Sengkyermey shing	Sissi
191	<i>Lithocarpus dealbatus</i>	Fagaceae			Shakor shing	Askaula
192	<i>Lithocarpus elegans</i>	Fagaceae			Shakor shing	Askaula
193	<i>Lithocarpus fenestratus</i>	Fagaceae	Thasa sokey		Sodhka tshai shing	
194	<i>Lithocarpus pachyphyllus</i>	Fagaceae	Sokey		Tshai shing	Sungurekatus
195	<i>Litsea hookeri</i>	Lauraceae				
196	<i>Litsea monopetala</i>	Lauraceae			Seychhanglu shing	Kutmeri
197	<i>Lyonia ovalifolia</i>	Ericaceae	Zentu shing		Shajuley shing	Angeri
198	<i>Lyonia spp.</i>	Ericaceae				
199	<i>Lyonia villosa</i>	Ericaceae				Lek angeri
200	<i>Macaranga denticulata</i>	Euphorbiaceae				
201	<i>Macaranga pustulata</i>	Euphorbiaceae				
202	<i>Macaranga spp.</i>	Euphorbiaceae				
203	<i>Machilus spp.</i>	Euphorbiaceae				
204	<i>Maclura cochinchinensis</i>	Moraceae				
205	<i>Macropanax spp.</i>	Araliaceae				
206	<i>Macropanax undulatus</i>	Araliaceae				
207	<i>Maddenia himalaica</i>	Rosaceae				
208	<i>Maesa chisia</i>	Primulaceae				
209	<i>Magnolia campbellii</i>	Magnoliaceae	Gong gong metog		Dzamling metog	Ghoge champ
210	<i>Magnolia globosa</i>	Magnoliaceae				Kokrechamp
211	<i>Magnolia pterocarpa</i>	Magnoliaceae				
212	<i>Magnolia spp.</i>	Magnoliaceae				
213	<i>Mallotus philippensis</i>	Euphorbiaceae				Rohini
214	<i>Mallotus spp.</i>	Euphorbiaceae				
215	<i>Malus spp.</i>	Euphorbiaceae				
216	<i>Mangifera indica</i>	Anacardiaceae	Am chukuli		Aam sey	Aam
217	<i>Mangifera spp.</i>	Anacardiaceae				
218	<i>Mangifera sylvatica</i>	Anacardiaceae				Chucheamp
219	<i>Melia azedarach</i>	Meliaceae			Jashing / Ngerashing	Kakaina
220	<i>Mesua ferrea</i>	Calophyllaceae		Ironwood		Nageswar
221	<i>Michelia cathcartii</i>	Magnoliaceae				Titechamp
222	<i>Michelia champaca</i>	Magnoliaceae	Kha shi		Kar shing or Champey shing	Champ
223	<i>Michelia doltsopa</i>	Magnoliaceae	Kha shi		Kar shing or Champey shing	Rani champ
224	<i>Michelia kisopa</i>	Magnoliaceae	Kha shi		Kar shing or Champey shing	
225	<i>Michelia spp.</i>	Magnoliaceae				
226	<i>Michelia velutina</i>	Magnoliaceae				Phusre, guaychamp
227	<i>Miliusa macrocarpa</i>	Annonaceae				
228	<i>Mimosa pudica</i>	Leguminosae				
229	<i>Mitrephora harae</i>	Annonaceae				
230	<i>Mohania nepalensis</i>	Berberidaceae				
231	<i>Mohania spp.</i>	Berberidaceae				
232	<i>Morus alba</i>	Moraceae				
233	<i>Morus laevigata</i>	Moraceae				Kimbu
234	<i>Morus macroura</i>	Moraceae	Tshendey			Bola
235	<i>Morus spp.</i>	Moraceae				
236	<i>Myrica esculenta</i>	Myricaceae	Chisishing			Kaphal
237	<i>Neolitsea foliosa</i>	Lauraceae				

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238	<i>Nyssa javanica</i>	Cornaceae	Pasjamshing		Lai momnang	Lekhchilau
239	<i>Oreocnide rubescens</i>	Urticaceae				
240	<i>Oroxylum indicum</i>	Bignoniaceae	Tshampaka metog		Namkhaling metog	
241	<i>Osmanthus spp.</i>	Oleaceae				
242	<i>Osmanthus suavis</i>	Oleaceae				
243	<i>Ostodes paniculata</i>	Euphorbiaceae				Bepari
244	<i>Pandanus nepalensis</i>	Pandanaceae				
245	<i>Pandanus sikkimensis</i>	Pandanaceae				Taari ka
246	<i>Pandanus spp.</i>	Pandanaceae				
247	<i>Parasassafras confertiflorum</i>	Lauraceae				
248	<i>Pentapanax racemosus</i>	Araliaceae				Chinde
249	<i>Pentapanax spp.</i>	Araliaceae				
250	<i>Persea bootanica</i>	Lauraceae				
251	<i>Persea clarkeana</i>	Lauraceae				Phampal
252	<i>Persea fructifera</i>	Lauraceae			Golee shing	Lapchephal
253	<i>Persea glaucescens</i>	Lauraceae				
254	<i>Persea spp.</i>	Lauraceae				
255	<i>Peveta spp.</i>	NA				
256	<i>Phoebe attenuata</i>	Lauraceae	Theinab			Angare
257	<i>Phoebe goalparensis</i>	Lauraceae				Bonsum
258	<i>Phoebe hainesiana</i>	Lauraceae				
259	<i>Phoebe lanceolata</i>	Lauraceae				Jhakrikath
260	<i>Phoebe spp.</i>	Lauraceae				
261	<i>Phoenix acaulis</i>	Arecaceae				
262	<i>Phoenix rupicola</i>	Arecaceae				
263	<i>Phyllanthus emblica</i>	Phyllanthaceae	Churooshing		Churgensey shing	Amla
264	<i>Picea spinulosa</i>	Pinaceae	Bashing	Spruce		Kalosalla
265	<i>Pieris formosa</i>	Ericaceae	Kheb-chey or Shadhoog Dhoog Shing			Dhoogshing, Balu
266	<i>Pinus bhutanica</i>	Pinaceae	Tongphu			
267	<i>Pinus roxburghii</i>	Pinaceae	Thaetong	Chir Pine	Roi nang shing	Chir
268	<i>Pinus wallichiana</i>	Pinaceae	Tongphu	Blue pine	Chang shing	
269	<i>Piptanthus nepalensis</i>	Leguminosae				
270	<i>Plectocomia himalayana</i>	Arecaceae				
271	<i>Podocarpus spp.</i>	<u>Podocarpaceae</u>				
272	<i>Polyalthia simiarum</i>	Annonaceae				
273	<i>Populus ciliata</i>	Salicaceae	Kashing		Kashing	Pipal pate
274	<i>Populus rotundifolia</i>	Salicaceae	Kashing chungku			
275	<i>Populus spp.</i>	Salicaceae				
276	<i>Prinsepia utilis</i>	Rosaceae				
277	<i>Prunus carmesina</i>	Rosaceae				
278	<i>Prunus cerasoides</i>	Rosaceae	Paiyun			
279	<i>Prunus nepalensis</i>	Rosaceae				
280	<i>Prunus spp.</i>	Rosaceae				
281	<i>Pterocarpus sinuata</i>	Fabaceae				
282	<i>Pterospermum acerifolium</i>	Malvaceae	Dha shom			Hatipaile
283	<i>Pterospermum spp.</i>	Malvaceae				
284	<i>Pterygota alata</i>	Malvaceae	Badam			
285	<i>Pyrus pashia</i>	Rosaceae	Lih	Pear	Litong	Lih
286	<i>Quercus glauca</i>	Fagaceae	Thonp shing		Thongpa shing	Musurephalan

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287	<i>Quercus glutinosa</i>	Fagaceae				
288	<i>Quercus griffithii</i>	Fagaceae	Sisi		Bainang Shing	Kasru
289	<i>Quercus lamellosa</i>	Fagaceae	Bangka or Dhom sokey		Fangkhoima shing	Bajranth
290	<i>Quercus lanata</i>	Fagaceae	Ghoom		Betshinang shing	Banj
291	<i>Quercus leucotricophora</i>	Fagaceae	Ghoom		Betshinang shing	
292	<i>Quercus oxyodon</i>	Fagaceae				
293	<i>Quercus semecarpifolia</i>	Fagaceae	Bjishing		Betshi nang shing	
294	<i>Quercus semiserrata</i>	Fagaceae				Khosru
295	<i>Quercus spp.</i>	Fagaceae				
296	<i>Rhododendron arboreum</i>	Ericaceae	Eto meto		Zhu daang metog	Guras
297	<i>Rhododendron barbatum</i>	Ericaceae				
298	<i>Rhododendron campylocarpum</i>	Ericaceae				
299	<i>Rhododendron cinnabarinum</i>	Ericaceae				
300	<i>Rhododendron falconeri</i>	Ericaceae				
301	<i>Rhododendron grande</i>	Ericaceae				
302	<i>Rhododendron hodgsonii</i>	Ericaceae				
303	<i>Rhododendron kendrickii</i>	Ericaceae				
304	<i>Rhododendron kesangiae</i>	Ericaceae				
305	<i>Rhododendron maddenii</i>	Ericaceae				
306	<i>Rhododendron neivium</i>	Fagaceae				
307	<i>Rhododendron nudiflorum</i>	Ericaceae				
308	<i>Rhododendron spp.</i>	Fagaceae				
309	<i>Rhododendron succothii</i>	Ericaceae				
310	<i>Rhododendron thomsonii</i>	Ericaceae				
311	<i>Rhododendron wallichii</i>	Ericaceae				
312	<i>Rhododendron wightii</i>	Ericaceae				
313	<i>Rhus chinensis</i>	Anacardiaceae				
314	<i>Rhus hookeri</i>	Anacardiaceae			Jar shing	Bhalayo
315	<i>Rhus paniculata</i>	Anacardiaceae	Choka shing		Khyr khobtang	
316	<i>Rhus spp.</i>	Anacardiaceae				
317	<i>Rhus succedanea</i>	Anacardiaceae	Say shing			
318	<i>Robinia pseudoacacia</i>	Leguminosae	Tshang tsha shing		Zoo tsee shing	
319	<i>Salix babylonica</i>	Salicaceae	Changma shing	Weeping willow	Changma shing	
320	<i>Salix bhutanensis</i>	Salicaceae			Borang changma	
321	<i>Salix calyculata</i>	Salicaceae			Kholongchuu changma	
322	<i>Salix daltoniana</i>	Salicaceae	Changma nab		Changma nagpo	
323	<i>Salix excelsa</i>	Salicaceae	Haa changma			
324	<i>Salix lindleyana</i>	Salicaceae	Jowodhoor shing changma			
325	<i>Salix longiflora</i>	Salicaceae	Changma chungku			
326	<i>Salix myrtilleacea</i>	Salicaceae	Lingzhi changma			
327	<i>Salix nepalensis</i>	Salicaceae				
328	<i>Salix obscura</i>	Salicaceae			Changma barma	
329	<i>Salix oreophila</i>	Salicaceae	Phu changma			
330	<i>Salix spp.</i>	Salicaceae				
331	<i>Salix thomsoniana</i>	Salicaceae	Chendebee changma			

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332	<i>Salix wallichiana</i>	Salicaceae	Langma			
333	<i>Sapindus rarak</i>	Sapindaceae	Nakupani		Killing Shing	Ritha
334	<i>Sapindus spp.</i>	Sapindaceae				
335	<i>Sapium baccatum</i>	Euphorbiaceae	Seleng			
336	<i>Sapium eugeniifolium</i>	Euphorbiaceae				Phirphire, Pipalpate
337	<i>Sapium insigne</i>	Euphorbiaceae				
338	<i>Sarcochlamys pulcherrima</i>	Urticaceae				
339	<i>Sarcosperma arboreum</i>	Sapotaceae				Kalikath
340	<i>Sauraja nepaulensis</i>	<u>Actinidiaceae</u>	Mangma dom		Mingdormashing	
341	<i>Schefflera impressa</i>	Araliaceae				
342	<i>Schefflera spp.</i>	Araliaceae				
343	<i>Schima wallichii</i>	Theaceae	Puyam or gogra		Zalashing	
344	<i>Schleichera spp.</i>	<u>Sapindaceae</u>				
345	<i>Shorea robusta</i>	Dipterocarpaceae		Sal		
346	<i>Sigesbeckia orientalis</i>	Compositae				
347	<i>Sloanea decicarpus</i>	Elaeocarpaceae				
348	<i>Sloanea sterculiacea</i>	Elaeocarpaceae		Schefflera impressa		
349	<i>Sloanea tomentosa</i>	Elaeocarpaceae				
350	<i>Sorbus griffithii</i>	Rosaceae				Pasi
351	<i>Sorbus microphylla</i>	Rosaceae	Tsema shing			Sanupasi
352	<i>Sorbus spp.</i>	Rosaceae				
353	<i>Spondias mangifera</i>	Anacardiaceae				Amaro
354	<i>Spondias pinnata</i>	Anacardiaceae	Bochong shing		Ambar shing	Amaro
355	<i>Spondias spp.</i>	Anacardiaceae				
356	<i>Stephania dludra</i>	<u>Menispermaceae</u>				
357	<i>Sterculia alata</i>	Malvaceae				
358	<i>Sterculia spp.</i>	Malvaceae				
359	<i>Sterculia villosa</i>	Malvaceae			Phrangshing	Odal/godgudal
360	<i>Stereospermum chelonoides</i>	Bignoniaceae				
361	<i>Stereospermum personatum</i>	Bignoniaceae				Parari
362	<i>Stereospermum sp.</i>	Bignoniaceae				
363	<i>Symplocos dryophila</i>	Symplocaceae				
364	<i>Symplocos glomerata</i>	Symplocaceae	Dhomzim		Zeem shing	Khara
365	<i>Symplocos lucida</i>	Symplocaceae	Dhomma shing			Khara
366	<i>Symplocos paniculata</i>	Symplocaceae	Pangtse shing		Zeem shing	
367	<i>Symplocos spicata</i>	Symplocaceae				Khara/ Kholme
368	<i>Symplocos spp.</i>	Symplocaceae				
369	<i>Syzygium claviflorum</i>	Myrtaceae				Harrejammuna
370	<i>Syzygium cumini</i>	Myrtaceae	Nyasse shing		Mentse sey shing	Jammun
371	<i>Syzygium formosum</i>	Myrtaceae				
372	<i>Syzygium spp.</i>	Myrtaceae				
373	<i>Talauma hodgsonii</i>	Magnoliaceae	Khem		Kadering shing	Balukath
374	<i>Tamarindus indica</i>	Leguminosae				Titiri
375	<i>Taxus baccata</i>	Taxaceae	Keyrangshing	Yew		
376	<i>Tectona grandis</i>	Lamiaceae	Tshomar shing	Teak	Teak shing	
377	<i>Terminalia alata</i>	Combretaceae	Ala shing		Baroo ata shing	Pakhasaj
378	<i>Terminalia arjuna</i>	Combretaceae				Arjun

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379	<i>Terminalia bellirica</i>	Combretaceae	Baroo			
380	<i>Terminalia bialata</i>	Combretaceae		White chaglan		
381	<i>Terminalia catappa</i>	Combretaceae			Leykhulong shing	Badam
382	<i>Terminalia chebula</i>	Combretaceae	Aaroo		Aaroo	Harra
383	<i>Terminalia myriocarpa</i>	Combretaceae	Bhoop shing	Hollock	Bakalo shing	Panisaj
384	<i>Terminalia procera</i>	Combretaceae				Badam
385	<i>Terminalia spp.</i>	Combretaceae				
386	<i>Terminalia tomentosa</i>	Combretaceae				Pakhasaj, Sain
387	<i>Tetradium fraxinifolium</i>	Rutaceae	Dongmar shing			
388	<i>Tetrameles nudiflora</i>	Tetramelaceae	Kadong shing			Mainakath
389	<i>Toona ciliata</i>	Meliaceae				Tooni/ poma
390	<i>Toona spp.</i>	Meliaceae				
391	<i>Toona sureni</i>	Meliaceae				Toon
392	<i>Toricellia tiliifolia</i>	Cornaceae				
393	<i>Trema integrifolia</i>	Ulmaceae				
394	<i>Trevesia palmata</i>	Araliaceae				
395	<i>Trevesia spp.</i>	Araliaceae				
396	<i>Trevisia nudiflora</i>	Euphorbiaceae				Pitali, ramritta
397	<i>Tsuga dumosa</i>	Pinaceae	Sey shing	Hemlock		Tengresallam
398	<i>Turpinia pomifera</i>	Staphyleaceae				Thali
399	<i>Ulmus lanceifolia</i>	Ulmaceae		Elm		Aulepipli/Sanda npipli
400	<i>Vaccinium spp.</i>	Ericaceae				
401	<i>Viburnum cylindricum</i>	Adoxaceae				
402	<i>Viburnum erubescens</i>	Adoxaceae				
403	<i>Viburnum nervosum</i>	Adoxaceae				
404	<i>Viburnum spp.</i>	Adoxaceae				
405	<i>Vitex heterophylla</i>	Lamiaceae				Panchpate
406	<i>Vitex negundo</i>	Lamiaceae				
407	<i>Wallichia densiflora</i>	Areaceae				Rang bhang
408	<i>Walsura tubulata</i>	Meliaceae				Phalame
409	<i>Wrightia arborea</i>	Apocynaceae				
410	<i>Zanthoxylum armatum</i>	Rutaceae			Thingye Gee shing	
411	<i>Zanthoxylum budrunga</i>	Rutaceae				Timur
412	<i>Zanthoxylum rhetsa</i>	Rutaceae				
413	<i>Zanthoxylum spp.</i>	Rutaceae				
414	<i>Ziziphus spp.</i>	<u>Rhamnaceae</u>				

1.5.4.2.8 Shrub Data

Shrub is a single or multi-stem woody perennial plant, generally more than 0.5 m and less than 5 m high at maturity without a definite crown. For NFI purpose, shrub data shall be collected from all three 12.62 m plots; Elbow, North and East. Follow the steps and description provided in *Table 1.20* to complete form F8/F18 with **shrub data** and use shrub list from *Table 1.21*. **Note:** Same data collection form shall be used for all three plots

Table 1.20: Shrub Data Collection

SN	Data Items	Description	Instructions
1	CP No	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot Name	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot	Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3	Scientific or botanical name	Refers to scientific or botanical name which conforms to the <i>International Code of Botanical Nomenclature (ICBN)</i> .	1. Choose appropriate Botanical Name as it appears against it as drop-down list on electronic form. 2. If the name of the plant is not in the list, then provision for typing the botanical name is also provided. 3. If Paper forms have been used, record accordingly.
4	Common Name/ Local Name	“Common name” herein is referred to the commonly used name of a shrub in English. "Local name" refers to name of tree in local dialect. For NFI, the Local Names in following dialects will be used; Dzongkha (Dz), Tshanglha kha (Ts), Lhotsham kha (Lh), Bumthangp (Bum), Khengkha (Kh), Trongsap (Tr) and Kurtoep (Kr).	The Crew can note either the common name or the local name of the plant. <i>Note: In case of local name, Crew must specify dialect in which the local name has been given. (For Berberis aristata, it is Kerpa zoo in Tshanglha kha, therefore, local name must be written as Kerpa zoo (Ts), Ts indicates it is in Tshanglha Kha)</i>
5	Layer height	The average height of the shrub in meters	Record the average height of the shrub in meters
6	Cover percent	Cover percent of shrub within 12.62 m radius plot.	Ocularly estimate as to the extent of coverage of shrub within 12.62 m plot and record it in terms of percentage.
7	Remarks	Any useful remarks related to the shrubs	Crews may or may not provide remarks.

Table 1.21: Shrub list and species code

Species code	Botanical Name	Family	Local Name /Common name
1	<i>Acacia farnesiana</i>	Leguminosae	
2	<i>Acacia gageana</i>	Leguminosae	ArareKhanra(Lh)
3	<i>Acalphahispida</i>	Euphorbiaceae	
4	<i>Acalphawilkesiana</i>	Euphorbiaceae	
5	<i>Acronychia pedunculata</i>	Rutaceae	Puanle(Lh)
6	<i>Actinidia callosa</i>	Actinidiaceae	Tekiphal(Lh)
7	<i>Actinidistrigosa</i>	Actinidiaceae	
8	<i>Alchorneamollis</i>	Euphorbiaceae	
9	<i>Alchorneatiliifolia</i>	Euphorbiaceae	Sanu Malata(Lh)

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10	<i>Allamanda cathartica</i>	Apocynaceae	Golden(Eng)
11	<i>Allophylus chartaceus</i>	Sapindaceae	
12	<i>Alstonia eriifolia</i>	Apocynaceae	Chatiwan(Lh)
13	<i>Alstonia sebusi</i>	Apocynaceae	
14	<i>Antidesma acidum</i>	Euphorbiaceae	Archal(Lh)
15	<i>Antidesma acuminatum</i>	Euphorbiaceae	Kalo Bilaune(Lh)
16	<i>Antidesma ghaesembilla</i>	Euphorbiaceae	Chipli(Lh)
17	<i>Antistrophe oxantha</i>	Myrsinaceae	
18	<i>Ardisia colorata</i>	Myrsinaceae	
19	<i>Ardisia crispa</i>	Myrsinaceae	
20	<i>Ardisia macrcarpa</i>	Myrsinaceae	Ressin (Dz) Damai Gera, Khao Argale (Lh)
21	<i>Ardisia thyriflora</i>	Myrsinaceae	
22	<i>Arenga westerhoutii</i>	Arecaceae	
23	<i>Artabotrys caudatus</i>	Annonaceae	Kali Lahara(Lh)
24	<i>Artabotrys hexapetalus</i>	Annonaceae	Katar Champa(Lh)
25	<i>Asidocaryauvifera</i>	Menispermaceae	
26	<i>Aspidopteryx glabriuscula</i>	Malpighiaceae	
27	<i>Baliospermum corymbiferum</i>	Euphorbiaceae	
28	<i>Baliospermum densiflorum</i>	Euphorbiaceae	
29	<i>Baliospermum montanum</i>	Euphorbiaceae	Harital(Lh)
30	<i>Baliospermum nepalense</i>	Euphorbiaceae	
31	<i>Bauhinia purpurea</i>	Leguminosae	Zibzib shing (Dz) Pegpeyposhing (Ts) Tanki (Lh)
32	<i>Bauhinia variegata</i>	Leguminosae	Rucha shing (Dz) Koerlo or Taki(Lh)
33	<i>Berberis angulosa</i>	Berberidaceae	Chutro(Lh)
34	<i>Berberis aristata</i>	Berberidaceae	Kerpazoo(Ts) Chutro(Lh)
35	<i>Berberis asiatica</i>	Berberidaceae	Kepaitsang(Dz) Kerpa zoo (Ts)
36	<i>Berberis beesiana</i>	Berberidaceae	
37	<i>Berberis griffithiana</i>	Berberidaceae	
38	<i>Berberis hookeri</i>	Berberidaceae	
39	<i>Berberis insignis</i>	Berberidaceae	Chutro(Lh)
40	<i>Berberis macrosepala</i>	Berberidaceae	
41	<i>Berberis praecipua</i>	Berberidaceae	Kepetsang(Dz)
42	<i>Berberis thomsoniana</i>	Berberidaceae	Chutro(Lh)
43	<i>Berberis tsarica</i>	Berberidaceae	
44	<i>Berberis virescens</i>	Berberidaceae	
45	<i>Bougainvillea jussieu</i>	Nyctaginaceae	
46	<i>Breynia retusa</i>	Euphorbiaceae	
47	<i>Bridelia retusa</i>	Euphorbiaceae	Gayo(Lh)
48	<i>Bridelia Sikkimensis</i>	Euphorbiaceae	Gayo(Lh)
49	<i>Bridelia stipularis</i>	Euphorbiaceae	Lahara Gayo(Lh)
50	<i>Bridelia tomentosa</i>	Euphorbiaceae	Muse Gayo(Lh)
51	<i>Brucia mollis</i>	Simaroubaceae	
52	<i>Caesalpinia cucullata</i>	Leguminosae	TseHein(Dz) , Bokshi Khanra (Lh)

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53	<i>Caesalpinia decapetala</i>	Leguminosae	Tatse Tsang, Tsangi Metog (Dz)
54	<i>Caesalpinia pulcherrima</i>	Leguminosae	
55	<i>Cajanus cajan</i>	Leguminosae	Pigeon pea (Eng)
56	<i>Calamus acanthospathus</i>	Arecaceae	Pukka bet (Lh)
57	<i>Calamus erectus</i>	Arecaceae	Phekri (Lh)
58	<i>Calliandra haematocephala</i>	Leguminosae	
59	<i>Callicarpa longifolia</i>	Verbenaceae	Sanu Guenyhlo (Lh)
60	<i>Callicarpa macrophylla</i>	Verbenaceae	
61	<i>Callicarpa rubella</i>	Verbenaceae	Nangay Wam (Dz) Jinlabsey shing (Ts)
62	<i>Camellia kissii</i>	Theaceae	Hinguwa (Lh)
63	<i>Camellia sinensis</i>	Theaceae	Jashing (Dz) Jashing (Ts) Cha (Lh)
64	<i>Campylotropis griffithii</i>	Leguminosae	
65	<i>Campylotropis speciosa</i>	Leguminosae	
66	<i>Capparis acutifolia</i>	Capparaceae	Chilapati (Lh)
67	<i>Capparis assamica</i>	Capparaceae	
68	<i>Capparis cantoniensis</i>	Capparaceae	
69	<i>Capparis multiflora</i>	Capparaceae	
70	<i>Capparis olacifolia</i>	Capparaceae	Naski, Hais (Lh)
71	<i>Capparis sikkimensis</i>	Capparaceae	
72	<i>Caragana jubata</i>	Leguminosae	
73	<i>Caragana sukiensis</i>	Leguminosae	
74	<i>Caryopteris bicolor</i>	Verbenaceae	Sun Pati (Lh)
75	<i>Caryopteris paniculata</i>	Verbenaceae	
76	<i>Cassia alata</i>	Leguminosae	Dhongkaladhaza (Ts)
77	<i>Cassia occidentalis</i>	Leguminosae	
78	<i>Cassia surattensis</i>	Leguminosae	
79	<i>Ceratostigma griffithii</i>	Plumbaginaceae	
80	<i>Cereus repandus</i>	Cactaceae	Hedge Cactus (Eng)
81	<i>Ceriscoides campanulata</i>	Rubiaceae	
82	<i>Chassalia curviflora</i>	Rubiaceae	
83	<i>Chloranthus elatior</i>	Chloranthaceae	
84	<i>Choenomeles lagenaria</i>	Rosaceae	Khomang Shing (Ts)
85	<i>Cinnamomum glanduliferum</i>	Lauraceae	Kipchushing (Dz), Kawla or malagiri (Lh)
86	<i>Cinnamomum glaucescens</i>	Lauraceae	Shingtsazim (Dz), Phagpaneng shing (Ts), Ghansaray (Lh)
87	<i>Cinnamomum tenuipilis</i>	Lauraceae	
88	<i>Circaea agrestis</i>	Circaeasteraceae	
89	<i>Cissampelos pareira</i>	Menispermaceae	Bueroobjee (Dz), jingroo (Ts), Thamarke, Batulpati (Lh)
90	<i>Citrus medica</i>	Rutaceae	Humpa (Dz)
91	<i>Clausena excavate</i>	Rutaceae	
92	<i>Cleidion speciflorum</i>	Euphorbiaceae	Bepari (Lh)
93	<i>Clerodendrum bracteatum</i>	Verbenaceae	Yong ziwashing (Ts) Chitu (Lh)
94	<i>Clerodendrum colebrookianum</i>	Verbenaceae	Boka Kane (Lh)
95	<i>Clerodendrum hastatum</i>	Verbenaceae	
96	<i>Clerodendrum serratum</i>	Verbenaceae	Andekhi (Lh)

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97	<i>Clerodendrum viscosum</i>	Verbenaceae	Chitu(Lh)
98	<i>Clerodendrum wallichii</i>	Verbenaceae	
99	<i>Cocculus laurifolius</i>	Menispermaceae	
100	<i>Codiaeum variegatum</i>	Euphorbiaceae	
101	<i>Colebrookea oppositifolia</i>	Labiatae	Dosro(Lh)
102	<i>Coriaria napalensis</i>	Coriariaceae	Limphushi, Nimbo(Dz)
103	<i>Coriaria terminalis</i>	Coriariaceae	
104	<i>Corylopsis himalayana</i>	Hamamelidaceae	Grong Grongmo Shing(Ts)
105	<i>Cotoneaster acuminatus</i>	Rosaceae	
106	<i>Cotoneaster microphyllus</i>	Rosaceae	Katragparoo(Ts), Brush jhar(Lh), Med: JaphoTsiTsi,
107	<i>Cotoneaster nitidus</i>	Rosaceae	
108	<i>Cotoneaster racemiflorus</i>	Rosaceae	
109	<i>Cotoneaster rotundifolius</i>	Rosaceae	
110	<i>Cotoneaster rubens</i>	Rosaceae	
111	<i>Cotoneaster sanguineus</i>	Rosaceae	
112	<i>Cotoneaster sherriffii</i>	Rosaceae	
113	<i>Cotoneaster simonsii</i>	Rosaceae	
114	<i>Crotalaria alata</i>	Leguminosae	
115	<i>Crotalaria bracteata</i>	Leguminosae	
116	<i>Crotalaria capitata</i>	Leguminosae	
117	<i>Crotalaria cytoides</i>	Leguminosae	
118	<i>Crotalaria pallid</i>	Leguminosae	
119	<i>Crotalaria tetragona</i>	Leguminosae	
120	<i>Croton bonplandianus</i>	Euphorbiaceae	SeytsalaNgyon(Ts)
121	<i>Croton joufra</i>	Euphorbiaceae	
122	<i>Croton roxburghii</i>	Euphorbiaceae	
123	<i>Cryptolepis burchanani</i>	Asclepiadaceae	LangchuRobji(Dz) Dude Lahara(Lh)
124	<i>Cyathula capitata</i>	Amaranthaceae	
125	<i>Cyathula tomentosa</i>	Amaranthaceae	Tagparoba(Ts)
126	<i>Cyclea bicristata</i>	Menispermaceae	
127	<i>Decaisnea insignis</i>	Lardizabalaceae	
128	<i>Deeringia amaranthoides</i>	Amaranthaceae	Sa shing(Ts) Bakri sag(Lh)
129	<i>Desmodium caudatum</i>	Leguminosae	
130	<i>Desmodium concinnum</i>	Leguminosae	
131	<i>Desmodium confertum</i>	Leguminosae	
132	<i>Desmodium elegans</i>	Leguminosae	TaturShi(Dz); Beymangrobu(Ts) ; Neptans Shing; Sarkinu(Lh)
133	<i>Desmodium gyroides</i>	Leguminosae	MardumKumchimoShing(Ts)
134	<i>Desmodium heterocarpon</i>	Leguminosae	
135	<i>Desmodium khasianum</i>	Leguminosae	
136	<i>Desmodium laxiflorum</i>	Leguminosae	
137	<i>Desmodium microphyllum</i>	Leguminosae	
138	<i>Desmodium motorium</i>	Leguminosae	
139	<i>Desmodium multiflorum</i>	Leguminosae	
140	<i>Desmodium sequax</i>	Leguminosae	
141	<i>Desmodium trifolium</i>	Leguminosae	

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142	<i>Desmodium triquetrum</i>	Leguminosae	
143	<i>Desmos chinensis</i>	Annonaceae	
144	<i>Desmos dumosus</i>	Annonaceae	Male Lahara(Lh)
145	<i>Deutzia corymbosa</i>	Philadelphaceae	
146	<i>Deutzia staminea</i>	Philadelphaceae	
147	<i>Dichroafebrifuga</i>	Hydrangceae	
148	<i>Dobinea vulgaris</i>	Anacardiaceae	Zumphusengkormay(Ts)
149	<i>Dodonaea angustifolia</i>	Sapindaceae	
150	<i>Ehretiapsilosiphon</i>	Boraginaceae	
151	<i>Elsholtziafrticosa</i>	Labiatae	Bhote(Lh)
152	<i>Embelia floribunda</i>	Myrsinaceae	Chiuri Amla Lahara(Lh)
153	<i>Embeliafrondosa</i>	Myrsinaceae	
154	<i>Embeliaribes</i>	Myrsinaceae	Khubari(Ts)
155	<i>Eriosemahimalaicum</i>	Leguminosae	
156	<i>Euchrestahorsfieldii</i>	Leguminosae	
157	<i>Euphorbia leucocephala</i>	Euphorbiaceae	
158	<i>Euphorbia millii</i>	Euphorbiaceae	
159	<i>Euphorbia pulcherrima</i>	Euphorbiaceae	
160	<i>Euphorbia royleana</i>	Euphorbiaceae	
161	<i>Eupteleapleiosperma</i>	Eupteleaceae	
162	<i>Eurya acuminate</i>	Theaceae	Sanu Jhingni(Lh)
163	<i>Euryacavinervis</i>	Theaceae	
164	<i>Fagerlindia fasciculata</i>	Rubiaceae	
165	<i>Fissistigma polyanthum</i>	Annonaceae	
166	<i>Flemengiabhutanica</i>	Leguminosae	
167	<i>Flemengiafruitculosa</i>	Leguminosae	
168	<i>Flemengia macrophylla</i>	Leguminosae	Batwasi(Lh)
169	<i>Flemengiastrobilifera</i>	Leguminosae	
170	<i>Flueggeavirosa</i>	Euphorbiaceae	GeykangShing(Ts) , Darim Pate, Phalame(Lh)
171	<i>Forsythia intermedia</i>	Oleaceae	
172	<i>Fraxinus floribunda</i>	Oleaceae	Draythub (Dz), lakuri(Lh)
173	<i>Fraxinus paxiana</i>	Oleaceae	Lankuri(Lh)
174	<i>Gardenia augusta</i>	Rubiaceae	
175	<i>Garuga floribunda</i>	Burseraceae	Dabdabe(Lh)
176	<i>Glochidion acuminatum</i>	Euphorbiaceae	Latikath(Lh)
177	<i>Glochidion ellipticum</i>	Euphorbiaceae	Haldikath(Lh)
178	<i>Glochidion bourdillonii var. bhutanicum</i>	Euphorbiaceae	KotokmoShing(Ts)
179	<i>Glochidion khasicum</i>	Euphorbiaceae	
180	<i>Glochidion nubigenum</i>	Euphorbiaceae	
181	<i>Glochidion oblatum</i>	Euphorbiaceae	
182	<i>Glochidion heyneanum</i>	Euphorbiaceae	
183	<i>Gomphostemma parviflorum</i>	Labiatae	Kaman Dhusur(Dz)
184	<i>Gylcosmiscymosa</i>	Rutaceae	
185	<i>Gylcosmis pentaphylla</i>	Rutaceae	
186	<i>Heyneatrijuga</i>	Meliaceae	Ankhataruwa(Lh)
187	<i>Himalrandiatetrasperma</i>	Rubiaceae	
188	<i>Hiptagebengalensis</i>	Malpighiaceae	CharpateLahara(Lh)

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189	<i>Holmskioldiasanguinea</i>	Verbenaceae	Chalingmomnang(Ts) Chinese Hat Plant(Eng)
190	<i>Holobellialatifolia</i>	Lardizabalaceae	Enterobjay(Dz)
191	<i>Homonoiariparia</i>	Euphorbiaceae	KholaRuis(Lh)
192	<i>Hoya lanceolata</i>	Asclepiadaceae	
193	<i>Hydrangea anomala</i>	Hydrangeaceae	
194	<i>Hydrangea aspera</i>	Hydrangeaceae	
195	<i>Hydrangea heteromalla</i>	Hydrangeaceae	
196	<i>Hydrangea macrophylla</i>	Hydrangeaceae	
197	<i>Hydrangea stylosa</i>	Hydrangeaceae	
198	<i>Hypericum choisianum</i>	Hypericaceae	
199	<i>Hypericum griffithii</i>	Hypericaceae	
200	<i>Hypericum hookerianum</i>	Hypericaceae	
201	<i>Hypericum sherriffii</i>	Hypericaceae	
202	<i>Hypericum uralum</i>	Hypericaceae	Urilo(Lh)
203	<i>Ichnocarpus frutescens</i>	Apocynaceae	Dude Lahara(Lh)
204	<i>Ichnocarpus polyanthus</i>	Apocynaceae	Dude Lahara(Lh)
205	<i>Illicium griffithii</i>	Illiciaceae	Dhomleeshi(Dz) Khailatseenang (Ts) Star Anis(Eng)
206	<i>Indigoferadosua</i>	Leguminosae	KumchingmaShing(Ts) ; ChiringgiJhar(Lh)
207	<i>Indigofera atropurpurea</i>	Leguminosae	
208	<i>Indigoferacassioidea</i>	Leguminosae	
209	<i>Indigoferacylindracea</i>	Leguminosae	
210	<i>Indigofera exilis</i>	Leguminosae	
211	<i>Indigofera hebeptala</i>	Leguminosae	
212	<i>Indigofera heterantha</i>	Leguminosae	
213	<i>Indigofera pseudoreticulata</i>	Leguminosae	
214	<i>Indigofera zollingeriana</i>	Leguminosae	
215	<i>Ipomea carnea</i>	Convolvaceae	
216	<i>Isodon coetse</i>	Labiatae	
217	<i>Isodon rugosus</i>	Labiatae	Siluguka(Dz)
218	<i>Isodon ternifolius</i>	Labiatae	Peng-dong-dongla(Dz)
219	<i>Ixora coccinea</i>	Rubiaceae	
220	<i>Ixora javanica</i>	Rubiaceae	
221	<i>Ixora undulate</i>	Rubiaceae	Kalikat(Lh)
222	<i>Jasminum caudatum</i>	Oleaceae	KagajiPhul(Lh)
223	<i>Jasminum dispersum</i>	Oleaceae	hare Lahara(Lh)
224	<i>Jasminum elongatum</i>	Oleaceae	
225	<i>Jasminum grandiflorum</i>	Oleaceae	
226	<i>Jasminum humile</i>	Oleaceae	
227	<i>Jasminum lanceolarium</i>	Oleaceae	
228	<i>Jasminum laurifolium</i>	Oleaceae	
229	<i>Jasminum nepalense</i>	Oleaceae	
230	<i>Jasminum nervosum</i>	Oleaceae	
231	<i>Jasminum officinale</i>	Oleaceae	
232	<i>Jasminum sambac</i>	Oleaceae	Arabian Jasmine(Eng)
233	<i>Jasminum sempervirens</i>	Oleaceae	

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234	<i>Jatropacuras</i>	Euphorbiaceae	Nera KharShing(Ts) Poison nut(Eng)
235	<i>Jatropapodagrica</i>	Euphorbiaceae	
236	<i>Juncus sphacelatus</i>	Juncaceae	
237	<i>Kadsura heteroclite</i>	Schisandraceae	Pattiamlo(Lh)
238	<i>Lantana camara</i>	Verbenaceae	Shing singba(Ts) Barra(Lh)
239	<i>Lasianthusbiermannii</i>	Rubiaceae	SiyalPhusre(Lh)
240	<i>Lepisanthes senegalensis</i>	Sapindaceae	Achatta(Lh)
241	<i>Leptodermisamoena</i>	Rubiaceae	
242	<i>Leptodermiskumaonensis</i>	Rubiaceae	
243	<i>Leptodermisludlowii</i>	Rubiaceae	
244	<i>Leptodermisstapfiana</i>	Rubiaceae	
245	<i>Lespedeza gerardiana</i>	Leguminosae	
246	<i>Lespedeza juncea</i>	Leguminosae	
247	<i>Leucaena leucocephala</i>	Leguminosae	Tsashing(Dz) Tsee shing (Ts) Ghans siris(Lh)
248	<i>Lindera heterophylla</i>	Lauraceae	Chur tego(Dz)
249	<i>Lindera melatomacea</i>	Lauraceae	
250	<i>Lindera neesiana</i>	Lauraceae	Nenshing/Roo neng(Ts)
251	<i>Lindera pulcherrima</i>	Lauraceae	Sengkyermayshing(Ts) Sisi (Lh)
252	<i>Litsea cubeba</i>	Lauraceae	Nenshing(Ts) , Timur(Lh)
253	<i>Litsea kingie</i>	Lauraceae	Siltimur(Lh)
254	<i>Litsea laeta</i>	Lauraceae	
255	<i>Litsea salicifolia</i>	Lauraceae	Sanu pahenle(Lh)
256	<i>Litsea sericea</i>	Lauraceae	Geywe(Dz), Lekhsiltimur (Lh)
257	<i>Luculia gratissima</i>	Rubiaceae	TongdenMeto(Dz)
258	<i>Maesa macrophylla</i>	Myrsinaceae	
259	<i>Mahonia napaulensis</i>	Berberidaceae	Chutro, Kesari(Lh)
260	<i>Malus bacata</i>	Rosaceae	KhomangShing(Dz),
261	<i>Malus pumila</i>	Rosaceae	Apple(Eng)
262	<i>Malus sikkimensis</i>	Rosaceae	MinduShing(Dz)
263	<i>Manihot esculenta</i>	Euphorbiaceae	Dori,SimalTarul(Lh) Sengi Ki(Kh) Casava Tapioca(Eng)
264	<i>Melianthus major</i>	Hippocastanaceae	
265	<i>Meliosmadilleniifolia</i>	Sabiaceae	LekhGogun(Lh)
266	<i>Meliosmasimplicifolia</i>	Sabiaceae	Chiuri, Chiwari, patpate(Lh)
267	<i>Miliusamacrocarpa</i>	Annonaceae	
268	<i>Miliusaroxburghiana</i>	Annonaceae	
269	<i>Mimosa himalayana</i>	Leguminosae	ArereKhanra(Lh)
270	<i>Mimosa pudica</i>	Leguminosae	Shawa-dengkhan ngon (Ts) Booarey (Lh)
271	<i>Morinda angustifolia</i>	Rubiaceae	Hardi-Kat(Lh)
272	<i>Murrayakoenigii</i>	Rutaceae	Ngebtangshing(Ts)
273	<i>Murrayapaniculata</i>	Rutaceae	
274	<i>Mussaenda glabra</i>	Rubiaceae	KangeLahara(Lh)
275	<i>Mussaenda macrophylla</i>	Rubiaceae	DhobinePhul(Lh)

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276	<i>Mussaendaroxburghii</i>	Rubiaceae	Menchapatong(Ts) Dhobi Kat(Lh)
277	<i>Mussaendatreutleri</i>	Rubiaceae	Neptenta (Dz) DhobinePhul(Lh)
278	<i>Myrsinesemiserrata</i>	Myrsinaceae	Palami,Phalame,Jhingni(Lh)
279	<i>Narveliazeylanica</i>	Ranunculaceae	
280	<i>Neilliarubiflora</i>	Rosaceae	
281	<i>Neillithyrsiflora</i>	Rosaceae	
282	<i>Nopaleacochenillifera</i>	Cactaceae	Cochineal Cactus(Eng)
283	<i>Nostolachmakhasiana</i>	Rubiaceae	
284	<i>Nyctanthes arbor</i>	Verbenaceae	
285	<i>Opuntia ficus-indica</i>	Cactaceae	GawairingaTsang(Dz)
286	<i>Orthosiphon rubicundus</i>	Labiatae	
287	<i>Osmanthus suavis</i>	Oleaceae	ChatsheKam(Dz) Silingi (Lh)
288	<i>Ostodespaniculata</i>	Euphorbiaceae	Bepari(Lh)
289	<i>Paederiacruddasiana</i>	Rubiaceae	Biri(Lh)
290	<i>Paederiafoetida</i>	Rubiaceae	Biri, Biri Lahare(Lh)
291	<i>Paeonia suffruticosa</i>	Ranunculaceae	
292	<i>Parabaenasagittata</i>	Menispermaceae	KarpatiLahara(Lh)
293	<i>Paramignyamophylla</i>	Rutaceae	Natkanta(Lh)
294	<i>Pavatta polyantha</i>	Rubiaceae	KanjolPhul(Lh)
295	<i>Pavattasubcapitata</i>	Rubiaceae	
296	<i>Pedilanthustithymaloides</i>	Euphorbiaceae	
297	<i>Pegianitida</i>	Anacardiaceae	Lahara Anp(Lh)
298	<i>Pericampylusglaucus</i>	Menispermaceae	Tschethangru(Lh)
299	<i>Periplocacalophylla</i>	Asclepiadaceae	
300	<i>Petreavolubilis</i>	Verbenaceae	Eng: Queen; Wreath(Lh)
301	<i>Philadelphustomentosus</i>	Philadelphaceae	
302	<i>Photinabeauverdiana</i>	Rosaceae	
303	<i>Phyllanthus clarkei</i>	Euphorbiaceae	
304	<i>Phyllanthus glaucus</i>	Euphorbiaceae	Dosem(Dz) Prang Shing (Tr)
305	<i>Phyllanthus leschenaultii</i>	Euphorbiaceae	
306	<i>Phyllanthus parvifolius</i>	Euphorbiaceae	
307	<i>Phyllanthus reticulatus</i>	Euphorbiaceae	Dosem(Dz)
308	<i>Phyllanthus sikkimensis</i>	Euphorbiaceae	
309	<i>Phyllanthus emblica</i>	Euphorbiaceae	Amala(Lh)
310	<i>Pinangagracilis</i>	Arecaceae	
311	<i>Piper attenuatum</i>	Piperaceae	Chabo(Lh)
312	<i>Piper betleoides</i>	Piperaceae	Pan(Lh)
313	<i>Piper chuyva</i>	Piperaceae	Chaba(Lh)
314	<i>Piper khasianum</i>	Piperaceae	Chabo(Lh)
315	<i>Piper longum</i>	Piperaceae	Peepeeling(Dz) Peepeeling(Ts) Pipla (Lh)
316	<i>Piper mullesua</i>	Piperaceae	Peepeeling(Dz) Peepeeling(Ts) DalaCharbo (Lh)
317	<i>Piper pedicellatum</i>	Piperaceae	Bale Chabo, Long pipala(Lh)
318	<i>Piper peepuloides</i>	Piperaceae	Rukpeepla(Lh)
319	<i>Piper rhytidocarpum</i>	Piperaceae	Chabo, Tsabo(Lh)
320	<i>Piper suipigua</i>	Piperaceae	DakleyChabo(Lh)
321	<i>Piper syvaticum</i>	Piperaceae	

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322	<i>Piptanthusnepalensis</i>	Leguminosae	GahatePhul(Lh)
323	<i>Pithecellobium dulce</i>	Leguminosae	
324	<i>Pittosporum napaulense</i>	Pittosporaceae	
325	<i>Pogostemonbenghalensis</i>	Labiatae	
326	<i>Pogostemonelsholtzioides</i>	Labiatae	
327	<i>Pogostemontuberculosis</i>	Labiatae	
328	<i>Polygala arillata</i>	Polgalaceae	Baahu(Dz)
329	<i>Polygala karensium</i>	Polgalaceae	
330	<i>Potentilla arbuscula</i>	Rosaceae	ChiriyaPhal(Lh)
331	<i>Premnainterrupta</i>	Verbenaceae	
332	<i>Prinsepiautilis</i>	Rosaceae	
333	<i>Prunus jenkinsii</i>	Rosaceae	
334	<i>Prunus rufa</i>	Rosaceae	Lekhpaiyun(Lh)
335	<i>Prunus undulata</i>	Rosaceae	Lekharupate(Lh)
336	<i>Psilanthusbengalensis</i>	Rubiaceae	Chitu,Morichikat(Lh)
337	<i>Psychotriacalocarpa</i>	Rubiaceae	DameyGach(Lh)
338	<i>Psychotriadenticulata</i>	Rubiaceae	Bon Golcul(Lh)
339	<i>Psychotriaerratica</i>	Rubiaceae	
340	<i>Psychotriamonticola</i>	Rubiaceae	
341	<i>Pterolobiumhexapetalum</i>	Leguminosae	
342	<i>Pterolobiummacropterum</i>	Leguminosae	
343	<i>Pycnarrhenapleniflora</i>	Menispermaceae	
344	<i>Pyracanthacrenulata</i>	Rosaceae	
345	<i>Rapaneacapitellata</i>	Myrsinaceae	Kalachamp,Phalamkanth(Lh)
346	<i>Reinwardtiaindica</i>	Linaceae	
347	<i>Rhuschinensis</i>	Anacardiaceae	Pokpokpa shing((Ts)
348	<i>Rhuspaniculata</i>	Anacardiaceae	Khyrkhobtang(Dz)
349	<i>Rhus succedanea</i>	Anacardiaceae	Say shing(Ts)
350	<i>Ribesacuminatum</i>	Grossulariaceae	
351	<i>Ribesalpestre</i>	Grossulariaceae	
352	<i>Ribesglaciale</i>	Grossulariaceae	
353	<i>Ribesgriffithii</i>	Grossulariaceae	
354	<i>Ribeshimalense</i>	Grossulariaceae	
355	<i>Ribeslaciniatum</i>	Grossulariaceae	
356	<i>Ribesluridum</i>	Grossulariaceae	
357	<i>Ribesorientale</i>	Grossulariaceae	
358	<i>Rosa brunonii</i>	Rosaceae	Tagtsherkaap(Dz)
359	<i>Rosa macrophylla</i>	Rosaceae	Tagtshermarp(Dz)
360	<i>Rosa sericea</i>	Rosaceae	Sew Shing(Dz), Sisi Chungchung (Lh) Med: SewaiMetog,
361	<i>Rubusacuminatus</i>	Rosaceae	Komatshang(Dz) Biraleykara or Sanu aselu(Lh)
362	<i>Rubusalexeterius</i>	Rosaceae	
363	<i>Rubusbiflorus</i>	Rosaceae	Thulugongsey(Ts)
364	<i>Rubuscalophyllus</i>	Rosaceae	
365	<i>Rubuscalycinoides</i>	Rosaceae	Tsheymaitsheloo (Dz)
366	<i>Rubuscooperi</i>	Rosaceae	

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367	<i>Rubusefferatus</i>	Rosaceae	
368	<i>Rubusellipticus</i>	Rosaceae	Tsheymaitsheloo(Dz) Sergong or Gong zoo(Ts)
369	<i>Rubushamiltoni</i>	Rosaceae	
370	<i>Rubushypargyrus</i>	Rosaceae	
371	<i>Rubusindotibetanus</i>	Rosaceae	N: GempeAselu(Lh)
372	<i>Rubusinopertus</i>	Rosaceae	(Lh) PhusreAsaelu(Lh)
373	<i>Rubus insignis</i>	Rosaceae	
374	<i>Rubusirritans</i>	Rosaceae	
375	<i>Rubuslineatus</i>	Rosaceae	
376	<i>Rubusmacilentus</i>	Rosaceae	
377	<i>Rubusmesogaeus</i>	Rosaceae	
378	<i>Rubusniveus</i>	Rosaceae	Thulu Gong; Trongsa(Ts): Tsang Guma;KaloAselu(Lh)
379	<i>Rubuspaniculatus</i>	Rosaceae	Domaytsheloo(Dz)
380	<i>Rubuspenagonous</i>	Rosaceae	
381	<i>Rubusphengodes</i>	Rosaceae	
382	<i>Rubuspreptanthus</i>	Rosaceae	
383	<i>RubusPungens</i>	Rosaceae	
384	<i>Rubussikkimensis</i>	Rosaceae	
385	<i>Rubussplendidissimus</i>	Rosaceae	
386	<i>Rubussumatranus</i>	Rosaceae	
387	<i>Rubusthompsonii</i>	Rosaceae	
388	<i>Rubustreutleri</i>	Rosaceae	
389	<i>Sabia campanulata</i>	Sabiaceae	Kali Lahara(Lh)
390	<i>Sabia lanceolata</i>	Sabiaceae	SimaliLahara(Lh)
391	<i>Sabia paniculata</i>	Sabiaceae	Kali Lahara(Lh)
392	<i>Sabia parviflora</i>	Sabiaceae	SimaliLahara(Lh)
393	<i>Sabia purpurea</i>	Sabiaceae	
394	<i>Sauraujaarmata</i>	Actinidiaceae	Mangmadom(Dz) Nyabjala shing(Ts)
395	<i>Sauropusandrogynus</i>	Euphorbiaceae	
396	<i>Sauropusquadrangularis</i>	Euphorbiaceae	
397	<i>Sauropusrepandus</i>	Euphorbiaceae	
398	<i>Schisandra grandiflora</i>	Schisandraceae	Singghattelahare(Lh)
399	<i>Skimmialaureola</i>	Rutaceae	Jainberiphul(Lh)
400	<i>Smilax minutiflora</i>	Smilacaceae	
401	<i>Smilax myrtillus</i>	Smilacaceae	
402	<i>Sophora velutina</i>	Leguminosae	
403	<i>Sophora wightii</i>	Leguminosae	
404	<i>Spartiumjunceum</i>	Leguminosae	
405	<i>Spermadictyonsuaveolens</i>	Rubiaceae	BhainChanpa(Lh)
406	<i>Spiraea arcuta</i>	Rosaceae	
407	<i>Spiraea bella</i>	Rosaceae	
408	<i>Spiraea canescens</i>	Rosaceae	
409	<i>Spiraea micrantha</i>	Rosaceae	Khangtshalo(Ts)
410	<i>Stephania elegans</i>	Menispermaceae	
411	<i>Stephania glabra</i>	Menispermaceae	TamarkePailo(Lh)

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412	<i>Stephania glandulifera</i>	Menispermaceae	Chechurobji (Dz) Zalamathangroo (Ts)
413	<i>Stephania japonica</i>	Menispermaceae	CharchareyLahara(Lh)
414	<i>Strophanthuswallichii</i>	Apocynaceae	
415	<i>Symplocosdryophila</i>	Symplocaceae	Kharane(Lh)
416	<i>Symplocosglomerata</i>	Symplocaceae	Kholme(Lh)
417	<i>Symplocosramosissima</i>	Symplocaceae	Kharane(Lh)
418	<i>Tarennoideawallichii</i>	Rubiaceae	
419	<i>Tephrosia candida</i>	Leguminosae	KumchumoShing(Ts), Bun Mara(Lh)
420	<i>Tetradiumglabrifolium</i>	Rutaceae	ThuloKhanakpa(Lh)
421	<i>Tetradiumruticarpum</i>	Rutaceae	
422	<i>Toddaliaasiatica</i>	Rutaceae	Kaporeru/Khaytore(Ts)
423	<i>Tournefortiahookeri</i>	Boraginaceae	ArupateLahara(Lh)
424	<i>Tournefortiamontana</i>	Boraginaceae	
425	<i>Toxocarpusaurantiacus</i>	Asclepiadaceae	
426	<i>Toxocarpushimalensis</i>	Asclepiadaceae	
427	<i>Trachelospermum assamense</i>	Apocynaceae	
428	<i>Trachelospermum axillare</i>	Apocynaceae	Lali-lara(Lh)
429	<i>Tylophoratenerrima</i>	Asclepiadaceae	
430	<i>Urarialagopus</i>	Leguminosae	
431	<i>Urariasinensis</i>	Leguminosae	
432	<i>Vitex negundo</i>	Verbenaceae	Sewali(Lh)
433	<i>Wallichiaadensiflora</i>	Arecaceae	Takoru(Lh)
434	<i>Wendlandiagrandis</i>	Rubiaceae	Tilki(Lh)
435	<i>Wendlandia pendula</i>	Rubiaceae	
436	<i>Wendlandiapuberula</i>	Rubiaceae	
437	<i>Wendlandiaspeciosa</i>	Rubiaceae	
438	<i>Wrightiaarborea</i>	Apocynaceae	Raba warongshing(Ts) Khirra (Lh)
439	<i>Wrightia coccinea</i>	Apocynaceae	
440	<i>Zanthoxylum acanthopodium</i>	Rutaceae	Dreytshang(Dz) Hagee zoo(Ts) Boke Timur(Lh)
441	<i>Zanthoxylum armatum</i>	Rutaceae	Thing-gi (Dz) Gee shing(Ts) Bale timur(Lh)
442	<i>Zanthoxylum bungeanum</i>	Rutaceae	Thing-gi (Dz) Gee shing(Ts) Timur(Lh)
443	<i>Zanthoxylum oxyphyllum</i>	Rutaceae	BhainsiTimur(Lh)
444	<i>Zanthoxylum tomentellum</i>	Rutaceae	

F8/18

1. CP No ☐ ☐ ☐ ☐

3. Date / / 4. Time / hrs

[illegible]

1.5.4.2.9 Herb Data

For NFI purpose, herb is any soft-stemmed plant with height equal to or less than 1 meter. The herb data shall be collected from 1 m² plot (radius 0.57 m) which shall be laid in North and East plots. NFI Crew must FIRST collect herb data (similar to regeneration data in Elbow plot) in North and East plots to avoid trampling of herbs. Follow the steps and description provided in the *Table 1.22* and complete form F9/F18 with **herb data** and herb list in *Table 1.23*

Table 1.22: Herb Data Collection

SN	Data Items	Description	Instructions
1	CP No	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot Name	Refers to one of the two plots (East or North Plot) of cluster plot	1. Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used. 2. If paper field forms have been used, tick the relevant plot from the two options provided.
3	Scientific or botanical name	Refers to scientific or botanical name which conforms to the <i>International Code of Botanical Nomenclature (ICBN)</i> . The list of herbs are provided in Table 1.23.	1. Choose appropriate Botanical Name as it appears in drop-down list on electronic form. 2. If the name of the plant is not in the list, then provision for typing the botanical name is also provided. 3. If Paper forms have been used, record accordingly.
4	Common Name/ Local Name	“Common name” herein is referred to the commonly used name of herb in English. "Local name" means name of tree in local dialect. For NFI, the Local Names in following dialects will be used; Dzongkha (Dz), Tshanglha Kha (Ts), Lhotsham kha (Lh), Bumthangp (Bum), Khengkha (Kh), Trongsap (Tr) and Kurtoep (Kr).	The Crew can note either the common name or the local name of the plant. In case of local name, Crew must specify dialect in which the local name has been given. (For <i>Houttuynia cordata</i> , it is Mombaring in Tshanglha Kha , therefore, local name must be written as Mombaring (Ts) , Ts indicates it is in Tshanglha Kha)
5	Number of individuals	Refers to number of individuals of a particular herb present in the subplot.	1. Count the number of individuals of a particular species of herb and record the number accordingly. 2. Likewise, record number of individuals of rest of the species of herb found in the subplot.
6	Cover percent	Refers to area of 0.57 m radius subplot, covered by herb	Occularly estimate as to the extent of coverage of herb within 0.57 m plot and record it in terms of percentage.

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7	Layer height	Refers to the average height of the herb in meters found within the subplot.	Record the average height of the herb in meters
8	Remarks		The Crew Leader or the data recorder may add any additional information on herbs found within the plot.

Table 1.23: Herb list and species code

Species code	Botanical Name	Family	Common Name
1	<i>Acalyphabrachystachya</i>	Euphorbiaceae	
2	<i>Achyranthes aspera</i>	Amaranthaceae	
3	<i>Achyranthes bidentata</i>	Amaranthaceae	
4	<i>Aconitum bisma</i>	Ranunculaceae	
5	<i>Aconitum bulbiferum</i>	Ranunculaceae	
6	<i>Aconitum deinorrhizum</i>	Ranunculaceae	
7	<i>Aconitum ferox</i>	Ranunculaceae	
8	<i>Aconitum fletcherianum</i>	Ranunculaceae	
9	<i>Aconitum funiculare</i>	Ranunculaceae	
10	<i>Aconitum heterophylloides</i>	Ranunculaceae	
11	<i>Aconitum hicksii</i>	Ranunculaceae	
12	<i>Aconitum hookeri</i>	Ranunculaceae	
13	<i>Aconitum laciniatum</i>	Ranunculaceae	
14	<i>Aconitum nakaoi</i>	Ranunculaceae	
15	<i>Aconitum naviculare</i>	Ranunculaceae	
16	<i>Aconitum novoluridum</i>	Ranunculaceae	
17	<i>Aconitum orochryseum</i>	Ranunculaceae	
18	<i>Aconitum patulum</i>	Ranunculaceae	
19	<i>Aconitum scaposum</i>	Ranunculaceae	
20	<i>Aconitum sherriffii</i>	Ranunculaceae	
21	<i>Aconitum spicatum</i>	Ranunculaceae	
22	<i>Acrocephalus indicus</i>	Lamiaceae	
23	<i>Acronema bellum</i>	Apiaceae	
24	<i>Acronemahookeri</i>	Apiaceae	
25	<i>Acronemanervosum</i>	Apiaceae	
26	<i>Acronemasichuanense</i>	Apiaceae	
27	<i>Acronematenerum</i>	Apiaceae	
28	<i>Actaeaacuminata</i>	Ranunculaceae	
29	<i>Adonis brevistyla</i>	Ranunculaceae	
30	<i>Aervasanguinolenta</i>	Amaranthaceae	
31	<i>Aeschynomeneindica</i>	Fabaceae	
32	<i>Ajuga bracteosa</i>	Lamiaceae	
33	<i>Ajuga lobata</i>	Lamiaceae	
34	<i>Ajuga macrosperma</i>	Lamiaceae	
35	<i>Alternanthera bettzickiana</i>	Amaranthaceae	
36	<i>Alternanthera brasiliana</i>	Amaranthaceae	
37	<i>Alternanthera pungens</i>	Amaranthaceae	
38	<i>Alternanthera sessilis</i>	Amaranthaceae	

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39	<i>Alysicarpus vaginalis</i>	Leguminosae	
40	<i>Amaranthus hybridus</i>	Amaranthaceae	Lasomo(Ts)
41	<i>Amaranthus spinosus</i>	Amaranthaceae	
42	<i>Amaranthus viridis</i>	Amaranthaceae	
43	<i>Anagallis arvensis</i>	Primulaceae	
44	<i>Androsacegeraniifolia</i>	Primulaceae	
45	<i>Androsaceglobifera</i>	Primulaceae	
46	<i>Androsacehemisphaerica</i>	Primulaceae	
47	<i>Androsacehenryi</i>	Primulaceae	
48	<i>Androsacehookeriana</i>	Primulaceae	
49	<i>Androsaceludlowiana</i>	Primulaceae	
50	<i>Androsaceselago</i>	Primulaceae	
51	<i>Androsacestrigillosa</i>	Primulaceae	
52	<i>Androsace tapete</i>	Primulaceae	
53	<i>Anemone demissa</i>	Ranunculaceae	
54	<i>Anemone griffithii</i>	Ranunculaceae	Ugala(Trongsa)
55	<i>Anemone obtusiloba</i>	Ranunculaceae	
56	<i>Anemone polyanthes</i>	Ranunculaceae	
57	<i>Anemone rivularis</i>	Ranunculaceae	
58	<i>Anemone rupestris</i>	Ranunculaceae	
59	<i>Anemone rupicola</i>	Ranunculaceae	
60	<i>Anemone smithiana</i>	Ranunculaceae	
61	<i>Anemone trullifolia</i>	Ranunculaceae	
62	<i>Anemone vitifolia</i>	Ranunculaceae	
63	<i>Anethumgraveolens</i>	Apiaceae	
64	<i>Anglelicacyclocarpa</i>	Apiaceae	
65	<i>Anglelicasikkimensis</i>	Apiaceae	
66	<i>Anisadeniameisner</i>	Linaceae	
67	<i>Anisadeniapubescens</i>	Linaceae	
68	<i>Anisadeniasaxatilis</i>	Linaceae	
69	<i>Anisochiluspallidus</i>	Lamiaceae	
70	<i>Apios carnea</i>	Leguminosae	
71	<i>Apiumgraveolens</i>	Apiaceae	
72	<i>Arabidopsis himalaica</i>	Brassicaceae	
73	<i>Arabidopsis lasiocarpa</i>	Brassicaceae	
74	<i>Arabidopsis mollissima</i>	Brassicaceae	
75	<i>Arabis amplexicaulis</i>	Brassicaceae	
76	<i>Arabis axilliflora</i>	Brassicaceae	
77	<i>Arabis pterosperma</i>	Brassicaceae	
78	<i>Arabis venusta</i>	Brassicaceae	
79	<i>Archyospermaprimulifolium</i>	Brassicaceae	
80	<i>Arenaria ciliolata</i>	Caryophyllaceae	
81	<i>Arenaria debilis</i>	Caryophyllaceae	
82	<i>Arenaria densissima</i>	Caryophyllaceae	
83	<i>Arenaria depauperata</i>	Caryophyllaceae	
84	<i>Arenaria edgeworthiana</i>	Caryophyllaceae	
85	<i>Arenaria glanduligera</i>	Caryophyllaceae	

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86	<i>Arenaria ischnophylla</i>	Caryophyllaceae	
87	<i>Arenaria ludlowii</i>	Caryophyllaceae	
88	<i>Arenaria melandryiformis</i>	Caryophyllaceae	
89	<i>Arenaria melandryoides</i>	Caryophyllaceae	
90	<i>Arenaria polytrichoides</i>	Caryophyllaceae	
91	<i>Arenaria pulvinata</i>	Caryophyllaceae	
92	<i>Arenaria rotundifolia</i>	Caryophyllaceae	Brumzey(Tr)
93	<i>Argimonia pilosa</i>	Rosaceae	
94	<i>Argostemma sarmentosum</i>	Rubiaceae	
95	<i>Argostemma verticillatum</i>	Rubiaceae	
96	<i>Argyrelavenusta</i>	Convolvulaceae	
97	<i>Aruncus dioicus</i>	Rosaceae	
98	<i>Asteropyrum peltatum</i>	Ranunculaceae	(Ts) TonsarGugay; Nep: BuroOkhate
99	<i>Astilbe rivularis</i>	Saxifragaceae	
100	<i>Astilbe rubra</i>	Saxifragaceae	
101	<i>Astragalus floridus</i>	Leguminosae	
102	<i>Astragalus acaulis</i>	Leguminosae	
103	<i>Astragalus bhotanensis</i>	Leguminosae	
104	<i>Astragalus chlorostachys</i>	Leguminosae	
105	<i>Astragalus concretus</i>	Leguminosae	
106	<i>Astragalus donianus</i>	Leguminosae	
107	<i>Astragalus kongrensis</i>	Leguminosae	
108	<i>Astragalus lessertoides</i>	Leguminosae	
109	<i>Astragalus rigidulus</i>	Leguminosae	
110	<i>Astragalus sikkimensis</i>	Leguminosae	
111	<i>Astragalus stipulatus</i>	Leguminosae	
112	<i>Astragalus strictus</i>	Leguminosae	
113	<i>Astragalus tongolensis</i>	Leguminosae	
114	<i>Barbarea elata</i>	Brassicaceae	
115	<i>Barbarea intermedia</i>	Brassicaceae	
116	<i>Basella alba</i>	Basellaceae	
117	<i>Bergenia ciliata</i>	Saxifragaceae	
118	<i>Bergenia purpurascens</i>	Saxifragaceae	Med: Yerma shing
119	<i>Boenninghausenia albiflora</i>	Rutaceae	
120	<i>Boerhavia coccinea</i>	Nyctaginaceae	
121	<i>Brachystemma calycinum</i>	Caryophyllaceae	
122	<i>Brassica juncea</i>	Brassicaceae	
123	<i>Brassica rapa</i>	Brassicaceae	
124	<i>Braya forrestii</i>	Brassicaceae	
125	<i>Braya oxycarpa</i>	Brassicaceae	
126	<i>Braya tibetica</i>	Brassicaceae	Dum (Dz)
127	<i>Bryocarpum himalaicum</i>	Primulaceae	
128	<i>Bupleurum candollei</i>	Apiaceae	
129	<i>Bupleurum dalhousieanum</i>	Apiaceae	
130	<i>Bupleurum falcatum</i>	Apiaceae	
131	<i>Bupleurum gracillimum</i>	Apiaceae	

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132	<i>Bupleurmhamiltonii</i>	Apiaceae	
133	<i>Bupleurm marginatum</i>	Apiaceae	PhrogpaLaga(Ts)
134	<i>Butea buteiformis</i>	Leguminosae	
135	<i>Cajanus elongatus</i>	Leguminosae	SemchungRobjay(Dz)
136	<i>Cajanus mollis</i>	Leguminosae	
137	<i>Calathodespalamata</i>	Ranunculaceae	
138	<i>Callianthemumpimpinelloides</i>	Ranunculaceae	
139	<i>Callitriche palustris</i>	Plantaginaceae	
140	<i>Callitriche stagnalis</i>	Plantaginaceae	
141	<i>Caltha palustris</i>	Ranunculaceae	
142	<i>Caltha scaposa</i>	Ranunculaceae	
143	<i>Calystegia hederacea</i>	Convolvulaceae	
144	<i>Camylotropisbunge</i>	Fabaceae	
145	<i>Capsella bursa-pastoris</i>	Brassicaceae	Shepherd's purse(Eng)
146	<i>Cardamineelegantula</i>	Brassicaceae	
147	<i>Cardamineflexuosa</i>	Brassicaceae	
148	<i>Cardaminegriffithii</i>	Brassicaceae	
149	<i>Cardamine impatiens</i>	Brassicaceae	
150	<i>Cardamineloxostemonoides</i>	Brassicaceae	
151	<i>Cardamine macrophylla</i>	Brassicaceae	
152	<i>Cardaminemultijuga</i>	Brassicaceae	
153	<i>Cardaminescoriarum</i>	Brassicaceae	
154	<i>Cardaminetrifoliolata</i>	Brassicaceae	
155	<i>Cardamineviolacea</i>	Brassicaceae	
156	<i>Cardamineyunnanensis</i>	Brassicaceae	
157	<i>Carumcarvi</i>	Apiaceae	
158	<i>Cassia hochstetteri</i>	Leguminosae	
159	<i>Cassia lechenaultiana</i>	Leguminosae	
160	<i>Cathcartiavillosa</i>	Papaveraceae	
161	<i>Celosia argentea</i>	Amaranthaceae	
162	<i>Centellaasiatica</i>	Apiaceae	Tunimanakuni (Dz)
163	<i>Cerastiumglomeratum</i>	Caryophyllaceae	
164	<i>Chaeropyllumvillosum</i>	Apiaceae	
165	<i>Chamaesiumnovemjugum</i>	Apiaceae	
166	<i>Chenopodium album</i>	Amaranthaceae	
167	<i>Chenopodium ambrosioides</i>	Amaranthaceae	
168	<i>Dysphaniabotrys</i>	Amaranthaceae	
169	<i>Chenopodium ficifolium</i>	Amaranthaceae	Hethu / Nep: Bethu(Dz)
170	<i>Chrysobrayaglaricola</i>	Brassicaceae	
171	<i>Chrysospleniumadoxoides</i>	Saxifragaceae	
172	<i>Chrysospleniumcarnosum</i>	Saxifragaceae	
173	<i>Chrysospleniumforrestii</i>	Saxifragaceae	
174	<i>Chrysospleniumgriffithii</i>	Saxifragaceae	
175	<i>Chrysospleniumnepalense</i>	Saxifragaceae	
176	<i>Chrysospleniumtenellum</i>	Saxifragaceae	
177	<i>Cimicifuga foetida</i>	Ranunculaceae	
178	<i>Cleome gynandra</i>	Cleomaceae	

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179	<i>Cleome viscosa</i>	Cleomaceae	
180	<i>Clitoriamariana</i>	Leguminosae	
181	<i>Clitoriatermatea</i>	Leguminosae	
182	<i>Cnidiumbhutanicum</i>	Apiaceae	Larkspur(Eng)
183	<i>Eutremahookeri</i>	Brassicaceae	
184	<i>Consolidaambigua</i>	Ranunculaceae	
185	<i>Convolvulus arvensis</i>	Convolvulaceae	
186	<i>Coriandrum sativum</i>	Apiaceae	
187	<i>Cortiadepressa</i>	Apiaceae	
188	<i>Cortiellacortioides</i>	Apiaceae	
189	<i>Cortiellahookeri</i>	Apiaceae	
190	<i>Corydalis alperstris</i>	Papaveraceae	
191	<i>Corydalis autantiaca</i>	Papaveraceae	
192	<i>Corydalis bowes-lyonii</i>	Papaveraceae	
193	<i>Corydalis calliantha</i>	Papaveraceae	
194	<i>Corydalis cashmeriana</i>	Papaveraceae	
195	<i>Corydalis casimiriana</i>	Papaveraceae	
196	<i>Corydalis chaerophylla</i>	Papaveraceae	
197	<i>Corydalis chasmophila</i>	Papaveraceae	
198	<i>Corydalis crispa</i>	Papaveraceae	
199	<i>Corydalis delicatula</i>	Papaveraceae	
200	<i>Corydalis dorjii</i>	Papaveraceae	
201	<i>Corydalis drepanantha</i>	Papaveraceae	
202	<i>Corydalis dubia</i>	Papaveraceae	
203	<i>Corydalis ecristata</i>	Papaveraceae	
204	<i>Corydalis flaccida</i>	Papaveraceae	
205	<i>Corydalis franchetiana</i>	Papaveraceae	
206	<i>Corydalis gerdae</i>	Papaveraceae	
207	<i>Corydalis juncea</i>	Papaveraceae	
208	<i>Corydalis laelia</i>	Papaveraceae	
209	<i>Corydalis lathyroides</i>	Papaveraceae	
210	<i>Corydalis leptocarpa</i>	Papaveraceae	
211	<i>Corydalis longipes</i>	Papaveraceae	
212	<i>Corydalis meifolia</i>	Papaveraceae	
213	<i>Corydalis oligantha</i>	Papaveraceae	
214	<i>Corydalis ophiocarpa</i>	Papaveraceae	
215	<i>Corydalis oxalidifolia</i>	Papaveraceae	
216	<i>Corydalis polygalina</i>	Papaveraceae	
217	<i>Corydalis sikkimensis</i>	Papaveraceae	
218	<i>Corydalis stracheyi</i>	Papaveraceae	
219	<i>Corydalis trifolitata</i>	Papaveraceae	
220	<i>Crawfuradiacampanulacea</i>	Gentianaceae	
221	<i>Crawfuradiapuberula</i>	Gentianaceae	
222	<i>Crawfuradiaspecousa</i>	Gentianaceae	
223	<i>Crotolariaalbida</i>	Leguminosae	
224	<i>Crotolariaferruginea</i>	Leguminosae	
225	<i>Crotolariahumifusa</i>	Leguminosae	

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226	<i>Crotolatrifoliastrum</i>	Leguminosae	
227	<i>Cucubalusbacciferus</i>	Caryophyllaceae	
228	<i>Cuminumcuminum</i>	Apiaceae	
229	<i>Cuscuta campestris</i>	Convolvulaceae	
230	<i>Cuscutaeuropaea</i>	Convolvulaceae	Roba-je (Dz)
231	<i>Cuscutareflexa</i>	Convolvulaceae	
232	<i>Cuscuta scandens</i>	Convolvulaceae	Khirpatey (Lh)
233	<i>Cyathulaprostrata</i>	Amaranthaceae	
234	<i>Cynoglossumlanceolatum</i>	Boraginaceae	
235	<i>Delphinium altissimum</i>	Ranunculaceae	
236	<i>Delphinium bhutanicum</i>	Ranunculaceae	
237	<i>Delphinium caeruleum</i>	Ranunculaceae	
238	<i>Delphinium cooperi</i>	Ranunculaceae	
239	<i>Delphinium glaciale</i>	Ranunculaceae	
240	<i>Delphinium ludlowii</i>	Ranunculaceae	
241	<i>Delphinium muscosum</i>	Ranunculaceae	
242	<i>Delphinium nepalense</i>	Ranunculaceae	
243	<i>Delphinium scabriflorum</i>	Ranunculaceae	
244	<i>Delphinium stapeliosmum</i>	Ranunculaceae	
245	<i>Delphinium viscosum</i>	Ranunculaceae	
246	<i>Desmodiumducclouxii</i>	Leguminosae	
247	<i>Desmodiumheterocarpon</i>	Leguminosae	
248	<i>Desmodiumpodocarpum</i>	Leguminosae	
249	<i>Desmodium williamsii</i>	Leguminosae	
250	<i>Dianthus barbatus</i>	Caryophyllaceae	Sweet William (Eng)
251	<i>Dianthus chinensis</i>	Caryophyllaceae	Chinese or Indian Pink (Eng)
252	<i>Dichocarpumadiantifolium</i>	Ranunculaceae	
253	<i>Dilophia salsa</i>	Brassicaceae	
254	<i>Dolichostenuicaulis</i>	Leguminosae	
255	<i>Dontostemonglandulosus</i>	Brassicaceae	
256	<i>Drababhutanica</i>	Brassicaceae	
257	<i>Drabaelata</i>	Brassicaceae	
258	<i>Drabaeriopoda</i>	Brassicaceae	
260	<i>Drabagracillima</i>	Brassicaceae	
261	<i>Drabahicksii</i>	Brassicaceae	
262	<i>Drabalasiophylla</i>	Brassicaceae	
263	<i>Drabaoariocarpa</i>	Brassicaceae	
264	<i>Drabaoreades</i>	Brassicaceae	
265	<i>Drabasherriffii</i>	Brassicaceae	
266	<i>Drabasikkimensis</i>	Brassicaceae	
267	<i>Draba williamsii</i>	Brassicaceae	
268	<i>Droserapeltata</i>	Droseraceae	
269	<i>Drymariacordata</i>	Caryophyllaceae	
270	<i>Drymariavillosa</i>	Caryophyllaceae	
271	<i>Duchesneaindica</i>	Rosaceae	
272	<i>Dumasia villosa</i>	Leguminosae	Shingtsem (Dz)
273	<i>Elsholtziablanda</i>	Lamiaceae	

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274	<i>Elsholtziaciliata</i>	Lamiaceae	
275	<i>Elsholtziaconcinna</i>	Lamiaceae	
276	<i>Elsholtziadensa</i>	Lamiaceae	
277	<i>Elsholtziaeristachya</i>	Lamiaceae	
278	<i>Elsholtziapilosa</i>	Lamiaceae	
279	<i>Elsholtziastachyodes</i>	Lamiaceae	
280	<i>Elsholtziastrobilifera</i>	Lamiaceae	
281	<i>Eryngium foetidum</i>	Apiaceae	
282	<i>Erysimumhieracifolium</i>	Brassicaceae	
283	<i>Erysimumlongisiliquum</i>	Brassicaceae	
284	<i>Erysimumpachycarpum</i>	Brassicaceae	
285	<i>Eutremadeltoideum</i>	Brassicaceae	
286	<i>Eutremagriffithii</i>	Brassicaceae	
287	<i>Eutremaheterophyllum</i>	Brassicaceae	
288	<i>Eutremahimalaicum</i>	Brassicaceae	
289	<i>Eutremahimalayensis</i>	Brassicaceae	
290	<i>Eutremahirta</i>	Brassicaceae	
291	<i>Eutremahypericifolia</i>	Brassicaceae	
292	<i>Eutremalongifolia</i>	Brassicaceae	
293	<i>Eutremaprostrata</i>	Brassicaceae	
294	<i>Eutremastracheyi</i>	Brassicaceae	
295	<i>Eutremathymifolia</i>	Brassicaceae	
296	<i>Evplulusalsinoides</i>	Convolvulaceae	GeethriMeto (Dz)
297	<i>Exacumhamiltonii</i>	Gentianaceae	
298	<i>Exacumters</i>	Gentianaceae	
299	<i>Foeniculum vulgare</i>	Apiaceae	
300	<i>Fragaria daltoniana</i>	Rosaceae	
301	<i>Fragaria nubicola</i>	Rosaceae	
302	<i>Fumaria indica</i>	Papaveraceae	
303	<i>Gentianaalbicalyx</i>	Gentianaceae	
304	<i>Gentianaalgida</i>	Gentianaceae	
305	<i>Gentianabryoides</i>	Gentianaceae	
306	<i>Gentianacapitata</i>	Gentianaceae	
307	<i>Gentianacephalodes</i>	Gentianaceae	
308	<i>Gentianacrassuloides</i>	Gentianaceae	
309	<i>Gentianadepressa</i>	Gentianaceae	
310	<i>Gentianaelwesii</i>	Gentianaceae	
311	<i>Gentianaemodi</i>	Gentianaceae	
312	<i>Gentianagilvostrata</i>	Gentianaceae	
313	<i>Gentianaglabriusula</i>	Gentianaceae	
314	<i>Gentianahicksii</i>	Gentianaceae	
315	<i>Gentianahimalayensis</i>	Gentianaceae	
316	<i>Gentianainfelix</i>	Gentianaceae	
317	<i>Gentianakarelinii</i>	Gentianaceae	
318	<i>Gentianalacerulata</i>	Gentianaceae	
319	<i>Gentianaleucantha</i>	Gentianaceae	
320	<i>Gentianaloureirii</i>	Gentianaceae	

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321	<i>Gentianamaeulchanensis</i>	Gentianaceae	
322	<i>Gentianamarginata</i>	Gentianaceae	
323	<i>Gentianamicans</i>	Gentianaceae	
324	<i>Gentianamicantiformis</i>	Gentianaceae	
325	<i>Gentiananyalamensis</i>	Gentianaceae	
326	<i>Gentianaobconica</i>	Gentianaceae	
327	<i>Gentianaoreodox</i>	Gentianaceae	
328	<i>Gentianaornata</i>	Gentianaceae	
329	<i>Gentianapedicellata</i>	Gentianaceae	
330	<i>Gentianaphyllocalyx</i>	Gentianaceae	
331	<i>Gentianaprainii</i>	Gentianaceae	
332	<i>Gentianaprolata</i>	Gentianaceae	
333	<i>Gentianasikkimensis</i>	Gentianaceae	
334	<i>Gentianasimulatrix</i>	Gentianaceae	
335	<i>Gentianatibetica</i>	Gentianaceae	
336	<i>Gentianatubiflora</i>	Gentianaceae	
337	<i>Gentianaurnula</i>	Gentianaceae	
338	<i>Gentianaveitchiorum</i>	Gentianaceae	
339	<i>Gentianaverayi</i>	Gentianaceae	
340	<i>Gentianella azurea</i>	Gentianaceae	
341	<i>Gentianella griersonii</i>	Gentianaceae	
342	<i>Gentianella paludosa</i>	Gentianaceae	
343	<i>Gentianella pedunculata</i>	Gentianaceae	
344	<i>Gentianella stellariifolia</i>	Gentianaceae	
345	<i>Gentianella urnigera</i>	Gentianaceae	
346	<i>Geranium donianum</i>	Geraniaceae	
347	<i>Geranium lambertii</i>	Geraniaceae	
348	<i>Geranium nakaoanum</i>	Geraniaceae	
349	<i>Geranium nepalense</i>	Geraniaceae	
350	<i>Geranium polyanthes</i>	Geraniaceae	
351	<i>Geranium procurrens</i>	Geraniaceae	
352	<i>Geranium refractum</i>	Geraniaceae	
353	<i>Geumaleppicum</i>	Rosaceae	
354	<i>Geumelatum</i>	Rosaceae	
355	<i>Geummacrpsepalum</i>	Rosaceae	
356	<i>Geumsikkimense</i>	Rosaceae	
357	<i>Glinuslotoides</i>	Molluginaceae	Soybean (Eng)
358	<i>Glycine max</i>	Leguminosae	
359	<i>Gomphrena celosioides</i>	Amaranthaceae	
360	<i>Gomphrena globosa</i>	Amaranthaceae	
361	<i>Gueldenstaedtiahimalaica</i>	Leguminosae	
362	<i>Gyposphilacerastioides</i>	Caryophyllaceae	
363	<i>Hackeliaabhutanica</i>	Boraginaceae	
364	<i>Hackeliaobtusifolia</i>	Boraginaceae	
365	<i>Hackeliauncinata</i>	Boraginaceae	
366	<i>Haleniaelliptica</i>	Gentianaceae	
367	<i>Haplospherahimalayensis</i>	Apiaceae	

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368	<i>Hedysarumsikkimense</i>	Leguminosae	
369	<i>Heliotropiumindcum</i>	Boraginaceae	
370	<i>Heliotropiumstrigosum</i>	Boraginaceae	
371	<i>Heracleum bhutanicum</i>	Apiaceae	
372	<i>Heracleum nepalense</i>	Apiaceae	
373	<i>Heracleum obtusifolium</i>	Apiaceae	
374	<i>Heracleum sphondylium</i>	Apiaceae	
375	<i>Heracleum sublineare</i>	Apiaceae	
376	<i>Heracleum woodii</i>	Apiaceae	Mombering / Nombaring (Ts)
377	<i>Houttuynia cordata</i>	Saururaceae	
378	<i>Hydrobryumgriggithii</i>	Podostemaceae	Ghoratophay (Lh)
379	<i>Hydrocotylehimalaica</i>	Araliaceae	
380	<i>Hydrocotylenepalensis</i>	Araliaceae	
381	<i>Hydrocotylesibthorpiodes</i>	Araliaceae	
382	<i>Hypericum elodeoides</i>	Hypericaceae	
383	<i>Hypericum gramineum</i>	Hypericaceae	
384	<i>Hypericum himalaicum</i>	Hypericaceae	
385	<i>Hypericum japonicum</i>	Hypericaceae	
386	<i>Hypericum leptocarpum</i>	Hypericaceae	
387	<i>Hypericum ludlowii</i>	Hypericaceae	
388	<i>Hypericum monanthemum</i>	Hypericaceae	
389	<i>Hypericum petiolulatum</i>	Hypericaceae	
390	<i>Hypericum wightianum</i>	Hypericaceae	
391	<i>Hyptissuaveolens</i>	Lamiaceae	
392	<i>Impatiens arguta</i>	Balsaminaceae	
393	<i>Impatiens cristata</i>	Balsaminaceae	
394	<i>Impatiens discolor</i>	Balsaminaceae	
395	<i>Impatiens drepanophora</i>	Balsaminaceae	
396	<i>Impatiens exilis</i>	Balsaminaceae	
397	<i>Impatiens florigera</i>	Balsaminaceae	
398	<i>Impatiens infundibularis</i>	Balsaminaceae	
399	<i>Impatiens jurpia</i>	Balsaminaceae	
400	<i>Impatiens latiflora</i>	Balsaminaceae	
401	<i>Impatiens longipes</i>	Balsaminaceae	
402	<i>Impatiens puberula</i>	Balsaminaceae	
403	<i>Impatiens pulchra</i>	Balsaminaceae	
404	<i>Impatiens racemosa</i>	Balsaminaceae	
405	<i>Impatiens radiata</i>	Balsaminaceae	
406	<i>Impatiens spirifer</i>	Balsaminaceae	
407	<i>Impatiens stenantha</i>	Balsaminaceae	Doorgonang (Ts)
408	<i>Impatiens tripetala</i>	Balsaminaceae	
409	<i>Indigoferalinifolia</i>	Leguminosae	
410	<i>Indigofera trifoliata</i>	Leguminosae	
411	<i>Ipomoea batatas</i>	Convolvulaceae	
412	<i>Ipomoea indica</i>	Convolvulaceae	
413	<i>Ipomoea nill</i>	Convolvulaceae	
414	<i>Ipomoea pes-tigridis</i>	Convolvulaceae	

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415	<i>Ipomoea purpurea</i>	Convolvulaceae	
416	<i>Ipomoea turbinata</i>	Convolvulaceae	
417	<i>Isodonatroruber</i>	Lamiaceae	
418	<i>Isodoncoetse</i>	Lamiaceae	
419	<i>Isodonhispidus</i>	Lamiaceae	Dolopatey (Dz)
420	<i>Isodonlophanthoides</i>	Lamiaceae	
421	<i>Isodonrepens</i>	Lamiaceae	
422	<i>Isodonscrophularioides</i>	Lamiaceae	Peng-dong-dongla (Dz)
423	<i>Isodonternifolius</i>	Lamiaceae	
424	<i>Kelloggiachinensis</i>	Rubiaceae	
425	<i>Keraymoniapinnatifolia</i>	Apiaceae	Orey(Ts) Shimi (Nep)
426	<i>Labilabpurpureus</i>	Leguminosae	
427	<i>Lalldhwojiaacronemiflia</i>	Apiaceae	
428	<i>Lasiocaryumdensiflorum</i>	Boraginaceae	
429	<i>Lasiocaryumludlowii</i>	Boraginaceae	
430	<i>Lasiocaryummunroi</i>	Boraginaceae	
431	<i>Lepidium capitatum</i>	Brassicaceae	
432	<i>Lepidostemonpedunculatus</i>	Brassicaceae	
433	<i>Lepidumvirginicum</i>	Brassicaceae	
434	<i>Leucas cephalotes</i>	Lamiaceae	
435	<i>Leucas ciliate</i>	Lamiaceae	
436	<i>Leucas indica</i>	Lamiaceae	
437	<i>Leucas lanata</i>	Lamiaceae	
438	<i>Leucas mollissima</i>	Lamiaceae	
439	<i>Lignariellahobsonii</i>	Brassicaceae	
440	<i>Ligusticumacuminatum</i>	Apiaceae	
441	<i>Ligusticumelatum</i>	Apiaceae	
442	<i>Lomatogoniumbrachyantherum</i>	Gentianaceae	
443	<i>Lomatogoniumchumbicum</i>	Gentianaceae	
444	<i>Lomatogoniumhimalayense</i>	Gentianaceae	
445	<i>Lomatogoniumsikkimense</i>	Gentianaceae	
446	<i>Lomatogoniumstapfii</i>	Gentianaceae	Birdsfoot Trefoil (Eng)
447	<i>Lotus corniculatus</i>	Leguminosae	
448	<i>Loxostemonpulchellus</i>	Brassicaceae	
449	<i>Lysimachia alternifolia</i>	Primulaceae	
450	<i>Lysimachiaachenopodio</i>	Primulaceae	
451	<i>Lysimachiacongestiflora</i>	Primulaceae	
452	<i>Lysimachia decurrens</i>	Primulaceae	
453	<i>Lysimachiaevalvis</i>	Primulaceae	
454	<i>Lysimachia ferruginea</i>	Primulaceae	
455	<i>Lysimachia japonica</i>	Primulaceae	
456	<i>Lysimachialaxa</i>	Primulaceae	
457	<i>Lysimachialobeliodes</i>	Primulaceae	
458	<i>Lysimachia prolifera</i>	Primulaceae	
459	<i>Macrotyloma uniflorum</i>	Leguminosae	
460	<i>Meconopsisconcinna</i>	Papaveraceae	
461	<i>Meconopsis discigera</i>	Papaveraceae	

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462	<i>Meconopsisgrandis</i>	Papaveraceae	
463	<i>Meconopsishorridula</i>	Papaveraceae	
464	<i>Meconopsisnapaulensis</i>	Papaveraceae	
465	<i>Meconopsispaniculata</i>	Papaveraceae	
466	<i>Meconopsisprimulina</i>	Papaveraceae	
467	<i>Meconopsissherriffii</i>	Papaveraceae	
468	<i>Meconopsissimplicifolia</i>	Papaveraceae	
469	<i>Meconopsis sinuate</i>	Papaveraceae	
470	<i>Meconopsis superb</i>	Papaveraceae	
471	<i>Meeboldiadigitata</i>	Apiaceae	
472	<i>Megacondonstylophorus</i>	Leguminosae	
473	<i>Melilotusindica</i>	Leguminosae	
474	<i>Melissa axillaris</i>	Lamiaceae	
475	<i>Mentha longifolia</i>	Lamiaceae	Babari (Lh)
476	<i>Mentha spicata</i>	Lamiaceae	
477	<i>Mercurialisleiocarpa</i>	Euphorbiaceae	
478	<i>Merremia umbellate</i>	Convolvulaceae	
479	<i>Merremiavitifolia</i>	Convolvulaceae	
480	<i>Micromeriabiflora</i>	Lamiaceae	
481	<i>Microsisymbriummaxillare</i>	Brassicaceae	
482	<i>Microsisymbriumdasycarpum</i>	Brassicaceae	
483	<i>Microulabhutanica</i>	Boraginaceae	
484	<i>Mirabilis himalaica</i>	Nyctaginaceae	4 o'clock (Eng)
485	<i>Mirabilis jalapa</i>	Nyctaginaceae	
486	<i>Mollugonudicaulis</i>	Molluginaceae	
487	<i>Mollugo stricta</i>	Molluginaceae	
488	<i>Neanotisgracilis</i>	Rubiaceae	
489	<i>Neanotis ingrate</i>	Rubiaceae	
490	<i>Nelumbo nucifera</i>	Nelumbonaceae	
491	<i>Nepeta lamiopsis</i>	Lamiaceae	
492	<i>Notochaetehamosa</i>	Lamiaceae	
493	<i>Ocimumamericanum</i>	Lamiaceae	
494	<i>Ocimumbasilicum</i>	Lamiaceae	
495	<i>Oenanthelhookeri</i>	Apiaceae	
496	<i>Oenantheljavanica</i>	Apiaceae	
497	<i>Oenanthelthomsonii</i>	Apiaceae	
498	<i>Olidenlandiabrachypoda</i>	Rubiaceae	
499	<i>Olidenlandiacorymbosa</i>	Rubiaceae	
500	<i>Olidenlandiadiiffusa</i>	Rubiaceae	
501	<i>Omphlogrammaelwesiana</i>	Leguminosae	
502	<i>Onosmabhutanica</i>	Boraginaceae	
503	<i>Onosmaemodi</i>	Boraginaceae	
504	<i>Onosmahookeri</i>	Boraginaceae	
505	<i>Onosmapaniculatum</i>	Boraginaceae	
506	<i>Ophiorrhiza fasciculata</i>	Rubiaceae	
507	<i>Ophiorrhizaheterostyla</i>	Rubiaceae	
508	<i>Ophiorrhizalongii</i>	Rubiaceae	

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509	<i>Ophiorrhiza ochroleuca</i>	Rubiaceae	
510	<i>Ophiorrhiza repens</i>	Rubiaceae	
511	<i>Ophiorrhiza rosea</i>	Rubiaceae	
512	<i>Ophiorrhiza rugosa</i>	Rubiaceae	
513	<i>Ophiorrhiza succirubra</i>	Rubiaceae	
514	<i>Ophiorrhiza treutleri</i>	Rubiaceae	
515	<i>Origanum vulgare</i>	Lamiaceae	
516	<i>Orthosiphon</i>	Lamiaceae	
517	<i>Orthosiphon rubicundus</i>	Lamiaceae	
518	<i>Osmorhiza aristata</i>	Apiaceae	
519	<i>Oxalis corniculata</i>	Oxalidaceae	
520	<i>Oxalis corymbosa</i>	Oxalidaceae	
521	<i>Oxalis griffithii</i>	Oxalidaceae	
522	<i>Oxalis latifolia</i>	Oxalidaceae	
523	<i>Oxalis leucolepis</i>	Oxalidaceae	
524	<i>Oxygraphis endlicheri</i>	Ranunculaceae	
525	<i>Oxytropis lapponica</i>	Leguminosae	Biri (Lh)
526	<i>Paederia cruddasiana</i>	Rubiaceae	Biri Lara (Lh)
527	<i>Paederia foetida</i>	Rubiaceae	Field Poppy (Eng)
528	<i>Papaver rhoeas</i>	Papaveraceae	
529	<i>Papaver somniferum</i>	Papaveraceae	
530	<i>Paraquilegia anemoneoides</i>	Ranunculaceae	
531	<i>Parnassia chinensis</i>	Celastraceae	
532	<i>Parnassia cooperi</i>	Celastraceae	
533	<i>Parnassia delavayi</i>	Celastraceae	
534	<i>Parnassia nubicola</i>	Celastraceae	
535	<i>Parnassia pusilla</i>	Celastraceae	
536	<i>Parnassia wightiana</i>	Celastraceae	
537	<i>Paroxygraphis sikkimensis</i>	Ranunculaceae	
538	<i>Parryan nudicaulis</i>	Brassicaceae	
539	<i>Pegaeophyton minutum</i>	Brassicaceae	
540	<i>Pegaeophyton scapiflorum</i>	Brassicaceae	
541	<i>Pelargonium aiton</i>	Geraniaceae	
542	<i>Peperomia heyneana</i>	Piperaceae	
543	<i>Peperomia pellucida</i>	Piperaceae	
544	<i>Peperomia tetraphylla</i>	Piperaceae	
545	<i>Phaeonychium parryoides</i>	Brassicaceae	
546	<i>Phlomis breviflora</i>	Lamiaceae	
547	<i>Phlomis macrophylla</i>	Lamiaceae	
548	<i>Phlomis rotata</i>	Lamiaceae	
549	<i>Phlomis tibetica</i>	Lamiaceae	
550	<i>Phyla nodiflora</i>	Verbenaceae	
551	<i>Phyllanthus debilis</i>	Phyllanthaceae	
552	<i>Phyllanthus urinaria</i>	Phyllanthaceae	
553	<i>Phyllanthus virgatus</i>	Phyllanthaceae	
554	<i>Physospermopsis kingdonwardii</i>	Apiaceae	
555	<i>Physospermopsis obtusiuscula</i>	Apiaceae	Kashakani (Dz)

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556	<i>Phytolaccaacinos</i>	Phytolaccaceae	
557	<i>Pimpinella diversifolia</i>	Apiaceae	
558	<i>Pimpinella tibetanica</i>	Apiaceae	
559	<i>Pimpinella urceolata</i>	Apiaceae	
560	<i>Pisum communis</i>	Fabaceae	Field Pea / Garden Pea (Eng)
561	<i>Pisum sativum</i>	Fabaceae	
562	<i>Plectranthus barbatus</i>	Lamiaceae	
563	<i>Pleurospermopsissikkimensis</i>	Apiaceae	
564	<i>Pleurospermum album</i>	Apiaceae	
565	<i>Pleurospermum amabile</i>	Apiaceae	
566	<i>Pleurospermumangelicoides</i>	Apiaceae	
567	<i>Pleurospermumapiolens</i>	Apiaceae	
568	<i>Pleurospermumbentharii</i>	Apiaceae	
569	<i>Pleurospermumdentatum</i>	Apiaceae	
570	<i>Pleurospermumhookeri</i>	Apiaceae	
571	<i>Pleurospermumpilosum</i>	Apiaceae	
572	<i>Podophylumhexandrum</i>	Berberidaceae	
573	<i>Podophylumsikkimense</i>	Berberidaceae	Namda (Dz)
574	<i>Pogostemonamaranthoides</i>	Lamiaceae	
575	<i>Pogostemonbrachystachys</i>	Lamiaceae	
576	<i>Pogostemonfraternus</i>	Lamiaceae	
577	<i>Pogostemonlinearis</i>	Lamiaceae	
578	<i>Polycarponprostratum</i>	Caryophyllaceae	
579	<i>Polygala furcata</i>	Polygalaceae	
580	<i>Polygala persicariifolia</i>	Polygalaceae	
581	<i>Polygala sibirica</i>	Polygalaceae	
582	<i>Polygala tararinowii</i>	Polygalaceae	
583	<i>Potentilla achilleifolia</i>	Rosaceae	
584	<i>Potentilla anserine</i>	Rosaceae	
585	<i>Potentilla bhutanica</i>	Rosaceae	
586	<i>Potentilla bryoides</i>	Rosaceae	
587	<i>Potentilla coriandrifolia</i>	Rosaceae	
588	<i>Potentilla cuneata</i>	Rosaceae	
589	<i>Potentilla eriocarpa</i>	Rosaceae	
590	<i>Potentilla eriocarpoides</i>	Rosaceae	
591	<i>Potentilla forestii</i>	Rosaceae	
592	<i>Potentilla fragaroides</i>	Rosaceae	
593	<i>Potentilla griffithii</i>	Rosaceae	
594	<i>Potentilla latiloba</i>	Rosaceae	
595	<i>Potentilla leuconota</i>	Rosaceae	
596	<i>Potentilla lineate</i>	Rosaceae	
597	<i>Potentilla microphylla</i>	Rosaceae	
598	<i>Potentilla monanthes</i>	Rosaceae	
599	<i>Potentilla peduncularis</i>	Rosaceae	
600	<i>Potentilla polyphylla</i>	Rosaceae	
601	<i>Potentilla saundersiana</i>	Rosaceae	
602	<i>Potentilla spodioclora</i>	Rosaceae	

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603	<i>Potentilla sundacia</i>	Rosaceae	
604	<i>Potentilla supine</i>	Rosaceae	
605	<i>Primula alpicola</i>	Primulaceae	
606	<i>Primula assamica</i>	Primulaceae	
607	<i>Primula atrodentata</i>	Primulaceae	
608	<i>Primula bellidifolia</i>	Primulaceae	
609	<i>Primula bhutanica</i>	Primulaceae	
610	<i>Primula bracteosa</i>	Primulaceae	
611	<i>Primula calderiana</i>	Primulaceae	
612	<i>Primula capitata</i>	Primulaceae	
613	<i>Primula caveana</i>	Primulaceae	
614	<i>Primula chumbiensis</i>	Primulaceae	
615	<i>Primula concinna</i>	Primulaceae	
616	<i>Primula denticulate</i>	Primulaceae	
617	<i>Primula dickieana</i>	Primulaceae	
618	<i>Primula dryadifolia</i>	Primulaceae	
619	<i>Primula eburnean</i>	Primulaceae	
620	<i>Primula elongate</i>	Primulaceae	
621	<i>Primula erythrocarpa</i>	Primulaceae	
622	<i>Primula filipes</i>	Primulaceae	
623	<i>Primula gambeliana</i>	Primulaceae	
624	<i>Primula geraniifolia</i>	Primulaceae	
625	<i>Primula glabra</i>	Primulaceae	
626	<i>Primula gracilipes</i>	Primulaceae	
627	<i>Primula griffithii</i>	Primulaceae	
628	<i>Primula hooheri</i>	Primulaceae	
629	<i>Primula jigmediana</i>	Primulaceae	
630	<i>Primula kingie</i>	Primulaceae	
631	<i>Primula klattii</i>	Primulaceae	
632	<i>Primula listeri</i>	Primulaceae	
633	<i>Primula macrophylla</i>	Primulaceae	
634	<i>Primula megalocarpa</i>	Primulaceae	
635	<i>Primula mollis</i>	Primulaceae	
636	<i>Primula munroi</i>	Primulaceae	
637	<i>Primula muscoides</i>	Primulaceae	
638	<i>Primula oblique</i>	Primulaceae	
639	<i>Primula prenantha</i>	Primulaceae	
640	<i>Primula primulina</i>	Primulaceae	
641	<i>Primula reticulate</i>	Primulaceae	
642	<i>Primula sapphirina</i>	Primulaceae	
643	<i>Primula sherriffae</i>	Primulaceae	
644	<i>Primula sikkimensis</i>	Primulaceae	
645	<i>Primula smithiana</i>	Primulaceae	
646	<i>Primula soldanelloides</i>	Primulaceae	
647	<i>Primula stirtoniana</i>	Primulaceae	
648	<i>Primula strumosa</i>	Primulaceae	
649	<i>Primula tanneri</i>	Primulaceae	

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650	<i>Primula tenella</i>	Primulaceae	
651	<i>Primula tsariensis</i>	Primulaceae	
652	<i>Primula vaginata</i>	Primulaceae	
653	<i>Primula waddellii</i>	Primulaceae	
654	<i>Primula walshii</i>	Primulaceae	
655	<i>Primula waltonii</i>	Primulaceae	
656	<i>Primula whitei</i>	Primulaceae	
657	<i>Primula xanthopa</i>	Primulaceae	
658	<i>Primulatenuiliba</i>	Primulaceae	
659	<i>Primulatibeteca</i>	Primulaceae	
660	<i>Prunella vulgaris</i>	Lamiaceae	
661	<i>Pseudostellariaheterantha</i>	Caryophyllaceae	
662	<i>Pseudostellaria pax</i>	Caryophyllaceae	
663	<i>Pseudostellaria sylvatica</i>	Caryophyllaceae	
664	<i>Pternopetalumradiatum</i>	Apiaceae	
665	<i>Pternopetalumsubalpinum</i>	Apiaceae	
666	<i>Pycnoplenthopsisbhutanica</i>	Brassicaceae	
667	<i>Ranunculus adoxifolius</i>	Ranunculaceae	
668	<i>Ranunculus brotherusii</i>	Ranunculaceae	
669	<i>Ranunculus cantoniensis</i>	Ranunculaceae	
670	<i>Ranunculus chinensis</i>	Ranunculaceae	
671	<i>Ranunculus diffuses</i>	Ranunculaceae	
672	<i>Ranunculus ficariifolius</i>	Ranunculaceae	
673	<i>Ranunculus laetus</i>	Ranunculaceae	
674	<i>Ranunculus pulchellus</i>	Ranunculaceae	
675	<i>Ranunculus sceleratus</i>	Ranunculaceae	
676	<i>Ranunculus silerifolius</i>	Ranunculaceae	
677	<i>Ranunculus trichophyllus</i>	Ranunculaceae	
678	<i>Ranunculus tricuspsis</i>	Ranunculaceae	Wild radish (Eng)
679	<i>Raphanusraphanistrum</i>	Brassicaceae	Radish (Eng)
680	<i>Raphanus sativus</i>	Brassicaceae	
681	<i>Rhodiolaamabilis</i>	Crassulaceae	
682	<i>Rhodiolaatsaensis</i>	Crassulaceae	
683	<i>Rhodiolabupleuroides</i>	Crassulaceae	
684	<i>Rhodiolachrysanthemifolia</i>	Crassulaceae	
685	<i>Rhodiola coccinea</i>	Crassulaceae	
686	<i>Rhodiolacrenulata</i>	Crassulaceae	
687	<i>Rhodiolacretinii</i>	Crassulaceae	
688	<i>Rhodiolafastigata</i>	Crassulaceae	
689	<i>Rhodiolahimalensis</i>	Crassulaceae	
690	<i>Rhodiolahobsonni</i>	Crassulaceae	
691	<i>Rhodiola humilis</i>	Crassulaceae	
692	<i>Rhodiolaludlowii</i>	Crassulaceae	
693	<i>Rhodiolamarginata</i>	Crassulaceae	
694	<i>Rhodiolasheriffi</i>	Crassulaceae	
695	<i>Rhodiolaastapfii</i>	Crassulaceae	
696	<i>Rhynchosaharae</i>	Leguminosae	

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697	<i>Rhynchosia minima</i>	Leguminosae	
698	<i>Rorippabenghalensis</i>	Brassicaceae	
699	<i>Rorippamadagascariensis</i>	Brassicaceae	
700	<i>Rorippapalustris</i>	Brassicaceae	
701	<i>Rubiahispidicaulis</i>	Rubiaceae	Manjit (Lh)
702	<i>Rubiamanjith</i>	Rubiaceae	
703	<i>Rubiawallichiana</i>	Rubiaceae	
704	<i>Sagina japonica</i>	Caryophyllaceae	
705	<i>Salomoniacantoniensis</i>	Polygalaceae	
706	<i>Salvia amplicalyx</i>	Lamiaceae	
707	<i>Salvia campanulata</i>	Lamiaceae	
708	<i>Salvia castanea</i>	Lamiaceae	
709	<i>Salvia nubicola</i>	Lamiaceae	
710	<i>Salvia plectranthoides</i>	Lamiaceae	
711	<i>Salvia sikkimensis</i>	Lamiaceae	
712	<i>Salvia species</i>	Lamiaceae	
713	<i>Salvia splendens</i>	Lamiaceae	
714	<i>Salvia wardii</i>	Lamiaceae	Jadum (Dz)
715	<i>Sanguisorbadiandra</i>	Rosaceae	
716	<i>Sanguisorbafiliformis</i>	Rosaceae	
717	<i>Saniculaelata</i>	Apiaceae	
718	<i>Saxifraga andersonii</i>	Saxifragaceae	
719	<i>Saxifraga asarifolia</i>	Saxifragaceae	
720	<i>Saxifraga bergenoides</i>	Saxifragaceae	
721	<i>Saxifraga brachypoda</i>	Saxifragaceae	
722	<i>Saxifraga brunosis</i>	Saxifragaceae	
723	<i>Saxifraga caveana</i>	Saxifragaceae	
724	<i>Saxifraga clivorum</i>	Saxifragaceae	
725	<i>Saxifraga contraria</i>	Saxifragaceae	
726	<i>Saxifraga diversifolia</i>	Saxifragaceae	
727	<i>Saxifraga erinacea</i>	Saxifragaceae	
728	<i>Saxifraga filicaulis</i>	Saxifragaceae	
729	<i>Saxifraga flavida</i>	Saxifragaceae	
730	<i>Saxifraga georgei</i>	Saxifragaceae	
731	<i>Saxifraga glabricaulis</i>	Saxifragaceae	
732	<i>Saxifraga granulifera</i>	Saxifragaceae	
733	<i>Saxifraga haematochora</i>	Saxifragaceae	
734	<i>Saxifraga harry-smithii</i>	Saxifragaceae	
735	<i>Saxifraga hemiphaerica</i>	Saxifragaceae	
736	<i>Saxifraga hispidula</i>	Saxifragaceae	
737	<i>Saxifraga hookeri</i>	Saxifragaceae	
738	<i>Saxifraga humilis</i>	Saxifragaceae	
739	<i>Saxifraga jacquemontiana</i>	Saxifragaceae	
740	<i>Saxifraga kinchingingae</i>	Saxifragaceae	
741	<i>Saxifraga kingiana</i>	Saxifragaceae	
742	<i>Saxifraga latiflora</i>	Saxifragaceae	
743	<i>Saxifraga lepida</i>	Saxifragaceae	

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744	<i>Saxifraga lychnitis</i>	Saxifragaceae	
745	<i>Saxifraga matta-florida</i>	Saxifragaceae	
746	<i>Saxifraga melanocentra</i>	Saxifragaceae	
747	<i>Saxifraga Montana</i>	Saxifragaceae	
748	<i>Saxifraga moorcroftiana</i>	Saxifragaceae	
749	<i>Saxifraga mucronulata</i>	Saxifragaceae	
750	<i>Saxifraga nigrolandulifera</i>	Saxifragaceae	
751	<i>Saxifraga pallid</i>	Saxifragaceae	
752	<i>Saxifraga parnassiflora</i>	Saxifragaceae	
753	<i>Saxifraga parva</i>	Saxifragaceae	
754	<i>Saxifraga perpusilla</i>	Saxifragaceae	
755	<i>Saxifraga petrophilia</i>	Saxifragaceae	
756	<i>Saxifraga pilifera</i>	Saxifragaceae	
757	<i>Saxifraga pseudopallida</i>	Saxifragaceae	
758	<i>Saxifraga pulvinaria</i>	Saxifragaceae	
759	<i>Saxifraga rubriflora</i>	Saxifragaceae	
760	<i>Saxifraga saginoides</i>	Saxifragaceae	
761	<i>Saxifraga saxorum</i>	Saxifragaceae	
762	<i>Saxifraga serrula</i>	Saxifragaceae	
763	<i>Saxifraga sherriiffii</i>	Saxifragaceae	
764	<i>Saxifraga sikkimensis</i>	Saxifragaceae	
765	<i>Saxifraga stella-aurea</i>	Saxifragaceae	
766	<i>Saxifraga stoltizkae</i>	Saxifragaceae	
767	<i>Saxifraga strigosa</i>	Saxifragaceae	
768	<i>Saxifraga subsessiliflora</i>	Saxifragaceae	
769	<i>Saxifraga subspathulata</i>	Saxifragaceae	
770	<i>Saxifraga tangutica</i>	Saxifragaceae	
771	<i>Saxifraga tentaculata</i>	Saxifragaceae	
772	<i>Saxifraga thiantha</i>	Saxifragaceae	
773	<i>Saxifraga tsangchanesis</i>	Saxifragaceae	
774	<i>Saxifraga umbellulata</i>	Saxifragaceae	
775	<i>Saxifraga vacillans</i>	Saxifragaceae	
776	<i>Saxifraga viscidula</i>	Saxifragaceae	
777	<i>Saxifraga wardii</i>	Saxifragaceae	
778	<i>Schulziabhutanica</i>	Apiaceae	
779	<i>Schulziadissecta</i>	Apiaceae	
780	<i>Scutellariadependens</i>	Lamiaceae	
781	<i>Scutellaria discolor</i>	Lamiaceae	
782	<i>Scutellariagrossa</i>	Lamiaceae	
783	<i>Scutellariaviolacea</i>	Lamiaceae	
784	<i>Sebaeamicrophylla</i>	Gentianaceae	
785	<i>Sedum correptum</i>	Crassulaceae	
786	<i>Sedum filipes</i>	Crassulaceae	
787	<i>Sedum fischeri</i>	Crassulaceae	
788	<i>Sedum gagei</i>	Crassulaceae	
789	<i>Sedum griffithi</i>	Crassulaceae	
790	<i>Sedum multiculae</i>	Crassulaceae	

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791	<i>Sedum oreades</i>	Crassulaceae	
792	<i>Sedum spectabile</i>	Crassulaceae	
793	<i>Sedum triactina</i>	Crassulaceae	
794	<i>Sedum trullipetalum</i>	Crassulaceae	
795	<i>Selinumcandollei</i>	Apiaceae	
796	<i>Selinumwallicianum</i>	Apiaceae	
797	<i>Shuteriaferruginea</i>	Leguminosae	
798	<i>Shuteria hirsute</i>	Leguminosae	
799	<i>Shuteria involucrate</i>	Leguminosae	
800	<i>Sibbaldiabyssitecta</i>	Rosaceae	
801	<i>Sibbaldiamacropetala</i>	Rosaceae	
802	<i>Sibbaldiamicropetala</i>	Rosaceae	
803	<i>Sibbaldia parviflora</i>	Rosaceae	
804	<i>Sibbaldiaperpusilloides</i>	Rosaceae	
805	<i>Sibbaldiapurpurea</i>	Rosaceae	
806	<i>Silene armeria</i>	Caryophyllaceae	
807	<i>Silene bhutanica</i>	Caryophyllaceae	
808	<i>Silene birgittae</i>	Caryophyllaceae	
809	<i>Silene caespitella</i>	Caryophyllaceae	
810	<i>Silene gonosperma</i>	Caryophyllaceae	
811	<i>Silene indica</i>	Caryophyllaceae	
812	<i>Silene julaensis</i>	Caryophyllaceae	
813	<i>Silene liniae</i>	Caryophyllaceae	
814	<i>Silene nepalensis</i>	Caryophyllaceae	
815	<i>Silene nigrescens</i>	Caryophyllaceae	
816	<i>Silene purii</i>	Caryophyllaceae	
817	<i>Silene stracheyi</i>	Caryophyllaceae	
818	<i>Sinocarum minus</i>	Apiaceae	
819	<i>Sinocarumpauciradiatum</i>	Apiaceae	
820	<i>Sinocarumpulchellum</i>	Apiaceae	
821	<i>Sinocarumsikkimense</i>	Apiaceae	
822	<i>Sinocarumwolffianum</i>	Apiaceae	
823	<i>Sinocrassulaberger</i>	Crassulaceae	
824	<i>Sinocrassulaindica</i>	Crassulaceae	
825	<i>Siphocranionmacranthum</i>	Lamiaceae	
826	<i>Soiradiclis cylindrical</i>	Rubiaceae	
827	<i>Soulieavaginata</i>	Ranunculaceae	
828	<i>Spergula arvensis</i>	Caryophyllaceae	
829	<i>Spermacocemauritiana</i>	Rubiaceae	
830	<i>Spermacocepusilla</i>	Rubiaceae	
831	<i>Spongiocarpellapurpurea</i>	Leguminosae	
832	<i>Stachys melissaefolia</i>	Lamiaceae	
833	<i>Stachys scaberula</i>	Lamiaceae	
834	<i>Stellaria congestiflora</i>	Caryophyllaceae	
835	<i>Stellaria decumbens</i>	Caryophyllaceae	
836	<i>Stellaria lanata</i>	Caryophyllaceae	
837	<i>Stellaria media</i>	Caryophyllaceae	

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838	<i>Stellaria monosperma</i>	Caryophyllaceae	
839	<i>Stellaria patens</i>	Caryophyllaceae	
840	<i>Stellaria reticulivena</i>	Caryophyllaceae	
841	<i>Stellaria sikkimensis</i>	Caryophyllaceae	
842	<i>Stellaria uliginosa</i>	Caryophyllaceae	
843	<i>Stellaria vestita</i>	Caryophyllaceae	
844	<i>Stilbanthus scandens</i>	Amaranthaceae	Chirata (Lh)
845	<i>Swertia bimaculata</i>	Gentianaceae	
846	<i>Swertia candelabrum</i>	Gentianaceae	
847	<i>Swertia cordata</i>	Gentianaceae	
848	<i>Swertia crossoloma</i>	Gentianaceae	
849	<i>Swertia grandiflora</i>	Gentianaceae	
850	<i>Swertia hookeri</i>	Gentianaceae	
851	<i>Swertia macrosperma</i>	Gentianaceae	
852	<i>Swertia multicaulis</i>	Gentianaceae	
853	<i>Swertia paniculata</i>	Gentianaceae	
854	<i>Swertia pseudohookeri</i>	Gentianaceae	
855	<i>Swertia ramosa</i>	Gentianaceae	
856	<i>Swertia staintonii</i>	Gentianaceae	
857	<i>Swertia teres</i>	Gentianaceae	
858	<i>Swertia virescens</i>	Gentianaceae	
859	<i>Tetramnusflexilis</i>	Leguminosae	
860	<i>Teucrium grandifolium</i>	Lamiaceae	
861	<i>Teucrium quadrifarium</i>	Lamiaceae	
862	<i>Teucrium viscidum</i>	Lamiaceae	
863	<i>Thalictrum alpinum</i>	Ranunculaceae	
864	<i>Thalictrum chelidonii</i>	Ranunculaceae	
865	<i>Thalictrum cultratum</i>	Ranunculaceae	
866	<i>Thalictrum elegans</i>	Ranunculaceae	
867	<i>Thalictrum foetidum</i>	Ranunculaceae	
868	<i>Thalictrum foliolosum</i>	Ranunculaceae	
869	<i>Thalictrum javanicum</i>	Ranunculaceae	
870	<i>Thalictrum leuconotum</i>	Ranunculaceae	
871	<i>Thalictrum punuanum</i>	Ranunculaceae	
872	<i>Thalictrum rostellatum</i>	Ranunculaceae	
873	<i>Thalictrum setulosinerve</i>	Ranunculaceae	
874	<i>Thalictrum squamiferum</i>	Ranunculaceae	
875	<i>Thalictrum virgatum</i>	Ranunculaceae	LosiMetok (Dz)
876	<i>Thermosisbarbata</i>	Leguminosae	
877	<i>Thlaspiandersonii</i>	Brassicaceae	
878	<i>Thlaspiarvense</i>	Brassicaceae	
879	<i>Thlaspicochleariodes</i>	Brassicaceae	
880	<i>Tiarella polyphylla</i>	Saxifragaceae	
881	<i>Tongoloagracilis</i>	Apiaceae	
882	<i>Tongoloaloloensis</i>	Apiaceae	
883	<i>Tordyliopsisbrunonis</i>	Apiaceae	
884	<i>Torilis Japonica</i>	Apiaceae	

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885	<i>Torularia humilis</i>	Brassicaceae	
886	<i>Trachyspermum ammi</i>	Apiaceae	
887	<i>Trachyspermum anethifolium</i>	Apiaceae	
888	<i>Tribulus terrestris</i>	Zygophyllaceae	
889	<i>Trigonella emodi</i>	Leguminosae	
890	<i>Tripterospermum nigrobaccatum</i>	Gentianaceae	
891	<i>Tripterospermum volubile</i>	Gentianaceae	
892	<i>Trollius pumilus</i>	Ranunculaceae	
893	<i>Trollius sikkimensis</i>	Ranunculaceae	
894	<i>Trollius vaginatus</i>	Ranunculaceae	
895	<i>Tropaeolum majus</i>	Tropaeolaceae	
896	<i>Tylophora fasciata</i>	Asclepiadaceae	
897	<i>Tylophora rotundifolia</i>	Asclepiadaceae	
898	<i>Uraria lagopodioides</i>	Leguminosae	
899	<i>Uraria picta</i>	Leguminosae	
900	<i>Veratrum baillonii</i>	Gentianaceae	
901	<i>Verbena officinalis</i>	Verbenaceae	
902	<i>Vicatia connifolia</i>	Apiaceae	

Herbs Data Form

F9/18

3. Date

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 4. Time

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 hrs

Herbs Data Form (*Data collected from only North and East plots (within r=0.57 m plot)*)[illegible]

1.5.4.2.10 Wildlife data

NFI shall also collect some information on wildlife from the three Plots: Elbow, North and East Plot. Wildlife field forms shall collect data on Mammals, Birds and Reptiles separately as described below. The presence-absence data of wild animals is useful for monitoring of populations and identifying habitats for species of conservation significance (MacKenzie, 2009).

1.5.4.2.11 Mammal data

The presence-absence information of mammals shall be collected from all three plots. Follow the steps and description provided in the *Table 1.24* and complete form F10/F18 with **mammal data** and mammal list in *Table 1.25*.

Table 1.24: Collection of Mammal Data

SN	Data Item	Definition	Instruction
1	CP No	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot name	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot. Refer Table 1.25 for names of mammals of Bhutan	Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3	Mammal Sighting	Refers to whether or not mammal was sighted, either through direct or indirect evidence, within 25 m around from the PC.	Record “Yes” if mammal was sighted, else “No”, from the drop-down list on electronic field form or tick appropriately on the paper field form.
4	Mammal sighted	Refers to identity of the particular mammal that has been sighted or identified.	1. Select from the drop-down list and record the mammal sighted or identified from the evidence on electronic field form or write down on the paper field form. 2. Select “None” if no mammal is observed.
5	Species identity	Refers to the level of confidence on the identification of mammal by crew and can be categorized as: 1. Certain : when one is very sure that the identification is correct 2. Doubtful : When one is not very confident about the identification 3. Not relevant : when no mammal is observed.	Depending on the level of confidence on the identification, choose and record from the drop-down list on electronic field form or record on the paper field form.
6	Evidence Type	Refers to the type of evidence using which mammal is identified. The categories are: 1. Direct sighting 2. Sound/calls 3. Dung/Pellets/Scats 4. Skeleton/Cadaver	1. Select the appropriate evidence type and record. 2. Not relevant should be selected when there are no mammals sighted or observed in the 25 m radius.

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		5. Horns/Antlers 6. Footprints/pugmarks 7. Tracks/Paths 8. Burrow/Den 9. Browsing 10. Debarking 11. Fraying 12. Digging 13. Not relevant	
7	Gender	Refers to the gender of the mammal sighted	1. If gender can be determined, record as determined. 2. If gender cannot be determined, then record as “Not known”.
8	Group size	Refers to the number of individuals of the same species sighted or observed.	1. Record the number of individuals of same species sighted (as identified from direct sighting) 2. It may not be possible to determine the number from indirect evidences, so record as “approximate size”.
9	Remarks	Refers to any other relevant information to be added by the crew.	The Crew Leader or the data recorder may add any additional information on mammal

Table 1.25: Mammals of Bhutan

Sl. No	Scientific Name	Common Name
1	<i>Hipposideros Pomona</i>	Andersen's Leaf-nosed Bat
2	<i>Soriculus macrusus</i>	Arboreal Brown Toothed Shrew
3	<i>Elephas maximus</i>	Asian elephant
4	<i>Barbastellaleucomelas</i>	Asian/Eastern Barbestelle Bat
5	<i>Scotophilus heathi</i>	Asiatic Greater Yellow Bat
6	<i>Bubalus arnee</i>	Asiatic Water Buffalo
7	<i>Macaca assamensis</i>	Assamese Macaque
8	<i>Soriculus baileyi</i>	Bailey's Shrew
9	<i>Tylonycteris pachypus</i>	Bamboo Bat
10	<i>Muntiacus muntjak</i>	Barking Deer
11	<i>Martes foina</i>	Beech or Stone marten
12	<i>Vulpes bengalensis</i>	Bengal Fox
13	<i>Arctictis binturong</i>	Binturong/ Asian Bearcat
14	<i>Rattus rattus</i>	Black Rat/ House Rat
15	<i>Taphozous melanopogon</i>	Black-bearded Tomb Bat
16	<i>Ochotanacurzoniae</i>	Black-lipped Pika ²
17	<i>Lepus nigricollis</i>	Blacknaped Hare
18	<i>Sphaerias blanfordi</i>	Blanford's Fruit Bat
19	<i>Pseudois nayaur</i>	Blue sheep
20	<i>Rhinolophus lepidus</i>	Blyth's Horseshoe Bat
21	<i>Plecotus auritus</i>	Brown long-eared Bat
22	<i>Mus platythrix</i>	Brown Spiny Field Mouse
23	<i>Trachypithecus pileatus</i>	Capped Langur
24	<i>Rhinolophus subbadius</i>	Chestnut Horseshoe Bat
25	<i>Manis pentadactyla</i>	Chinese Pangolin
26	<i>Axis axis</i>	Chital/spotted Deer
27	<i>Pipistrellus affinis</i>	Chocolate Pipistrelle

² Source: Nature Conservation Division, Department of Forests and Park Services

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28	<i>Neofelisnebulosa</i>	Clouded leopard
29	<i>Nyctalusnoctula</i>	Common Noctule
30	<i>Herpestesedwardsii</i>	Common or Grey Mongoose
31	<i>Lutralutra</i>	Common Otter
32	<i>Paradoxurus hermaphroditus</i>	Common Palm Civet
33	<i>Ochotona roylei</i>	Common Pika
34	<i>Pipistrelluspipistrellus</i>	Common Pipistrelle
35	<i>Eptesicusserotinus</i>	Common Serotine Bat
36	<i>Herpestesurva</i>	Crab-eating Mongoose
37	<i>Cuonalphinusprimaevus</i>	Dhole/ Wild Dog
38	<i>Scotozous dormer</i>	Dormer's Bat
39	<i>Leopoldamysedwardsi</i>	Edward's Rat
40	<i>Nectogale elegans</i>	Elegant/Tibetan water Shrew
41	<i>Mus saxicola</i>	Elliot's Spiny Mouse
42	<i>Mus cervicolor</i>	Fawn-coloured Mouse
43	<i>Prionailurusviverrinus</i>	Fishing cat
44	<i>Ochotanaforresti</i>	Forrest's Pika
45	<i>Rousettus leschenaultia</i>	Fulvous Fruit bat
46	<i>Hipposiderousfulvus</i>	Fulvus Leaf-nosed Bat
47	<i>Platanista gangetica</i>	Ganges River Dolphins
48	<i>Bos gaurus</i>	Gaur
49	<i>Ochotanagloveri</i>	Glover's Pika
50	<i>Catopumatemmincki</i>	Golden cat
51	<i>Trachypithecusgeeii</i>	Golden Langur
52	<i>Nemorhaedus goral</i>	Goral
53	<i>Petauristacaniceps</i>	Gray-Headed Flying Squirrel
54	<i>Petauristanoblis</i>	Gray's Giant Flying Squirrel
55	<i>Iaio</i>	Great Evening Bat
56	<i>Rhinolophus luctus</i>	Great Indian Horse shoe bat
57	<i>Rhinoceros unicornis</i>	Great one-horned Rhinoceros
58	<i>Murinaleucogaster</i>	Great Tube-nosed Bat
59	<i>Bandicotaindica</i>	Greater Bandicoot Rat
60	<i>Megaderma lyra</i>	Greater False Vampire Bat
61	<i>Hipposiderousarminger</i>	Greater Himalayan Leaf-nosed bat
62	<i>Rhinolophus ferrumequinum</i>	Greater Horseshoe Bat
63	<i>Semnopithecus entellus</i>	Grey Langur/ Hanuman Langur
64	<i>Crocidura attenuate</i>	Grey/Woodland Shrew
65	<i>Myotis annectans</i>	Hairy-faced Bat
66	<i>Harpiocephalusharpia</i>	Hairy-winged Bat
67	<i>Kerivoulahardwickii</i>	Hardwicke's forest Bat
68	<i>Scotomanesornatus</i>	Harlequin Bat
69	<i>Macroglossussobrinus</i>	Hill Long- tongued Fruit bat
70	<i>Ursusthibetanuslaniger</i>	Himalayan Black Bear
71	<i>Petauristamagnificus</i>	Himalayan Flying Squirrel
72	<i>Pagumalarvata</i>	Himalayan Palm Civet
73	<i>Rattus nitidus</i>	Himalayan Rat
74	<i>Capricornissumatraensis</i>	Himalayan Serow
75	<i>Soriculusnigrescens</i>	Himalayan Shrew/ Sikkim Large Clawed Shrew
76	<i>Alticolastoliczkanus</i>	Himalayan Vole
77	<i>Mustela sibirica</i>	Himalayan Weasel
78	<i>Martes flavigula</i>	Himalayan Yellow-Throated Marten
79	<i>Chimarrogalehimalayica</i>	Himalayan Water Shrew
80	<i>Canis lupus</i>	Himalayan Wolf/ Tibetan Wolf
81	<i>Caprolagushispidus</i>	Hispid Hare
82	<i>Myotis formosus</i>	Hodgson's Bat
83	<i>Soriculuscaudatus</i>	Hodgson's Brown Toothed Shrew
84	<i>Arctonyxcollaris</i>	Hog badger
85	<i>Axis porcinus</i>	Hog Deer
86	<i>Hipposiderouslarvatus</i>	Horsefield's Leaf-nosed Bat

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87	<i>Crocidurahorsfieldi</i>	Horsefiled's Shrew
88	<i>Mus musculus</i>	House Mouse
89	<i>Suncusmurinus</i>	House/Musk Shrew
90	<i>Murinahuttoni</i>	Hutton's Tube-nosed Bat
91	<i>Golundaellioti</i>	Indian Bush Rat
92	<i>Pteropusgiganteus</i>	Indian Flying Fox
93	<i>Soriculusleucops</i>	Indian long-tailed Shrew
94	<i>Manis crassicaudata</i>	Indian Pangolin
95	<i>Pipistrelluscoromandra</i>	Indian Pipistrelle
96	<i>Rhinolophus affinis</i>	Intermediate Horseshoe Bat
97	<i>Pipistrellusjavanicus</i>	Javan's Pipistrelle
98	<i>Felis chaus</i>	Jungle Cat
99	<i>Hipposiderouslankadiva</i>	Lankadiva Bat
100	<i>Pipistrelluscircumdatus</i>	Large Black Pipistrelle
101	<i>Viverrazibetha</i>	Large Indian civet
102	<i>Rhinolophus macrotis</i>	Large-eared Horseshoe bat
103	<i>Ochotona macrotis</i>	Large-eared Pika
104	<i>Melogalepersonata</i>	Large-toothed Ferret Badger
105	<i>Dacnomysmillardi</i>	Large-toothed Rat
106	<i>Hipposiderousater Dusky</i>	Leaf-nosed Bat
107	<i>Rhinolophupusillus</i>	Least Horseshoe Bat
108	<i>Hipposiderouscineraceus</i>	Least Leaf- nosed Bat
109	<i>Panthera pardus</i>	Leopard
110	<i>Prionailursusbengalensis</i>	Leopard cat
111	<i>Bandicotabengalensis</i>	Lesser Bandicot Rat
112	<i>Cynopterusbrachyotis</i>	Lesser Dog-faced Fruit bat
113	<i>Megadermaspasa</i>	Lesser False Vampire Bat
114	<i>Sorexbedfordia</i>	Lesser Stripe-backed Shrew
115	<i>Myotis sicarius</i>	Little Brown bat
116	<i>Niviventerha</i>	Little Himalayan Rat
117	<i>Murinaaurata</i>	Little Tube-nosed Bat
118	<i>Vandeleuria oleracea</i>	Long-tailed Tree Mouse
119	<i>Eonycterisspelaea</i>	Long-tongued Fruit Bat
120	<i>Canis aureus</i>	Lower Risk
121	<i>Lynx lynx</i>	Lynx
122	<i>Pardofelis marmorata</i>	Marbled cat
123	<i>Bos frontalis</i>	Mithun
124	<i>Ochotona thibetana</i>	Moupin'sPika
125	<i>Moschus chrysogaster</i>	Musk Deer
126	<i>Taphozousnudiventris</i>	Naked-rumped Tomb Bat
127	<i>Myotis muricola</i>	Nepalese- whiskered Bat
128	<i>Megaeropsniphanae</i>	Niphan's Tailless Fruit bat
129	<i>Tupaia belangeri</i>	Northern Tree Shrew
130	<i>Rattus norvegicus</i>	Norway Rat
131	<i>Ochotananubrica</i>	NubraPika
132	<i>Kerivoulapicta</i>	Painted Bat
133	<i>Mustela altaica</i>	Pale Weasel
134	<i>Felis manul</i>	Pallas cat
135	<i>Hylopetesalboniger</i>	Parti-coloured Flying Squirrel
136	<i>Pipistrelluspaterculus</i>	Paternal Pipistrelle
137	<i>Belomyspearsoni</i>	Pearson's / Hairy footed Flying Squirrel
138	<i>Rhinolophus pearsonii</i>	Pearson's Horseshoe bat
139	<i>Minopteruspusillus</i>	Pusillus Long- Fingered Bat
140	<i>Sus salvanius</i>	Pygmy hog
141	<i>Pipistrellusmimus</i>	Pygmy Pipistrelle
142	<i>Sorex minutes</i>	Pygmy Shrew
143	<i>Suncusetruscus</i>	Pygmy White-toothed Shrew
144	<i>Cervus elaphuswallichi</i>	Red deer/Sikkim Red Deer
145	<i>Vulpes vulpes</i>	Red Fox

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146	<i>Petauristapetaurista</i>	Red Giant Flying squirrel
147	<i>Ailurus fulgens</i>	Red Panda
148	<i>Macaca mulatta</i>	Rhesus Macaque
149	<i>Murinacyclotis</i>	Round- eared Tube-nosed bat
150	<i>Rhinolophus rouxii</i>	Rufous Horseshoe Bat
151	<i>Minopterusschreibersii</i>	Schreiber's Long Fingered Bat
152	<i>Talpamicroura</i>	Short - tailed Mole
153	<i>Cynopterus sphinx</i>	Short- nosed Fruit Bat
154	<i>Mus pahari</i>	Sikkim Mouse
155	<i>Rattus sikkimensis</i>	Sikkim Rat
156	<i>Microtus sikimensis</i>	Sikkim Vole
157	<i>Melursus ursinus</i>	Sloth Bear
158	<i>NycticebusBengalensis</i>	Slow Loris
159	<i>Cervus unicolor</i>	Smabar
160	<i>Viverriculaindica</i>	Small India Civet
161	<i>Herpestesjavanicus</i>	Small Indian Mongoose
162	<i>Amblonyxcinerus</i>	Small-Clawed Otter
163	<i>Melogalemoschata</i>	Small-toothed Ferret Badger
164	<i>Myotis siligorensis</i>	Small-toothed Whiskered Bat
165	<i>Lutrogaleperspicillata</i>	Smooth Coated Otter
166	<i>Uncia uncia</i>	Snow Leopard
167	<i>Millardiameltda</i>	Soft-furred Field Rat/Metad
168	<i>Crocidurafuliginosa</i>	South east Asian White Toothed Shrew
169	<i>Peturista elegans</i>	Spotted Giant Flying Squirrel
170	<i>Prionodonpardicolor</i>	Spotted Linsang
171	<i>Cervus duvauceli</i>	Swamp Deer
172	<i>Coelopsfriti</i>	Tail-less Leaf-nosed Bat
173	<i>Budorcastaxicolor</i>	Takin
174	<i>Eptesicustatei</i>	Tate's Bat
175	<i>Alticolastracheyi</i>	Thoma's Mountain Vole
176	<i>Pipistrelluscadornae</i>	Thomas's Pipistrelle
177	<i>Hesperoptenustickelli</i>	Tickell's Bat
178	<i>Panthera tigris</i>	Tiger
179	<i>Rhinolophus trifolius</i>	TrefoliHorseshe Bat
180	<i>Rattus turkestanicus</i>	Turkestan Rat
181	<i>Myotis daubentonii</i>	Water Bat
182	<i>Myotis mystacinus</i>	Whiskered Bat
183	<i>Niniventerminiventer</i>	White-bellied Rat
184	<i>Sus scrofa</i>	Wild boar
185	<i>Apodemussylavaticus</i>	Wood Mouse
186	<i>Eupetauruscinerus</i>	Wooly Flying Squirrel
187	<i>Lepus oiostolus</i>	Wooly Hare
188	<i>Bos grunniens</i>	Yak
189	<i>Mustela kathia</i>	Yellow-Bellied Weasel



NATIONAL FOREST INVENTORY FIELD FORM

Wildlife (mammal) Data Form

F10/18

Department of Forests and Park Services

Forest Resources Management Division

1. CP No

2. Plot Name Elbow ☐ North ☐ East ☐ (Tick the appropriate plot)

3. Date / / 4. Time / hrs

Wildlife (mammal) Data Form (Data to be collected from all three plots)

(within 25 m around PC)

SN	Scientific name	Local name	Species Identity		Wildlife Evidence (Enter code)	Gender (Tick appropriately)			Group size	Remarks
			Certain	Doubtful		Male	Female	Not known		

SN	Wildlife evidence (Mammal)	Code	SN	Wildlife evidence	Code
1	Direct sighting	ME1	8	Burrow/Den	ME8
2	Sound/calls	ME2	9	Browsing	ME9
3	Dung/Pellets/Scats	ME3	10	Debarking	ME10
4	Skeleton/Cadaver	ME4	11	Fraying	ME11
5	Horns/Antlers	ME5	12	Digging	ME12
6	Footprints/Pugmarks	ME6	13	Not relevant	ME13
7	Tracks/Paths	ME7			

1.5.4.2.12 Bird Data

Information on the presence- absence of birds shall be collected from all three plots. Follow the steps and description provided in the Table 1.26 to complete Form F11/F18 with **bird data** (Table 1.27).

Table 1.26: Bird Data Collection

SN	Data Item	Description	Instruction
1	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot name	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot	Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3	Bird sighting	Refers to whether or not bird was sighted, either through direct or indirect evidence, within 25 m around from the PC.	Record “Yes” if bird was sighted, else “No”, from the drop-down list on electronic field form or tick appropriately on the paper field form.
4	Bird sighted	Refers to identity of the particular bird that has been sighted or identified. The list of birds will be provided in Table 1.27	1. Select from the drop-down list and record the bird sighted or identified from the evidence on electronic field form or write down on the paper field form. 2. Select “None” if no bird is observed.
5	Species identity	Refers to the level of confidence on identification of bird by crew and can be categorized as: 1. Certain: when one is very sure that the identification is correct 2. Doubtful: When one is not very confident about the identification 3. Not relevant: When no birds have been sighted.	1. Depending on the level of confidence on the identification of bird, choose and record from the drop-down list on electronic field form or record on the paper field form.
6	Evidence Type	Refers to the type of evidence using which the bird is identified. The categories are: 1. Direct sighting 2. Sound/calls 3. Droppings 4. Eggs 5. Skeleton/Cadaver 6. Feathers 7. Footprints 8. Tracks/Paths 9. Nests/Burrows 10. Not relevant	1. Select the appropriate evidence type based on which the bird has been identified and record. 2. “Not relevant” should be selected when there are no birds sighted or observed in the 25 m radius from the PC.
7	Gender	Refers to the gender of the bird sighted	1. If gender can be determined, record as determined. 2. If gender cannot be determined, then record as “Not known”.

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8	Group size	Refers to the number of individuals of the same species sighted or observed.	<ol style="list-style-type: none"> Record the number of individuals of same species sighted (as identified from direct sighting) It may not be possible to determine the number from indirect evidences, so record “approximate size”.
9	Remarks	Refers to any relevant information on bird that crew provides.	The Crew Leader or the data recorder shall add any additional information on birds.

Table 1.27: Birds of Bhutan

Sl. No	Scientific name	Common name
1	<i>Abroscopus albobularis</i>	Rufous-faced Warbler
2	<i>Abroscopus schisticeps</i>	Black-faced Warbler
3	<i>Abroscopus superciliosus</i>	Yellow-bellied Warbler
4	<i>Accipiter badius</i>	Shikra
5	<i>Accipiter gentilis</i>	Northern Goshawk
6	<i>Accipiter nisus</i>	Eurasian Sparrowhawk
7	<i>Accipiter trivirgatus</i>	Crested Goshawk
8	<i>Accipiter virgatus</i>	Besra
9	<i>Aceros nipalensis</i>	Rufous-necked Hornbill
10	<i>Aceros undulatus</i>	Wreathed Hornbill
11	<i>Acridotheres fuscus</i>	Jungle Myna
12	<i>Acridotheres ginginianus</i>	Bank Myna
13	<i>Acridotheres grandis</i>	Great Myna
14	<i>Acridotheres tristis</i>	Common Myna
15	<i>Acrocephalus aedon</i>	Thick-billed Warbler
16	<i>Acrocephalus agricola</i>	Paddyfield Warbler
17	<i>Acrocephalus dumetorum</i>	Blyth's Reed Warbler
18	<i>Actinodura aegertoni</i>	Rusty-fronted Barwing
19	<i>Actinodura nipalensis</i>	Hoary-throated Barwing
20	<i>Actitis hypoleucos</i>	Common Sandpiper
21	<i>Aegithalos concinnus</i>	Black-throated Tit
22	<i>Aegithalos iouschistos</i>	Rufous-fronted Tit
23	<i>Aegithina tiphia</i>	Common Iora
24	<i>Aegolius funereus</i>	Boreal Owl
25	<i>Aegypius monachus</i>	Cinereous Vulture
26	<i>Aethopyga gouldiae</i>	Mrs Gould's Sunbird
27	<i>Aethopyga ignicauda</i>	Fire-tailed Sunbird
28	<i>Aethopyga nipalensis</i>	Green-tailed Sunbird
29	<i>Aethopyga saturata</i>	Black-throated Sunbird
30	<i>Aethopyga siparaja</i>	Crimson Sunbird
31	<i>Aix galericulata</i>	Mandarin Duck
32	<i>Alauda gulgula</i>	Oriental Skylark
33	<i>Alcedo atthis</i>	Common Kingfisher
34	<i>Alcedo hercules</i>	Blyth's Kingfisher
35	<i>Alcippe castaneiceps</i>	Rufous-winged Fulvetta
36	<i>Alcippe ludlowi</i>	Brown-throated Fulvetta
37	<i>Alcippe nipalensis</i>	Nepal Fulvetta
38	<i>Alcippe rufogularis</i>	Rufous-throated Fulvetta

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39	<i>Alcippevinipectus</i>	White-browed Fulvetta
40	<i>Alophoixusflaveolus</i>	White-throated Bulbul
41	<i>Amaurornisphoenicurus</i>	White-breasted Waterhen
42	<i>Ampelicepscoronatus</i>	Yellow-crested Myna
43	<i>Anas acuta</i>	Northern Pintail
44	<i>Anas clypeata</i>	Northern Shoveler
45	<i>Anas crecca</i>	Common Teal
46	<i>Anas falcata</i>	Falcated Duck
47	<i>Anas formosa</i>	Baikal Teal
48	<i>Anas penelope</i>	Eurasian Wigeon
49	<i>Anas platyrhynchos</i>	Mallard
50	<i>Anas poecilorhyncha</i>	Indian Spot-billed Duck
51	<i>Anas querquedula</i>	Garganey
52	<i>Anas strepera</i>	Gadwall
53	<i>Anastomusoscitans</i>	Asian Openbill
54	<i>Anseralbifrons</i>	Greater White-fronted Goose
55	<i>Anseranser</i>	Greylag Goose
56	<i>Anser indicus</i>	Bar-headed Goose
57	<i>Anthracoserosalbirostris</i>	Oriental Pied Hornbill
58	<i>Anthreptessingalensis</i>	Ruby-cheeked Sunbird
59	<i>Anthus campestris</i>	Tawny Pipit
60	<i>Anthuscervinus</i>	Red-throated Pipit
61	<i>Anthusgodlewskii</i>	Blyth's Pipit
62	<i>Anthushodgsoni</i>	Olive-backed Pipit
63	<i>Anthusrichardi</i>	Richard's Pipit
64	<i>Anthusroseatus</i>	Rosy Pipit
65	<i>Anthusrubescens</i>	Buff-bellied Pipit
66	<i>Anthusrufulus</i>	Paddyfield Pipit
67	<i>Anthusspinoletta</i>	Water Pipit
68	<i>Anhustrivialis</i>	Tree Pipit
69	<i>Apus nipalensis</i>	House Swift
70	<i>Apus acuticauda</i>	Dark-rumped Swift
71	<i>Apus pacificus</i>	Fork-tailed Swift
72	<i>Aquila chrysaetos</i>	Golden Eagle
73	<i>Aquila clanga</i>	Greater Spotted Eagle
74	<i>Aquila hastata</i>	Indian Spotted Eagle
75	<i>Aquila heliaca</i>	Eastern Imperial Eagle
76	<i>Aquila nipalensis</i>	Steppe Eagle
77	<i>Arachnotheralongirostra</i>	Little Spiderhunter
78	<i>Arachnothera magna</i>	Streaked Spiderhunter
79	<i>Arborophilamandellii</i>	Chestnut-breasted Partridge
80	<i>Arborophilarufogularis</i>	Rufous-throated Partridge
81	<i>Arborophilatorqueola</i>	Hill Partridge
82	<i>Ardeacinerea</i>	Grey Heron
83	<i>Ardea insignis</i>	White-bellied Heron
84	<i>Ardeapurpurea</i>	Purple Heron
85	<i>Ardeolabacchus</i>	Chinese Pond Heron
86	<i>Ardeolagrayii</i>	Indian Pond Heron

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87	<i>Artamus fuscus</i>	Ashy Woodswallow
88	<i>Asio flammeus</i>	Short-eared Owl
89	<i>Asio otus</i>	Long-eared Owl
90	<i>Athene brama</i>	Spotted Owlet
91	<i>Athene noctua</i>	Little Owl
92	<i>Aviceda jerdoni</i>	Jerdon's Baza
93	<i>Aviceda leucophotes</i>	Black Baza
94	<i>Aythya baeri</i>	Baer's Pochard
95	<i>Aythya ferina</i>	Common Pochard
96	<i>Aythya fuligula</i>	Tufted Duck
97	<i>Aythya nyroca</i>	Ferruginous Duck
98	<i>Batastur teesa</i>	White-eyed Buzzard
99	<i>Batrachostomus hodgsoni</i>	Hodgson's Frogmouth
100	<i>Blythipicus pyrrhotis</i>	Bay Woodpecker
101	<i>Brachypteryx hyperythra</i>	Rusty-bellied Shortwing
102	<i>Brachypteryx leucophrys</i>	Lesser Shortwing
103	<i>Brachypteryx montana</i>	White-browed Shortwing
104	<i>Brachypteryx stellata</i>	Gould's Shortwing
105	<i>Bradypterus luteoventris</i>	Brown Bush Warbler
106	<i>Bradypterus seebohmii</i>	Russet Bush Warbler
107	<i>Bradypterus tacsanowskii</i>	Chinese Bush Warbler
108	<i>Bradypterus thoracicus</i>	Spotted Bush Warbler
109	<i>Bubo bengalensis</i>	Indian Eagle Owl
110	<i>Bubo bubo</i>	Eurasian Eagle Owl
111	<i>Bubo nipalensis</i>	Spot-bellied Eagle Owl
112	<i>Bubulcus ibis</i>	Cattle Egret
113	<i>Buceros bicornis</i>	Great Hornbill
114	<i>Burhinus indicus</i>	Indian Thick-knee
115	<i>Buteo burmanicus</i>	Himalayan Buzzard
116	<i>Buteo hemilasius</i>	Upland Buzzard
117	<i>Buteo rufinus</i>	Long-legged Buzzard
118	<i>Butorides striata</i>	Striated Heron
119	<i>Cacomantis merulinus</i>	Plaintive Cuckoo
120	<i>Cacomantis passerinus</i>	Grey-bellied Cuckoo
121	<i>Cacomantis sonneratii</i>	Banded Bay Cuckoo
122	<i>Cairina scutulata</i>	White-winged Duck
123	<i>Calandrella acutirostris</i>	Hume's Short-toed Lark
124	<i>Calandrella brachydactyla</i>	Greater Short-toed Lark
125	<i>Calandrella cheleensis</i>	Asian Short-toed Lark
126	<i>Calandrella raytal</i>	Sand Lark
127	<i>Calcarius lapponicus</i>	Lapland Longspur
128	<i>Calidris ferruginea</i>	Curlew Sandpiper
129	<i>Calidris minuta</i>	Little Stint
130	<i>Calidris temminckii</i>	Temminck's Stint
131	<i>Callacanthis burtoni</i>	Spectacled Finch
132	<i>Calomotor jacobinus</i>	Jacobin Cuckoo
133	<i>Caprimulgus affinis</i>	Savanna Nightjar

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134	<i>Caprimulgus asiaticus</i>	Indian Nightjar
135	<i>Caprimulgus indicus</i>	Grey Nightjar
136	<i>Caprimulgus macrurus</i>	Large-tailed Nightjar
137	<i>Carduelis spinoides</i>	Yellow-breasted Greenfinch
138	<i>Carpodacus edwardsii</i>	Dark-rumped Rosefinch
139	<i>Carpodacus erythrinus</i>	Common Rosefinch
140	<i>Carpodacus nipalensis</i>	Dark-breasted Rosefinch
141	<i>Carpodacus pulcherrimus</i>	Beautiful Rosefinch
142	<i>Carpodacus puniceus</i>	Red-fronted Rosefinch
143	<i>Carpodacus rodochroa</i>	Pink-browed Rosefinch
144	<i>Carpodacus rubescens</i>	Blanford's Rosefinch
145	<i>Carpodacus rubicilloides</i>	Streaked Rosefinch
146	<i>Carpodacus thura</i>	White-browed Rosefinch
147	<i>Carpodacus trifasciatus</i>	Three-banded Rosefinch
148	<i>Casmerodius albus</i>	Great Egret
149	<i>Celeus brachyurus</i>	Rufous Woodpecker
150	<i>Centropus bengalensis</i>	Lesser Coucal
151	<i>Centropus sinensis</i>	Greater Coucal
152	<i>Cephalopyrus flammiceps</i>	Fire-capped Tit
153	<i>Certhia discolor</i>	Brown-throated Treecreeper
154	<i>Certhia hodgsoni</i>	Hodgson's Treecreeper
155	<i>Certhia nipalensis</i>	Rusty-flanked Treecreeper
156	<i>Ceryle rudis</i>	Pied Kingfisher
157	<i>Cettia acanthizoides</i>	Yellowish-bellied Bush Warbler
158	<i>Cettia brunnifrons</i>	Grey-sided Bush Warbler
159	<i>Cettia flavolivacea</i>	Aberrant Bush Warbler
160	<i>Cettia fortipes</i>	Brownish-flanked Bush Warbler
161	<i>Cettia major</i>	Chestnut-crowned Bush Warbler
162	<i>Cettia pallidipes</i>	Pale-footed Bush Warbler
163	<i>Ceyxerithacus</i>	Oriental Dwarf Kingfisher
164	<i>Chaimarrornis leucocephalus</i>	White-capped Water Redstart
165	<i>Chalcophaps indica</i>	Emerald Dove
166	<i>Charadrius alexandrinus</i>	Kentish Plover
167	<i>Charadrius dubius</i>	Little Ringed Plover
168	<i>Charadrius leschenaultii</i>	Greater Sand Plover
169	<i>Charadrius mongolus</i>	Lesser Sand Plover
170	<i>Charadrius placidus</i>	Long-billed Plover
171	<i>Chloropsis aurifrons</i>	Golden-fronted Leafbird
172	<i>Chloropsis hardwickii</i>	Orange-bellied Leafbird
173	<i>Chroicocephalus brunnicephalus</i>	Brown-headed Gull
174	<i>Chroicocephalus genei</i>	Slender-billed Gull
175	<i>Chroicocephalus ridibundus</i>	Black-headed Gull
176	<i>Chrysococcyx maculatus</i>	Asian Emerald Cuckoo
177	<i>Chrysococcyx xanthorhynchus</i>	Violet Cuckoo
178	<i>Chrysocolaptes lucidus</i>	Greater Flameback
179	<i>Chrysomasinense</i>	Yellow-eyed Babbler
180	<i>Ciconia episcopus</i>	Woolly-necked Stork

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181	<i>Ciconia nigra</i>	Black Stork
182	<i>Cinclidium frontale</i>	Blue-fronted Robin
183	<i>Cinclus cinclus</i>	White-throated Dipper
184	<i>Cinclus pallasi</i>	Brown Dipper
185	<i>Circaetus gallicus</i>	Short-toed Snake Eagle
186	<i>Circus spilonotus</i>	Eastern Marsh Harrier
187	<i>Circus aeruginosus</i>	Eurasian Marsh Harrier
188	<i>Circus cyaneus</i>	Hen Harrier
189	<i>Circus macrourus</i>	Pallid Harrier
190	<i>Circus melanoleucos</i>	Pied Harrier
191	<i>Cissachinensis</i>	Common Green Magpie
192	<i>Clamator coromandus</i>	Chestnut-winged Cuckoo
193	<i>Clangula hyemalis</i>	Long-tailed Duck
194	<i>Cochoa purpurea</i>	Purple Cochoa
195	<i>Cochoa viridis</i>	Green Cochoa
196	<i>Collocalia brevirostris</i>	Himalayan Swiftlet
197	<i>Columba hodgsonii</i>	Speckled Wood Pigeon
198	<i>Columba leuconota</i>	Snow Pigeon
199	<i>Columba livia</i>	Common Pigeon
200	<i>Columba pulchricollis</i>	Ashy Wood Pigeon
201	<i>Columba rupestris</i>	Hill Pigeon
202	<i>Conostoma oemodum</i>	Great Parrotbill
203	<i>Copsychus malabaricus</i>	White-rumped Shama
204	<i>Copsychus saularis</i>	Oriental Magpie Robin
205	<i>Coracias benghalensis</i>	Indian Roller
206	<i>Coracias garrulus</i>	Eurasian Roller
207	<i>Coracinamacei</i>	Large Cuckoo shrike
208	<i>Coracinamelaschistos</i>	Black-winged Cuckoo shrike
209	<i>Corvus leuclantii</i>	Eastern Jungle Crow
210	<i>Corvus corax</i>	Northern Raven
211	<i>Corvus macrorhynchos</i>	Large-billed Crow
212	<i>Corvus splendens</i>	House Crow
213	<i>Coturnix coturnix</i>	Common Quail
214	<i>Coturnix japonica</i>	Japanese Quail
215	<i>Cuculus canorus</i>	Eurasian Cuckoo
216	<i>Cuculus micropterus</i>	Indian Cuckoo
217	<i>Cuculus poliocephalus</i>	Lesser Cuckoo
218	<i>Cuculus saturatus</i>	Oriental Cuckoo
219	<i>Culicicapaceylonensis</i>	Grey-headed Canary Flycatcher
220	<i>Cutianipalensis</i>	Himalayan Cutia
221	<i>Cyornis poliopteryx</i>	Pale-chinned Flycatcher
222	<i>Cyornis rubeculoides</i>	Blue-throated Flycatcher
223	<i>Cyornis unicolor</i>	Pale Blue Flycatcher
224	<i>Cypsiurus balasorensis</i>	Asian Palm Swift
225	<i>Delichondasypus</i>	Asian House Martin
226	<i>Delichon nipalensis</i>	Nepal House Martin
227	<i>Dendrocitta formosae</i>	Grey Treepie

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228	<i>Dendrocitta frontalis</i>	Collared Treepie
229	<i>Dendrocittavagabunda</i>	Rufous Treepie
230	<i>Dendrocopos atratus</i>	Stripe-breasted Woodpecker
231	<i>Dendrocopos canicapillus</i>	Grey-capped Pygmy Woodpecker
232	<i>Dendrocopos cathpharius</i>	Crimson-breasted Woodpecker
233	<i>Dendrocopos darjellensis</i>	Darjeeling Woodpecker
234	<i>Dendrocopos hyperythrus</i>	Rufous-bellied Woodpecker
235	<i>Dendrocopos macei</i>	Fulvous-breasted Woodpecker
236	<i>Dendrocygna bicolor</i>	Fulvous Whistling-duck
237	<i>Dendrocygna javanica</i>	Lesser Whistling-duck
238	<i>Dendronanthus indicus</i>	Forest Wagtail
239	<i>Dicaeum chrysorrheum</i>	Yellow-vented Flowerpecker
240	<i>Dicaeum concolor</i>	Plain Flowerpecker
241	<i>Dicaeum cruentatum</i>	Scarlet-backed Flowerpecker
242	<i>Dicaeum erythrorhynchus</i>	Pale-billed Flowerpecker
243	<i>Dicaeum ignipectus</i>	Fire-breasted Flowerpecker
244	<i>Dicaeum melanoxanthum</i>	Yellow-bellied Flowerpecker
245	<i>Dicrurus aeneus</i>	Bronzed Drongo
246	<i>Dicrurus annectans</i>	Crow-billed Drongo
247	<i>Dicrurus hottentottus</i>	Spangled Drongo
248	<i>Dicrurus leucophaeus</i>	Ashy Drongo
249	<i>Dicrurus macrocercus</i>	Black Drongo
250	<i>Dicrurus paradiseus</i>	Greater Racket-tailed Drongo
251	<i>Dicrurus remifer</i>	Lesser Racket-tailed Drongo
252	<i>Dinopium shorii</i>	Himalayan Flameback
253	<i>Ducula aenea</i>	Green Imperial Pigeon
254	<i>Ducula badia</i>	Mountain Imperial Pigeon
255	<i>Egretta garzetta</i>	Little Egret
256	<i>Elanus caeruleus</i>	Black-winged Kite
257	<i>Emberiza bhanjani</i>	Grey-necked Bunting
258	<i>Emberiza godlewskii</i>	Godlewski's Bunting
259	<i>Emberiza melanocephala</i>	Black-headed Bunting
260	<i>Emberiza pusilla</i>	Little Bunting
261	<i>Emberiza rustica</i>	Rustic Bunting
262	<i>Emberiza spodocephala</i>	Black-faced Bunting
263	<i>Enicurus immaculatus</i>	Black-backed Forktail
264	<i>Enicurus leschenaulti</i>	White-crowned Forktail
265	<i>Enicurus maculatus</i>	Spotted Forktail
266	<i>Enicurus schistaceus</i>	Slaty-backed Forktail
267	<i>Enicurus scouleri</i>	Little Forktail
268	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork
269	<i>Epornis zantholeuca</i>	White-bellied Epornis
270	<i>Esacus recurvirostris</i>	Great Thick-knee
271	<i>Eudynamis scolopacea</i>	Asian Koel
272	<i>Eumyias thalassina</i>	Verditer Flycatcher
273	<i>Eurystomus orientalis</i>	Dollarbird
274	<i>Falco amurensis</i>	Amur Falcon

275	<i>Falco chicquera</i>	Red-necked Falcon
276	<i>Falco columbarius</i>	Merlin
277	<i>Falco peregrinus</i>	Peregrine Falcon
278	<i>Falco severus</i>	Oriental Hobby
279	<i>Falco subbuteo</i>	Eurasian Hobby
280	<i>Falco tinnunculus</i>	Common Kestrel
281	<i>Ficedula albicilla</i>	Taiga Flycatcher
282	<i>Ficedula hodgsonii</i>	Slaty-backed Flycatcher
283	<i>Ficedula hyperythra</i>	Snowy-browed Flycatcher
284	<i>Ficedula monileger</i>	White-gorgeted Flycatcher
285	<i>Ficedula parva</i>	Red-breasted Flycatcher
286	<i>Ficedula sapphira</i>	Sapphire Flycatcher
287	<i>Ficedula trochilata</i>	Rufous-gorgeted Flycatcher
288	<i>Ficedula subrubra</i>	Kashmir Flycatcher
289	<i>Ficedula superciliosa</i>	Ultramarine Flycatcher
290	<i>Ficedula tricolor</i>	Slaty-blue Flycatcher
291	<i>Ficedula westermanni</i>	Little Pied Flycatcher
292	<i>Francolinus francolinus</i>	Black Francolin
293	<i>Fringilla coelebs</i>	Common Chaffinch
294	<i>Fringilla montifringilla</i>	Brambling
295	<i>Fulica atra</i>	Eurasian Coot
296	<i>Gallicrex cinerea</i>	Watercock
297	<i>Gallinago gallinago</i>	Common Snipe
298	<i>Gallinago nemoricola</i>	Wood Snipe
299	<i>Gallinago solitaria</i>	Solitary Snipe
300	<i>Gallinago stenura</i>	Pintail Snipe
301	<i>Gallinula chloropus</i>	Common Moorhen
302	<i>Gallinula striata</i>	Slaty-breasted Rail
303	<i>Gallus gallus</i>	Red Junglefowl
304	<i>Gampsorhynchus rufulus</i>	White-hooded Babbler
305	<i>Garrulax affinis</i>	Black-faced Laughingthrush
306	<i>Garrulax albogularis</i>	White-throated Laughingthrush
307	<i>Garrulax caeruleus</i>	Grey-sided Laughingthrush
308	<i>Garrulax erythrocephalus</i>	Chestnut-crowned Laughingthrush
309	<i>Garrulax gularis</i>	Rufous-vented Laughingthrush
310	<i>Garrulax imbricatus</i>	Bhutan Laughingthrush
311	<i>Garrulax leucolophus</i>	White-crested Laughingthrush
312	<i>Garrulax monileger</i>	Lesser Necklaced Laughingthrush
313	<i>Garrulax ocellatus</i>	Spotted Laughingthrush
314	<i>Garrulax pectoralis</i>	Greater Necklaced Laughingthrush
315	<i>Garrulax ruficollis</i>	Rufous-necked Laughingthrush
316	<i>Garrulax rufogularis</i>	Rufous-chinned Laughingthrush
317	<i>Garrulax squamatus</i>	Blue-winged Laughingthrush
318	<i>Garrulax striatus</i>	Striated Laughingthrush
319	<i>Garrulax subunicolor</i>	Scaly Laughingthrush
320	<i>Garrulus glandarius</i>	Eurasian Jay
321	<i>Gecinulus grantia</i>	Pale-headed Woodpecker

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322	<i>Glareolalactea</i>	Small Pratincole
323	<i>Glaucidium brodiei</i>	Collared Owlet
324	<i>Glaucidium cuculoides</i>	Asian Barred Owlet
325	<i>Glaucidium radiatum</i>	Jungle Owlet
326	<i>Gorsachiusmelanolophus</i>	Malayan Night Heron
327	<i>Gracula religiosa</i>	Common Hill Myna
328	<i>Grandala coelicolor</i>	Grandala
329	<i>Grus grus</i>	Common Crane
330	<i>Grus nigricollis</i>	Black-necked Crane
331	<i>Grus virgo</i>	Demoiselle Crane
332	<i>Gypaetus barbatus</i>	Bearded Vulture
333	<i>Gyps bengalensis</i>	White-rumped Vulture
334	<i>Gyps himalayensis</i>	Himalayan Griffon
335	<i>Haematospizasipahi</i>	Scarlet Finch
336	<i>Halcyon coromanda</i>	Ruddy Kingfisher
337	<i>Halcyon pileata</i>	Black-capped Kingfisher
338	<i>Halcyon smyrnensis</i>	White-throated Kingfisher
339	<i>Haliaeetus albicilla</i>	White-tailed Eagle
340	<i>Haliaeetus leucoryphus</i>	Pallas's Fish Eagle
341	<i>Haliasturindus</i>	Brahminy Kite
342	<i>Harpacteserythrocephalus</i>	Red-headed Trogon
343	<i>Harpacteswardi</i>	Ward's Trogon
344	<i>Hemiprocne coronata</i>	Crested Treeswift
345	<i>Hemipuspicatus</i>	Bar-winged Flycatcher-shrike
346	<i>Hemixosflavala</i>	Ashy Bulbul
347	<i>Heterophasiaannectans</i>	Rufous-backed Sibia
348	<i>Heterophasiapicaoides</i>	Long-tailed Sibia
349	<i>Hieraaetusfasciatus</i>	Bonelli's Eagle
350	<i>Hieraaetuskienerii</i>	Rufous-bellied Eagle
351	<i>Hieraaetuspennatus</i>	Booted Eagle
352	<i>Hierococcyx fugax</i>	Hodgson's Hawk Cuckoo
353	<i>Hierococcyxsparveroides</i>	Large Hawk Cuckoo
354	<i>Hierococcyxvarius</i>	Common Hawk Cuckoo
355	<i>Himantopus himantopus</i>	Black-winged Stilt
356	<i>Hirundapuscaudacutus</i>	White-throated Needletail
357	<i>Hirundodaurica</i>	Red-rumped Swallow
358	<i>Hirundorupestris</i>	Eurasian Crag Martin
359	<i>Hirundorustica</i>	Barn Swallow
360	<i>Hodgsoniusphaenicuroides</i>	White-bellied Redstart
361	<i>Hydrophasianuschirurgus</i>	Pheasant-tailed Jacana
362	<i>Hypothymisazurea</i>	Black-naped Monarch
363	<i>Hypsipetesleucocephalus</i>	Black Bulbul
364	<i>Ibidorhynchastruthersii</i>	Ibisbill
365	<i>Ichthyiaetusichthyiaetus</i>	Pallas's Gull
366	<i>Ichthyophaga humilis</i>	Lesser Fish Eagle
367	<i>Ictinaetusmalayensis</i>	Black Eagle
368	<i>Idunacaligata</i>	Booted Warbler

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369	<i>Indicator xanthonotus</i>	Yellow-rumped Honeyguide
370	<i>Irena puella</i>	Asian Fairy Bluebird
371	<i>Ithaginis cruentus</i>	Blood Pheasant
372	<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern
373	<i>Ixos mcclellandii</i>	Mountain Bulbul
374	<i>Jynx torquilla</i>	Eurasian Wryneck
375	<i>Ketupa flavipes</i>	Tawny Fish Owl
376	<i>Ketupa zeylonensis</i>	Brown Fish Owl
377	<i>Lanius collurio</i>	Burmese Shrike
378	<i>Lanius cristatus</i>	Brown Shrike
379	<i>Lanius schach</i>	Long-tailed Shrike
380	<i>Lanius stephensoni</i>	Grey-backed Shrike
381	<i>Lanius vittatus</i>	Bay-backed Shrike
382	<i>Larus barabensis</i>	Steppe Gull
383	<i>Larus canus</i>	Mew Gull
384	<i>Larus heuglini</i>	Heuglin's Gull
385	<i>Leiothrix argentauris</i>	Silver-eared Mesia
386	<i>Leiothrix lutea</i>	Red-billed Leiothrix
387	<i>Leptopoeila sibirica</i>	White-browed Tit Warbler
388	<i>Leptopoeila javanica</i>	Lesser Adjutant
389	<i>Lerwa lerwa</i>	Snow Partridge
390	<i>Leucosticte brandti</i>	Brandt's Mountain Finch
391	<i>Leucosticte nemoricola</i>	Plain Mountain Finch
392	<i>Liocichla phoenicea</i>	Red-faced Liocichla
393	<i>Lioparus chrysotis</i>	Golden-breasted Fulvetta
394	<i>Lonchura punctulata</i>	Scaly-breasted Munia
395	<i>Lonchura striata</i>	White-rumped Munia
396	<i>Lophophanes impejanus</i>	Himalayan Monal
397	<i>Lophura leucomelanos</i>	Kalij Pheasant
398	<i>Loxia curvirostra</i>	Red Crossbill
399	<i>Luscinia sibilatrix</i>	Indian Blue Robin
400	<i>Luscinia calliope</i>	Siberian Rubythroat
401	<i>Luscinia pectoralis</i>	White-tailed Rubythroat
402	<i>Luscinia svecica</i>	Bluethroat
403	<i>Lymnocyttus minimus</i>	Jack Snipe
404	<i>Macronous gularis</i>	Pin-striped Tit Babbler
405	<i>Macropygia unchall</i>	Barred Cuckoo Dove
406	<i>Malaciascapistrata</i>	Rufous Sibia
407	<i>Malacias pulchellus</i>	Beautiful Sibia
408	<i>Malacocincla abbotti</i>	Abbott's Babbler
409	<i>Megaceryle lugubris</i>	Crested Kingfisher
410	<i>Megalaima asiatica</i>	Blue-throated Barbet
411	<i>Megalaima australis</i>	Blue-eared Barbet
412	<i>Megalaima franklinii</i>	Golden-throated Barbet
413	<i>Megalaima haemacephala</i>	Coppersmith Barbet
414	<i>Megalaima lineata</i>	Lineated Barbet
415	<i>Megalaima virens</i>	Great Barbet

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416	<i>Megaluruspallustris</i>	Striated Grassbird
417	<i>Melanochlorasultanea</i>	Sultan Tit
418	<i>Melophuslathamii</i>	Crested Bunting
419	<i>Mergus merganser</i>	Goosander
420	<i>Meropsleschenaultii</i>	Chestnut-headed Bee-eater
421	<i>Meropsorientalis</i>	Green Bee-eater
422	<i>Meropsphilippinus</i>	Blue-tailed Bee-eater
423	<i>Mesophoyx intermedia</i>	Intermediate Egret
424	<i>Metopidius indicus</i>	Bronze-winged Jacana
425	<i>Microhieraxcaerulescens</i>	Collared Falconet
426	<i>Microhieraxmelanoleucos</i>	Pied Falconet
427	<i>Milvus migrans</i>	Black Kite
428	<i>Minlacyanouropetra</i>	Blue-winged Siva
429	<i>Minlaignotincta</i>	Red-tailed Minla
430	<i>Minlastrigula</i>	Bar-throated Siva
431	<i>Mirafraassamica</i>	Bengal Bushlark
432	<i>Monticolacinclorhynchus</i>	Blue-capped Rock Thrush
433	<i>Monticolarufiventris</i>	Chestnut-bellied Rock Thrush
434	<i>Monticola solitarius</i>	Blue Rock Thrush
435	<i>Motacilla alba</i>	White Wagtail
436	<i>Motacillacinerea</i>	Grey Wagtail
437	<i>Motacillacitreola</i>	Citrine Wagtail
438	<i>Motacilla flava</i>	Yellow Wagtail
439	<i>Motacillamaderaspatensis</i>	White-browed Wagtail
440	<i>Mulleripicuspulverulentus</i>	Great Slaty Woodpecker
441	<i>Muscicapadauaurica</i>	Asian Brown Flycatcher
442	<i>Muscicapaferruginea</i>	Ferruginous Flycatcher
443	<i>Muscicapamuttui</i>	Brown-breasted Flycatcher
444	<i>Muscicapasibirica</i>	Dark-sided Flycatcher
445	<i>Muscicapellahodgsoni</i>	Pygmy Blue Flycatcher
446	<i>Mycerobasaffinis</i>	Collared Grosbeak
447	<i>Mycerobascarnipes</i>	White-winged Grosbeak
448	<i>Mycerobasmelanozanthos</i>	Spot-winged Grosbeak
449	<i>Myiomelaleucura</i>	White-tailed Robin
450	<i>Myophonus caeruleus</i>	Blue Whistling Thrush
451	<i>Myzornispyrrhura</i>	Fire-tailed Myzornis
452	<i>Napotheraepilepidota</i>	Eyebrowed Wren Babbler
453	<i>Nectariniaasiatica</i>	Purple Sunbird
454	<i>Neophron percnopterus</i>	Egyptian Vulture
455	<i>Niltavagrandis</i>	Large Niltava
456	<i>Niltavamacgrigoriae</i>	Small Niltava
457	<i>Niltavasundara</i>	Rufous-bellied Niltava
458	<i>Niltavavivida</i>	Vivid Niltava
459	<i>Ninoxscutulata</i>	Brown Hawk Owl
460	<i>Nisaetusnipalensis</i>	Mountain Hawk Eagle
461	<i>Nucifragacaryocatactes</i>	Spotted Nutcracker
462	<i>Numenius arquata</i>	Eurasian Curlew

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463	<i>Numenius phaeopus</i>	Whimbrel
464	<i>Nycticorax nycticorax</i>	Black-crowned Night Heron
465	<i>Nyctyornis aethertoni</i>	Blue-bearded Bee-eater
466	<i>Oenanthe isabellina</i>	Isabelline Wheatear
467	<i>Oenanthe pleschanka</i>	Pied Wheatear
468	<i>Oriolus kundoo</i>	Indian Golden Oriole
469	<i>Oriolus tenuirostris</i>	Slender-billed Oriole
470	<i>Oriolus traillii</i>	Maroon Oriole
471	<i>Oriolus xanthornus</i>	Black-hooded Oriole
472	<i>Orthotomus cuculatus</i>	Mountain Tailorbird
473	<i>Orthotomus sutorius</i>	Common Tailorbird
474	<i>Otus lettia</i>	Collared Scops Owl
475	<i>Otus pilosus</i>	Mountain Scops Owl
476	<i>Otus sunia</i>	Oriental Scops Owl
477	<i>Pandion haliaetus</i>	Osprey
478	<i>Paradoxornis atrisuperciliaris</i>	Lesser Rufous-headed Parrotbill
479	<i>Paradoxornis fulvifrons</i>	Fulvous Parrotbill
480	<i>Paradoxornis singularis</i>	Grey-headed Parrotbill
481	<i>Paradoxornis nipalensis</i>	Black-throated Parrotbill
482	<i>Paradoxornis ruficeps</i>	Greater Rufous-headed Parrotbill
483	<i>Paradoxornis unicolor</i>	Brown Parrotbill
484	<i>Parus ater</i>	Coal Tit
485	<i>Parus dichrous</i>	Grey-crested Tit
486	<i>Parus major</i>	Great Tit
487	<i>Parus monticolus</i>	Green-backed Tit
488	<i>Parus rubriventer</i>	Rufous-vented Tit
489	<i>Parus spilonotus</i>	Yellow-cheeked Tit
490	<i>Passer domesticus</i>	House Sparrow
491	<i>Passer montanus</i>	Eurasian Tree Sparrow
492	<i>Passer rutilans</i>	Russet Sparrow
493	<i>Pavocristatus</i>	Indian Peafowl
494	<i>Pelargopsis capensis</i>	Stork-billed Kingfisher
495	<i>Pellorneum albibentre</i>	Spot-throated Babbler
496	<i>Pellorneum ruficeps</i>	Puff-throated Babbler
497	<i>Perdix hodgsoniae</i>	Tibetan Partridge
498	<i>Pericrocotus speciosus</i>	Scarlet Minivet
499	<i>Pericrocotus brevirostris</i>	Short-billed Minivet
500	<i>Pericrocotus cinnamomeus</i>	Small Minivet
501	<i>Pericrocotus divaricatus</i>	Ashy Minivet
502	<i>Pericrocotus ethologus</i>	Long-tailed Minivet
503	<i>Pericrocotus roseus</i>	Rosy Minivet
504	<i>Pericrocotus solaris</i>	Grey-chinned Minivet
505	<i>Pernis ptilorhynchus</i>	Oriental Honey-buzzard
506	<i>Phaenicophaeus tristis</i>	Green-billed Malkoha
507	<i>Phalacrocorax carbo</i>	Great Cormorant
508	<i>Phalacrocorax fuscicollis</i>	Indian Cormorant
509	<i>Phalacrocorax niger</i>	Little Cormorant

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510	<i>Philomachus pugnax</i>	Ruff
511	<i>Phodilus badius</i>	Oriental Bay Owl
512	<i>Phoenicurus aureus</i>	Daurian Redstart
513	<i>Phoenicurus coeruleocephala</i>	Blue-capped Redstart
514	<i>Phoenicurus erythrogaster</i>	White-winged Redstart
515	<i>Phoenicurus frontalis</i>	Blue-fronted Redstart
516	<i>Phoenicurus hodgsoni</i>	Hodgson's Redstart
517	<i>Phoenicurus ochruros</i>	Black Redstart
518	<i>Phoenicurus schisticeps</i>	White-throated Redstart
519	<i>Phylloscopus mandellii</i>	Mandelli's Leaf Warbler
520	<i>Phylloscopus affinis</i>	Tickell's Leaf Warbler
521	<i>Phylloscopus cantator</i>	Yellow-vented Warbler
522	<i>Phylloscopus chloronotus</i>	Lemon-rumped Warbler
523	<i>Phylloscopus collybita</i>	Common Chiffchaff
524	<i>Phylloscopus fuliginiventer</i>	Smoky Warbler
525	<i>Phylloscopus fuscatus</i>	Dusky Warbler
526	<i>Phylloscopus humei</i>	Hume's Warbler
527	<i>Phylloscopus inornatus</i>	Yellow-browed Warbler
528	<i>Phylloscopus maculipennis</i>	Ashy-throated Warbler
529	<i>Phylloscopus magnirostris</i>	Large-billed Leaf Warbler
530	<i>Phylloscopus pulcher</i>	Buff-barred Warbler
531	<i>Phylloscopus reguloides</i>	Blyth's Leaf Warbler
532	<i>Phylloscopus trochiloides</i>	Greenish Warbler
533	<i>Pica pica</i>	Eurasian Magpie
534	<i>Picumnus innominatus</i>	Speckled Piculet
535	<i>Picus canus</i>	Grey-headed Woodpecker
536	<i>Picus chlorolophus</i>	Lesser Yellownappe
537	<i>Picus flavinucha</i>	Greater Yellownappe
538	<i>Picus xanthopygaeus</i>	Streak-throated Woodpecker
539	<i>Pitta cyanea</i>	Blue Pitta
540	<i>Pitta nipalensis</i>	Blue-naped Pitta
541	<i>Pitta sordida</i>	Hooded Pitta
542	<i>Ploceus benghalensis</i>	Black-breasted Weaver
543	<i>Ploceus manyar</i>	Streaked Weaver
544	<i>Ploceus philippinus</i>	Baya Weaver
545	<i>Pluvialis apricaria</i>	European Golden Plover
546	<i>Pluvialis fulva</i>	Pacific Golden Plover
547	<i>Pnoepyga albigaster</i>	Scaly-breasted Wren Babbler
548	<i>Pnoepyga pusilla</i>	Pygmy Wren Babbler
549	<i>Podiceps cristatus</i>	Great Crested Grebe
550	<i>Podiceps nigricollis</i>	Black-necked Grebe
551	<i>Polyplectron bicalcaratum</i>	Grey Peacock Pheasant
552	<i>Pomatorhinus erythronemus</i>	Spot-breasted Scimitar Babbler
553	<i>Pomatorhinus erythrogenus</i>	Rusty-cheeked Scimitar Babbler
554	<i>Pomatorhinus ferruginosus</i>	Coral-billed Scimitar Babbler
555	<i>Pomatorhinus ruficollis</i>	Streak-breasted Scimitar Babbler
556	<i>Pomatorhinus schisticeps</i>	White-browed Scimitar Babbler

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557	<i>Porphyrioporphyrus</i>	Purple Swamphen
558	<i>Porzana bicolor</i>	Black-tailed Crake
559	<i>Porzana fusca</i>	Ruddy-breasted Crake
560	<i>Porzana parva</i>	Little Crake
561	<i>Prinia atrogularis</i>	Hill Prinia
562	<i>Prinia cinereocapilla</i>	Grey-crowned Prinia
563	<i>Prinia cinerica</i>	Striated Prinia
564	<i>Prinia hodgsonii</i>	Grey-breasted Prinia
565	<i>Prinia inornata</i>	
566	<i>Prinia rufescens</i>	Rufescent Prinia
567	<i>Prinia socialis</i>	Ashy Prinia
568	<i>Prinia sylvatica</i>	Jungle Prinia
569	<i>Pyrrhuloxia himachala</i>	Crimson-browed Finch
570	<i>Prunella collaris</i>	Alpine Accentor
571	<i>Prunella fulvescens</i>	Brown Accentor
572	<i>Prunella himalayana</i>	Altai Accentor
573	<i>Prunella immaculata</i>	Maroon-backed Accentor
574	<i>Prunella rubeculoides</i>	Robin Accentor
575	<i>Prunella strophias</i>	Rufous-breasted Accentor
576	<i>Psarisomus dalhousiae</i>	Long-tailed Broadbill
577	<i>Pseudibis papillosa</i>	Red-naped Ibis
578	<i>Pseudominia cinerea</i>	Yellow-throated Fulvetta
579	<i>Psittacula alexandri</i>	Red-breasted Parakeet
580	<i>Psittacula eupatria</i>	Alexandrine Parakeet
581	<i>Psittacula finschii</i>	Grey-headed Parakeet
582	<i>Psittacula himalayana</i>	Slaty-headed Parakeet
583	<i>Psittacula krameri</i>	Rose-ringed Parakeet
584	<i>Psittacula roseata</i>	Blossom-headed Parakeet
585	<i>Pteruthius flaviscapula</i>	White-browed Shrike Babbler
586	<i>Pteruthius melanotis</i>	Black-eared Shrike Babbler
587	<i>Pteruthius rufiventer</i>	Black-headed Shrike Babbler
588	<i>Pteruthius xanathochlorus</i>	Green Shrike Babbler
589	<i>Pycnonotus cafer</i>	Red-vented Bulbul
590	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul
591	<i>Pycnonotus leucogenys</i>	Himalayan Bulbul
592	<i>Pycnonotus melanicterus</i>	Black-crested Bulbul
593	<i>Pycnonotus striatus</i>	Striated Bulbul
594	<i>Pyrrhonorax graculus</i>	Yellow-billed Chough
595	<i>Pyrrhonorax pyrrhonorax</i>	Red-billed Chough
596	<i>Pyrrhoptes epauletta</i>	Gold-naped Finch
597	<i>Pyrrhula erythraea</i>	Grey-headed Bullfinch
598	<i>Pyrrhula erythrocephala</i>	Red-headed Bullfinch
599	<i>Pyrrhula nipalensis</i>	Brown Bullfinch
600	<i>Recurvirostra avosetta</i>	Pied Avocet
601	<i>Regulus regulus</i>	Goldcrest
602	<i>Rhipidura albicollis</i>	White-throated Fantail
603	<i>Rhipidura hypoxantha</i>	Yellow-bellied Fantail

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604	<i>Rhodonessarusufina</i>	Red-crested Pochard
605	<i>Rhyacornisfuliginosus</i>	Plumbeous Water Redstart
606	<i>Rimotormalacoptilus</i>	Long-billed Wren Babbler
607	<i>Ripariadiluta</i>	Pale Martin
608	<i>Ripariapaludicola</i>	Plain Martin
609	<i>Ripariariparia</i>	Sand Martin
610	<i>Rostratulabenghalensis</i>	Greater Painted-snipe
611	<i>Sarcogyps calvus</i>	Red-headed Vulture
612	<i>Saroglossaspiloptera</i>	Spot-winged Starling
613	<i>Sasiaochracea</i>	White-browed Piculet
614	<i>Saxicola caprata</i>	Pied Bushchat
615	<i>Saxicola ferrea</i>	Grey Bushchat
616	<i>Saxicola insignis</i>	Hodgson's Bushchat
617	<i>Saxicola torquata</i>	Common Stonechat
618	<i>Saxicoloidesfulicata</i>	Indian Robin
619	<i>Schoeniparusdubia</i>	Rusty-capped Fulvetta
620	<i>Scolopaxrusticola</i>	Eurasian Woodcock
621	<i>Seicercusaffinis</i>	White-spectacled Warbler
622	<i>Seicercusburkii</i>	Green-crowned Warbler
623	<i>Seicercuscastaniceps</i>	Chestnut-crowned Warbler
624	<i>Seicercuspoliogenys</i>	Grey-cheeked Warbler
625	<i>Seicercuswhistleri</i>	Whistler's Warbler
626	<i>Seicercusxanthoschistos</i>	Grey-hooded Warbler
627	<i>Serilophuslunatus</i>	Silver-breasted Broadbill
628	<i>Serinuspusillus</i>	Red-fronted Serin
629	<i>Serinus tibetanus</i>	Tibetan Serin
630	<i>Sittacinnamoventris</i>	Chestnut-bellied Nuthatch
631	<i>Sittaformosa</i>	Beautiful Nuthatch
632	<i>Sitta frontalis</i>	Velvet-fronted Nuthatch
633	<i>Sittahimalayensis</i>	White-tailed Nuthatch
634	<i>Spelaorniscaudatus</i>	Rufous-throated Wren Babbler
635	<i>Spelaornisformosus</i>	Spotted Wren Babbler
636	<i>Spelaornistrogodyoides</i>	Bar-winged Wren Babbler
637	<i>Sphenocichlahumei</i>	Himalayan Wedge-billed Babbler
638	<i>Spilornischeela</i>	Crested Serpent Eagle
639	<i>Spinus spinus</i>	Eurasian Siskin
640	<i>Stachyrischrysa</i>	Golden Babbler
641	<i>Stachyrisnigricaps</i>	Grey-throated Babbler
642	<i>Stachyrisruficeps</i>	Rufous-capped Babbler
643	<i>Stachyrisrufifrons</i>	Rufous-fronted Babbler
644	<i>Staphidacastaniceps</i>	Striated Yuhina
645	<i>Sterna aurantia</i>	River Tern
646	<i>Sterna hirundo</i>	Common Tern
647	<i>Sternulaacuticauda</i>	Black-bellied Tern
648	<i>Stigmatopeliachinensis</i>	Spotted Dove
649	<i>Stigmatopelia senegalensis</i>	Laughing Dove
650	<i>Streptopeliadecaoto</i>	Eurasian Collared Dove

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651	<i>Streptopeliaorientalis</i>	Oriental Turtle Dove
652	<i>Streptopeliatranquebarica</i>	Red Collared Dove
653	<i>Strixnivicola</i>	Himalayan Wood Owl
654	<i>Strixleptogrammica</i>	Brown Wood Owl
655	<i>Sturnus contra</i>	Asian Pied Starling
656	<i>Sturnus malabaricus</i>	Chestnut-tailed Starling
657	<i>Sturnus pagodarum</i>	Brahminy Starling
658	<i>Sturnus vulgaris</i>	Common Starling
659	<i>Surniculslugubris</i>	Drongo Cuckoo
660	<i>Sylvia curruca</i>	Lesser Whitethroat
661	<i>Sylviparusmodestus</i>	Yellow-browed Tit
662	<i>Tachybaptusruficollis</i>	Little Grebe
663	<i>Tachymarptis melba</i>	Alpine Swift
664	<i>Tadornaferruginea</i>	Ruddy Shelduck
665	<i>Tadornatadorna</i>	Common Shelduck
666	<i>Tarsigerchrysaesus</i>	Golden Bush Robin
667	<i>Tarsigercyanurus</i>	Orange-flanked Bush Robin
668	<i>Tarsigerhyperythrus</i>	Rufous-breasted Bush Robin
669	<i>Tarsiger indicus</i>	White-browed Bush Robin
670	<i>Tephrodornisgularis</i>	Large Woodshrike
671	<i>Terpsiphoneparadisi</i>	Asian Paradise-flycatcher
672	<i>Tesiacastaneocoronata</i>	Chestnut-headed Tesia
673	<i>Tesiacyaniventer</i>	Grey-bellied Tesia
674	<i>Tesiaolivea</i>	Slaty-bellied Tesia
675	<i>Tetraogallustibetanus</i>	Tibetan Snowcock
676	<i>Tichodromamuraria</i>	Wallcreeper
677	<i>Tickelliahodgsoni</i>	Broad-billed Warbler
678	<i>Tragopanblythii</i>	Blyth's Tragopan
679	<i>Tragopansatyra</i>	Satyr Tragopan
680	<i>Tragopantemminckii</i>	Temminck's Tragopan
681	<i>Treronapicauda</i>	Pin-tailed Green Pigeon
682	<i>Treronbicincta</i>	Orange-breasted Green Pigeon
683	<i>Treroncurvirostra</i>	Thick-billed Green Pigeon
684	<i>Treronphoenicoptera</i>	Yellow-footed Green Pigeon
685	<i>Treronpompadora</i>	Pompadour Green Pigeon
686	<i>Treronsphenura</i>	Wedge-tailed Green Pigeon
687	<i>Tringaerythtopus</i>	Spotted Redshank
688	<i>Tringaglareola</i>	Wood Sandpiper
689	<i>Tringanebularia</i>	Common Greenshank
690	<i>Tringaochropus</i>	Green Sandpiper
691	<i>Tringatotanus</i>	Common Redshank
692	<i>Troglodytes troglodytes</i>	Eurasian Wren
693	<i>Turdoidesstriatus</i>	Jungle Babbler
694	<i>Turdus maximus</i>	Tibetan Blackbird
695	<i>Turdusalbocinctus</i>	White-collared Blackbird
696	<i>Turdusatrogularis</i>	Black-throated Thrush
697	<i>Turdusboulboul</i>	Grey-winged Blackbird

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698	<i>Turduseunomus</i>	Dusky Thrush
699	<i>Turdusfeae</i>	Grey-sided Thrush
700	<i>Turduskessleri</i>	Kessler's Thrush
701	<i>Turdusnaumanni</i>	Naumann's Thrush
702	<i>Turdus obscurus</i>	Eye-browed Thrush
703	<i>Turdusrubrocanus</i>	Chestnut Thrush
704	<i>Turdusruficollis</i>	Red-throated Thrush
705	<i>Turdus unicolor</i>	Tickell's Thrush
706	<i>Turnixsuscitator</i>	Barred Buttonquail
707	<i>Turnixtanki</i>	Yellow-legged Buttonquail
708	<i>Tyto alba</i>	Barn Owl
709	<i>Upupa epops</i>	Common Hoopoe
710	<i>Urocissaflavirostris</i>	Yellow-billed Blue Magpie
711	<i>Vanelluscinereus</i>	Grey-headed Lapwing
712	<i>Vanellusduvaucelii</i>	River Lapwing
713	<i>Vanellus indicus</i>	Red-wattled Lapwing
714	<i>Vanellusmalarbaricus</i>	Yellow-wattled Lapwing
715	<i>Vanellusvanellus</i>	Northern Lapwing
716	<i>Xiphirhynchussuperciliaris</i>	Slender-billed Scimitar Babbler
717	<i>Yuhina bakeri</i>	White-naped Yuhina
718	<i>Yuhina flavicollis</i>	Whiskered Yuhina
719	<i>Yuhina gularis</i>	Stripe-throated Yuhina
720	<i>Yuhina nigrimenta</i>	Black-chinned Yuhina
721	<i>Yuhina occipitalis</i>	Rufous-vented Yuhina
722	<i>Zootheracitrina</i>	Orange-headed Thrush
723	<i>Zootheradauma</i>	Scaly Thrush
724	<i>Zootheradixoni</i>	Long-tailed Thrush
725	<i>Zootheramollissima</i>	Plain-backed Thrush
726	<i>Zootheramonticola</i>	Long-billed Thrush
727	<i>Zosteropsalpebrosus</i>	Oriental White-eye
728	<i>Turdusdissimilis</i>	Black-breasted Thrush
729	<i>Cyanoptilacyanomelana</i>	Black-and-White Flycatcher
730	<i>Erythruraprasina</i>	Pin-tailed Parrotfinch
731	<i>Chlidoniashybrida</i>	Whiskered Tern
732	<i>Muscicaparuficauda</i>	Rusty-tailed Flycatcher
733	<i>Psittaculacyanocephala</i>	Plum-headed Parakeet
734	<i>Todiramphuscloris</i>	Collared Kingfisher
735	<i>Pluvialissquatarola</i>	Grey Plover
736	<i>Eremophilaalpestris</i>	Horned Lark
737	<i>Bucephala clangula</i>	Common Goldeneye
738	<i>Pellorneumtickelli</i>	Buff-breasted Babbler
739	<i>Botaurus stellaris</i>	Great Bittern
740	<i>Geokichlawardii</i>	Pied Thrush
741	<i>Sternulaalbifrons</i>	Little Tern
742	<i>Pitta brachyura</i>	Indian Pitta
743	<i>Rallinaeurizonoides</i>	Slaty-legged Pitta
744	<i>Pastor roseus</i>	Rosy Starling



NATIONAL FOREST INVENTORY FIELD FORM

Wildlife (Bird) Data Form

Department of Forests and Park Services

Forest Resources Management Division

F11/18

1. CP No
2. Plot Name Elbow North East (Tick the appropriate plot)
3. Date / / 4. Time / hrs

Wildlife (Bird) Data Form (Data to be collected from all three plots)
(within 25 m around PC)

SN	Scientific name	Local name	Species Identity		Wildlife Evidence (Enter code)	Gender (Tick appropriately)			Group size	Remarks
			Certain	Doubtful		Male	Female	Not known		

SN	Wildlife evidence (Bird)	Code	SN	Wildlife evidence	Code
1	Direct sighting	BE1	6	Feathers	BE6
2	Sound/calls	BE2	7	Footprints	BE7
3	Droppings	BE3	8	Tracks/Paths	BE8
4	Eggs	BE4	9	Nest/Burrows	BE9
5	Skeleton/Cadaver	BE5	10	Not relevant	BE10

1.5.4.2.13 Reptile data

The presence- absence information of reptiles shall be collected from all three plots. Follow the steps and description provided in the Table 1.28 to complete form F12/F18 with **reptile data** (Table 1.29).

Table 1.28: Collection of reptile data

SN	Data Item	Description	Instruction
1	CP No.	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. <i>Note: Paper Field Forms are to be used only if the Android Tablet does not function in the field.</i>
2	Plot name	Refers to one of the three plots (Elbow, East or North Plot) of cluster plot	Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3	Reptiles sighting	Refers to whether or not reptile was sighted, either through direct or indirect evidence, within 25 m around from the PC.	Record “Yes” if bird was sighted, else “No”, from the drop-down list on electronic field form or tick appropriately on the paper field form.
4	Reptiles sighted	Refers to identity of the particular bird that has been sighted or identified. The list of reptiles will be provided in Table 1.29.	1. Select and record the reptile from the drop-down list on electronic field form or record on the paper field form. 2. Select “None” if no reptile is observed.
5	Species identity	Refers to the level of confidence on the identification of reptiles by the crew and can be categorized as: 1. Certain: when one is very sure that the identification is correct 2. Doubtful: When one is not very confident about the identification 3. Not relevant	Depending on the level of confidence on identification, choose and record from the drop-down list on electronic field form or record on paper field form.
6	Evidence Type	Refers to the type of evidence using which the reptile is identified. The categories are: 1. Direct sighting 2. Sound/calls 3. Dung 4. Skin 5. Skeleton/Cadaver 6. Footprints/pugmarks 7. Tracks/Paths 8. Burrow 9. Den 10. Not relevant	1. Select the appropriate evidence type and record by selecting from the drop-down list on electronic field form or selecting relevant evidence type on paper field form. 2. “Not relevant” should be selected when there are no reptiles sighted or observed within the 25 m radius.
7	Gender	Refers to the gender of the reptile sighted.	1. If gender can be determined, record as determined. 2. If gender cannot be determined, then record as “Not known”.

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8	Group size	Refers to the number of individuals of the same species sighted or observed.	1. Record the number of individuals of same species sighted (as identified from direct sighting) 2. It may not be possible to determine the number from indirect evidences, so record “approximate” size
9	Remarks	Refers to any other relevant information provided by crew.	The Crew Leader or the data recorder shall add any additional information on reptiles

Table 1.29: Reptiles of Bhutan and species code

SN	Scientific name	Common name
1	<i>Ahaetullanasuta</i>	common vine snake
2	<i>Ahaetullaprasina</i>	Asian vine snake
3	<i>Amphiesmaparallelum</i>	
4	<i>Amphiesmaplatyceps</i>	Himalayan keelback
5	<i>Amphiesmasieboldii</i>	Sikkim keelback
6	<i>Amphiesmastolatum</i>	Buff striped keelback
7	<i>Boiga cyanea</i>	Green Cat Snake
8	<i>Boiga gokool</i>	Arrowback tree snake
9	<i>Boiga multifasciata</i>	Many-banded tree snake
10	<i>Boiga ochracea</i>	Tawny cat snake
11	<i>Chrysopeleaornata</i>	Flying tree snake
12	<i>Coelognathus radiatus</i>	Copperhead rat snake
13	<i>Dendrelaphiscyanochloris</i>	Wall's Bronzeback
14	<i>Dendrelaphispictus</i>	Painted bronzeback
15	<i>Dendrelaphistristis</i>	Tree snake
16	<i>Dinodongammiei</i>	Sikkim False Wolf Snake
17	<i>Dinodonseptentrionalis</i>	Wolf snake
18	<i>Dryocalamusdavisonii</i>	
19	<i>Enhydrisenhydris</i>	Rainbow water snake
20	<i>Lycodonaulicus</i>	Indian wolf snake
21	<i>Lycodonfasciatus</i>	Banded wolf snake
22	<i>Lycodonjara</i>	Yellow-speckled wolf snake
23	<i>Oligodonalbocinctus</i>	Light-barred kukri snake
24	<i>Oligodoncinereus</i>	Black cross-barred kukri snake, golden kukri snake
25	<i>Oligodoncyclurus</i>	Cantor's Kukri Snake
26	<i>Oligodon dorsalis</i>	Bengalese kukri snake or Gray's kukri snake
27	<i>Oligodonjuglandifer</i>	Walnut kukri snake
28	<i>Oreocryptophisporphyracea</i>	Black-banded trinket snake, red bamboo snake, Thai bamboo rat snake or red mountain racer
29	<i>Orthriophis cantoris</i>	
30	<i>Orthriophistaeniurus</i>	Beauty ratsnake
31	<i>Psammodynastespulverulentus</i>	Common mock viper
32	<i>Psedoxenodonmacrops</i>	Large-eyed bamboo snake or Chinese false cobra
33	<i>Ptyaskorros</i>	Chinese ratsnake or Indo-Chinese rat snake
34	<i>Ptyasnigromarginata</i>	Green rat snake
35	<i>Ptyas mucosa</i>	Oriental ratsnake, Indian rat snake
36	<i>Rhabdophishimalayanus</i>	Orange-collared keelback
37	<i>Rhabdophissubminiatus</i>	Red-necked keelback
38	<i>Sibynophiscollaris</i>	Common many-toothed snake
39	<i>Sibynophissagittarius</i>	Cantor's black-headed snake.
40	<i>Trachischium leave</i>	Olive Oriental Slender Snake
41	<i>Trachischiumguentheri</i>	Rosebelly worm-eating snake
42	<i>Trachischiumtenuiceps</i>	Yellowbelly worm-eating snake

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43	<i>Xenochrophis piscator</i>	Asiatic water snake
44	<i>Bungarusbungaroides</i>	Northeastern hill krait
45	<i>Bungarusfasciatus</i>	Banded krait
46	<i>Bungarusniger</i>	Greater black krait
47	<i>Najakaouthia</i>	Monocellate cobra
48	<i>Najanaja</i>	Spectacled cobra, Asian cobra, or binocellate cobra
49	<i>Ophiophagus hannah</i>	King cobra
50	<i>Sinomicrurusmacclellandii</i>	MacClelland's Coral Snake
51	<i>Python molurus</i>	Indian python or Indian rock python
52	<i>Python bivittatus</i>	Burmese python
53	<i>Ramphotyphlopsbraminus</i>	Brahminy Blindsnake
54	<i>Typhlopsjerdonii</i>	Jerom's worm snake
55	<i>Typhlopsdiardii</i>	Diard'sBlindsnake
56	<i>Daboia russelii</i>	Russel's viper
57	<i>Gloydiushimalayanus</i>	Himalayan pit viper or Himalayan viper
58	<i>Ovophismonticola</i>	Mountain pit viper
59	<i>Protobothropsjerdonii</i>	Jerdon's Pit viper
60	<i>Trimeresurusjerdonii</i>	Pit viper
61	<i>Trimeresurusalbolabris</i>	White-lipped pit viper
62	<i>Trimeresuruserythrus</i>	Red-tailed bamboo pitviper
63	<i>Protobothropshimalayanus</i>	Himalayan pit viper
64	<i>Calotesbhutanensis</i>	Forest Lizard
65	<i>Calotesjerdonii</i>	Indo-Chinese forest lizard or Jerdon's forest lizard
66	<i>Calotes versicolor</i>	Oriental garden lizard
67	<i>Japaluraravariiegata</i>	Variegated Mountain Lizard
68	<i>Ophisaurusgracilis</i>	Asian glass lizard
69	<i>Cyrtodactyluskhasiensis</i>	Khasi Hills bent-toed gecko
70	<i>Gekko gekko</i>	Tokay gecko
71	<i>Hemidactylus brookii</i>	Brooke's house gecko or spotted house gecko
72	<i>Hemidactylus frenatus</i>	Common house gecko
73	<i>Hemidactylus platyurus</i>	Flat-tailed house gecko
74	<i>Asymblepharussikimmensis</i>	Sikkim ground skink or bronzy-brown skink
75	<i>Eutropiscarinata</i>	Golden skink
76	<i>Eutropismaculata</i>	Bronze grass skink
77	<i>Eutropisquadratilobus</i>	
78	<i>Riopapunctata</i>	
79	<i>Sphenomorphus indicus</i>	Himalayan litter skink
80	<i>Sphenomorphus maculatus</i>	Spotted forest skink
81	<i>Varanus bengalensis</i>	Bengal monitor or common Indian monitor
82	<i>Varanus flavescens</i>	Yellow monitor or golden monitor



NATIONAL FOREST INVENTORY FIELD FORM

Wildlife (Reptile) Data Form

Department of Forests and Park Services

Forest Resources Management Division

F12/18

1. CP No

2. Plot Name Elbow ☐ North ☐ East ☐ (Tick the appropriate plot)

3. Date / / 4. Time / hrs

Wildlife (Reptile) Data Form (Data to be collected from all three plots)

(within 25 m around PC)

SN	Scientific name	Local name	Species Identity		Wildlife Evidence (Enter code)	Gender (Tick appropriately)			Group size	Remarks
			Certain	Doubtful		Male	Female	Not known		

SN	Wildlife evidence (Reptile)	Code	SN	Wildlife evidence	Code
1	Direct sighting	RE1	5	Skin	RE5
2	Sound/calls	RE2	6	Tracks/Paths	RE6
3	Eggs	RE3	7	Nests/Burrows	RE7
4	Skeleton	RE4	8	Not relevant	RE8

1.5.4.2.14 Coarse Woody Debris Data

Once the work (data collection) is completed in Elbow Plot, the Crew will move to North Plot making a transect of 50 m to collect data. Similarly, upon completion of the data collection in the North Plot, the Crew will move back to Elbow Plot and, from the Elbow Plot, make a 50 m transect to East Plot. Coarse Woody Debris (CWD) data will be collected from these two 50 m transects (Elbow to North and Elbow to East).

All fallen dead tree bole, large branches and other woody pieces that are severed from their original source of growth shall be considered as CWD. **CWD shall not include standing dead trees, stumps, separated barks, non woody pieces, roots or the part of the bole below the root collar** (Waddell, 2002). Woody debris of more than 10 cm diameter at the point of intersection with transect shall be sampled. Not all CWD shall be measured but only those, which meet the following criteria shall be tallied for measurement:

- The central longitudinal axis of CWD must intersect with transect
- Must have minimum 10 cm diameter at point of intersect with transect
- Length of the piece is at least 1m or greater.
- The piece should not be decayed to the point of having no structural integrity.

If a woody debris of 10 cm minimum diameter is found along the transect but does not intersect with the transect, the CWD shall be **ignored**. Any CWD less than 1 m shall also be ignored even if it intersects the transect (Refer to Figure 1.5)³.

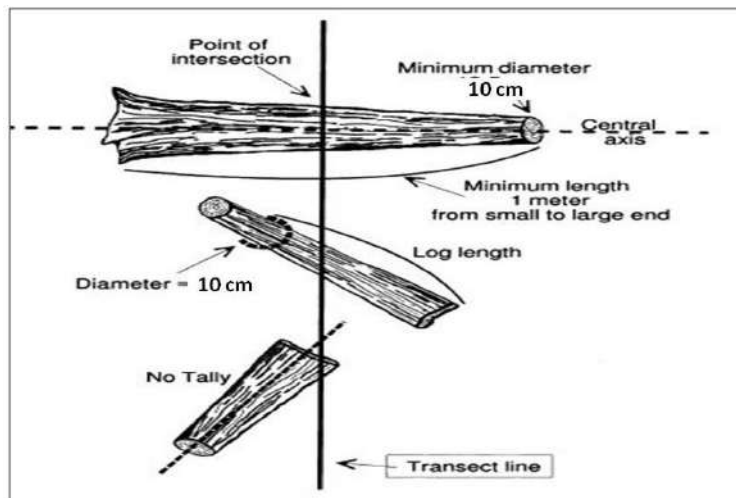


Figure 1.5 Condition for tally of CWD for measurement

³ Illustration source: Waddell, Karen L. (2002), *Sampling coarse woody debris for multiple attributes in extensive resource inventories*, *Ecological Indicators*

In case of CWD, where the main bole as well as the branches intersect with the transect and if the intersecting segments has more than 10 cm at the point of intersection, then the segments shall be considered as separate pieces.

In case of forked trees, the forked segment with largest diameter shall be considered as the main bole and therefore the length shall be measured from tip of the fork to the end of the log. For the smaller segment (having smaller diameter), it shall be recorded as the second piece and the length shall be measured from the fork tip to the point where this piece separates as a fork (Refer to Figure 1.6).

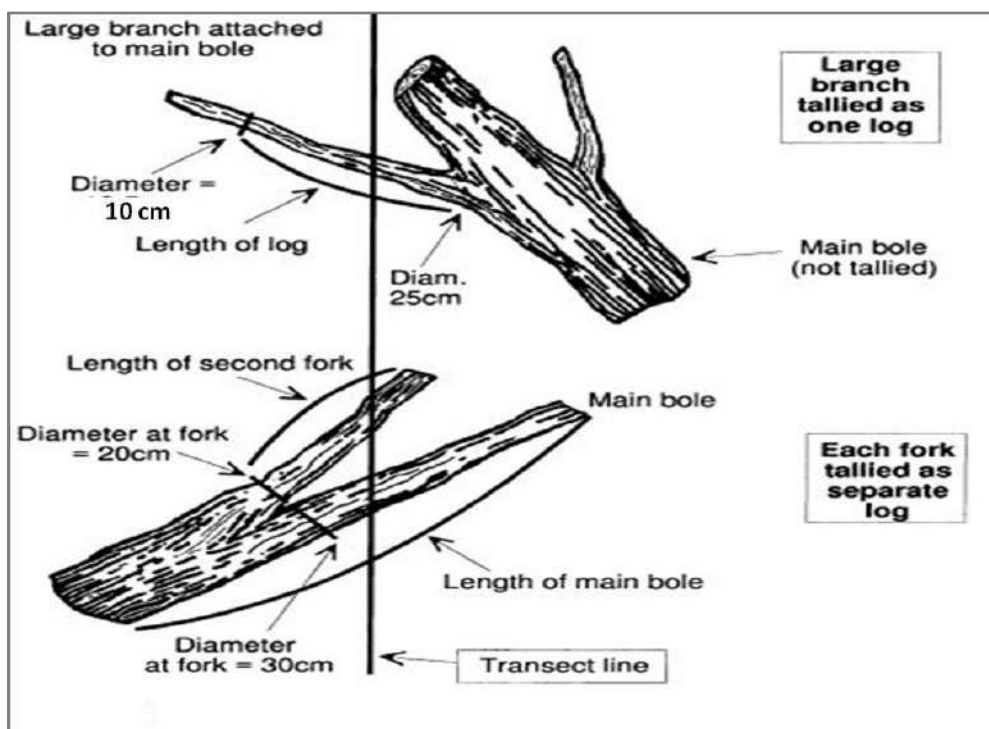


Figure 1.6: Measuring of forked and branched CWD

For every tallied CWD piece and segments, the following data and measurements shall be recorded in Form No. F13/F18 based on description provided in Table 1.30 using the tree species list in Table 1.19 .

Table 1.30: Collection of CWD data

SN	Data	Description	Instruction
1.	CP No	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. Note: Paper Field Forms are to be used only if the Tablet does not function in the field.
2.	Plot Name	Refers to one of the two plots (East or North Plot) of cluster plot to which transect is moving.	Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3.	CWD Scientific or Botanical name	Refers to scientific or botanical name which conforms to the International Code of Botanical Nomenclature (ICBN)	1. If the CWD can be identified, record the botanical name of the tallied piece or else record it by common name or local name. 2. List of botanical names shall appear as drop-down list on electronic field form. But on the paper field form, record manually.
4.	Diameter large end	Refers to the diameter of the CWD at large end.	Record the diameter of large end in centimeters to nearest one decimal place.

5.	Diameter intersection	Refers to the diameter of the CWD at point of intersection with transect.	Record the diameter of CWD at the point of intersection in centimeters to nearest one decimal place.
6.	Diameter small end	Refers to the diameter of the CWD at small end.	Record the diameter of small end of CWD in centimeters to nearest one decimal place.
7.	Length of intersection	Refers to the length of CWD from the small end side to the point of intersection	Record the length in meters to nearest one decimal place
8.	CWD length	Refers to the total length of the CWD	Record the length in meters to nearest one decimal place.
9.	CWD width	Refers to the perpendicular distance covered by the CWD to the transect. Refer Figure 1.7	Record the width of CWD in meters to nearest one decimal place.

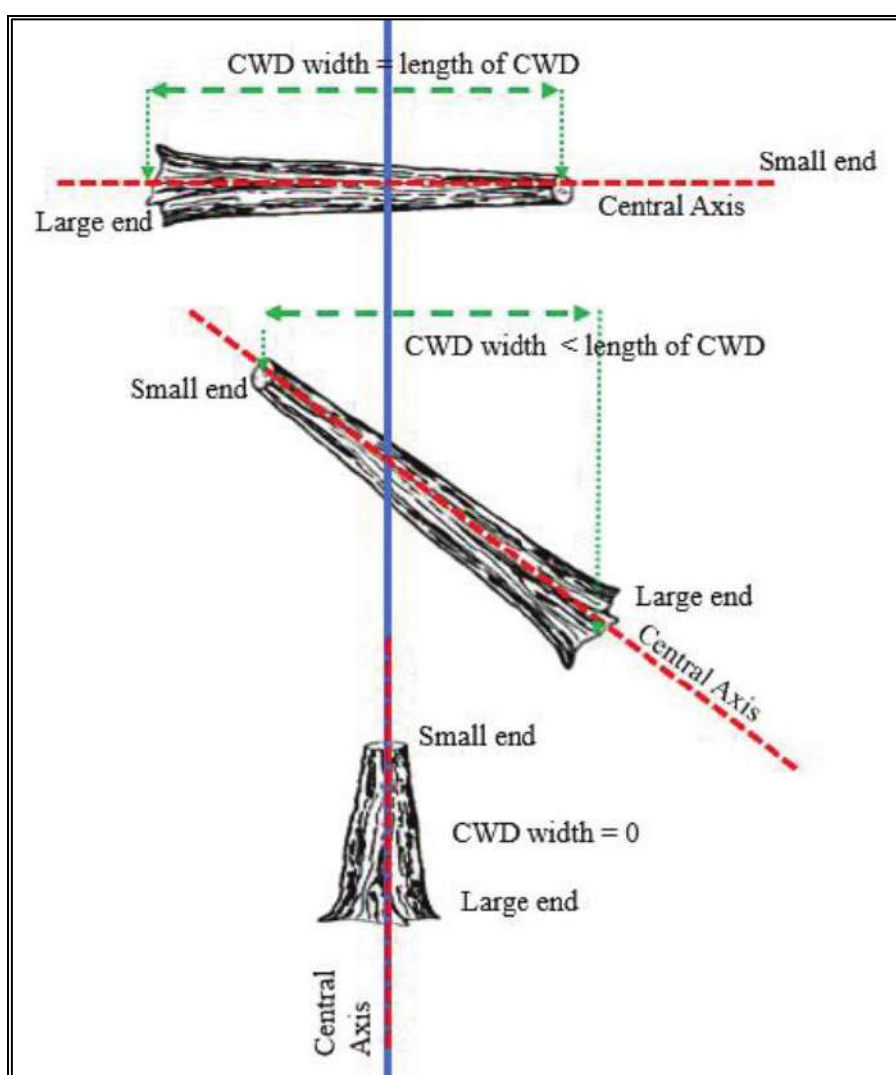


Figure 1.7 Measuring the Width of CWD

Guidelines for decay class

Decay Class	Structural integrity	Texture	Color of Wood	Presence of Invading Roots	Branches
1	Sound, freshly fallen, intact logs	Intact, no rots, conks of stem decay absent	Original color	Absent	If branches are present, fine twigs are still attached and have tight bark
2	Sound	Mostly intact, sapwood partly soft (starting to decay) but can't be pulled apart by hand	Original color	Absent	If branches are present, many fine twigs are gone and remaining fine twigs have peeling bark
3	Heartwood sound, piece supports its own weight	Hard. Large pieces, sapwood can be pulled apart by hand or sapwood absent	Reddish brown or original color	Sapwood only	Branch stubs will not pull out
4	Heart wood rotten, piece does not support its own weight, but maintains its shape	Soft, small blocky pieces, a metal pin can be pushed into heartwood	Reddish or light brown	Throughout	Branch stubs will pull out
5	None, piece no longer maintains its shape, it spreads out on ground	Soft, powdery when dry	Red-brown to dark brown	Throughout	Branch stubs and pitch pockets have usually rotted down

Forest Resources Management Division

1. CP No ☐ ☐ ☐ ☐

2. Plot Name Elbow ☐ North ☐ East ☐ (Tick the appropriate plot)

3. Date

4. Time hrs

[illegible]

Forest Resources Management Division

1. CPN₀ ☐ ☐ ☐ ☐

2. To Plot Name North ☐ East ☐ (Tick the appropriate plot)

3. Date

4. Time hrs

[illegible]

1.5.4.2.15 Fine Woody Debris

Fine Woody Debris (FWD) is defined as those woody litters comprising the down and dead tree bole, branches and other woody pieces severed from original source of growth; and has diameter of 1 cm -10 cm. FWD data shall be collected only if FWD intersects two numbers of 4 m transects located within the Elbow plot at each cluster site. Two transects of 4 m is laid at the outer ends of the two 12.62 m radius Elbow. Data recording shall be done as per the following criteria:

1. Lay two numbers of 4 m transects, located towards outer end of Elbow plot
2. Record the botanical name of FWD encountered along the transect if possible.
3. FWD data shall be collected only if the diameter of FWD at intersection is less than 10 cm.
4. Follow the protocols for measurement of diameter (large, intersection and smaller end); and length of intersection and total length of fine woody debris, as defined for Coarse Woody Debris (CWD).
5. Also measure width of FWD following the protocol.

Note: Cones, bark, wood fragments are not included typically in FWD.

SN	Data Item	Description	Instruction
1.	CP No	This is the unique identification number given to Cluster Plot. Eg. CP0001	Select correct CP No from the drop-down list on electronic field form or record the correct CP No, if the paper field form is used. Note: Paper Field Forms are to be used only if the Samsung Tablet does not function in the field.
2.	Plot Name	Refers to one of the two plots (East or North Plot) of cluster plot to which transect is moving.	Select and record correct Plot No. from the drop-down list on electronic field form or tick appropriate Plot No. if the paper field form is used.
3.	FWD Scientific or Botanical name	Refers to scientific or botanical name which conforms to the International Code of Botanical Nomenclature (ICBN)	1. If the FWD can be identified, record the botanical name of the tallied piece or else record it by common name or local name. 2. List of botanical names shall appear as drop-down list on electronic field form. But on the paper field form, record manually.
4.	Diameter large end	Refers to the diameter of the FWD at large end.	Record the diameter of large end in centimeters to nearest one decimal place.
5.	Diameter intersection	Refers to the diameter of the FWD at point of intersection with transect.	Record the diameter of FWD at the point of intersection in centimeters to nearest one decimal place.
6.	Diameter small end	Refers to the diameter of the FWD at small end.	Record the diameter of small end of FWD in centimeters to nearest one decimal place.
7.	Length of intersection	Refers to the length of FWD from the small end side to the point of intersection	Record the length in meters to nearest one decimal place
8	FWD length	Refers to the total length of the FWD	Record the length in meters to nearest one decimal place.
9	FWD width	Refers to the perpendicular distance covered by the FWD to the transect. Refer Plate 8 for guidance.	Record the width of FWD in meters to nearest one decimal place.

1.6 Aboveground Understorey and Soil Carbon

1.6.1 Understorey and Soil Carbon Sampling

Data and samples of Shrubs, Herbs, Organic Surface Litters and Soil shall be collected for the laboratory analysis of carbon content following the methodology developed and adopted during the first NFI. The step-by-step instructions to collect the data and samples is detailed out in the subsequent sections.

1.6.1.1 General equipment and supplies

Following are some of the general equipment required for the field work;

1. Global Positioning System (GPS) - for locating NFI plot and collecting data
2. Compass - for direction
3. Clinometer - for slope assessment
4. 50 meter measuring tape - for distance measurement
5. Knife - for multipurpose use

Equipment specific to each carbon pool are listed separately in the relevant chapters.

Note: The Field crews may suggest and add equipment as needed to improve efficiency of the field work.

1.6.1.2 Plot Design for Aboveground Understorey Carbon Pools

The carbon plots shall be laid 20 meters south-west of Elbow plot of NFI (Figure 1.8 and Figure 1.9). The plots shall be positioned so as to minimize any disturbance from sampling done in this plot that may affect any future tree growth in North, East and Elbow overstorey plots in each cluster site.

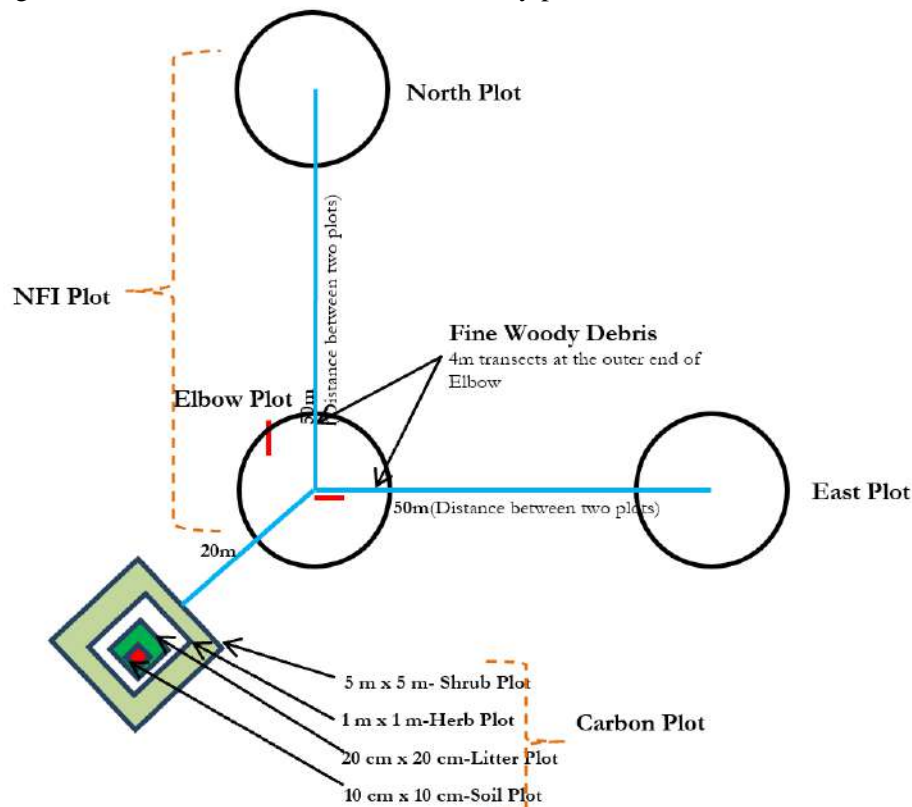


Figure 1.8: Schematic arrangement of the plots for assessing carbon stock

A 5 m x 5 m plot shall be laid 20 m away towards the South-west of Elbow plot of NFI cluster plot to collect data and samples for shrubs. Subsequently, a 1 m x 1 m plot shall randomly be laid within 5 m x 5 m shrub plot to collect samples and data for Herbs.

The surface organic litter data and samples shall be collected from 20 cm x 20 cm plot which shall randomly placed within herb plot. Once the surface organic litter sample is collected, the same plot shall be used for collecting soil sample. 3 separate soil samples shall be collected by excavation method, that is, from 0-10 cm depth, from 10-20 cm depth and 20-30 cm depth, using 10 cm x 10 cm soil frame.

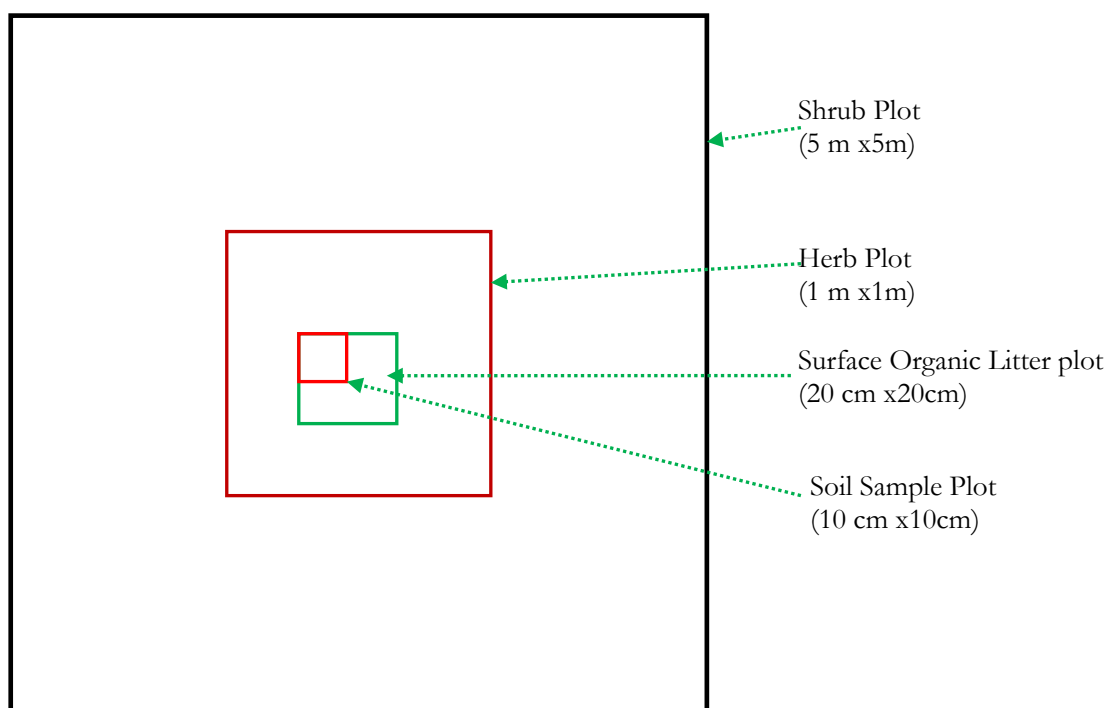


Figure 1.9: Carbon plot (for collection of Shrub, Herb, Litter and Soil sample)

1.6.1.3 Shrubs Sampling

1.6.1.3.1 Equipment and supplies

The equipment needed for sampling shrubs in the field are:

1. Weighing balance-for weighing shrub samples
2. Pruning shears- for cutting shrubs
3. Rite-in-Rain notebooks- for recording data
4. Calipers- for measuring tree seedling diameters
5. Labeling pens - for labelling samples
6. 0.5 Mechanical pencils- for recording data
7. Flagging Tapes- for demarcating boundaries
8. Tarpaulin with grommet- for collecting and weighing samples
9. Stitched Muslin bags (40 cm x 60 cm)- for transporting shrub samples
10. Polyester bags- for transporting samples
11. Ropes- for tying and weighing the tarpaulin containing samples and for suspending a scale from the rope to weigh larger masses, as may be necessary.

1.6.1.3.2 Sample Plot Design

Lay a 5 m x 5 m Shrub plot 20 m North-east of Elbow plot center of NFI Cluster plot.

- Locate the NFI Elbow plot center using Global Positioning System (GPS).
- Move 20 meters away towards South -West direction from elbow plot center at 225° azimuth and mark the point with stick.
- Take fore bearing and back bearing of 315° NW and 135° SE
- respectively to establish a 5 m x 5 m dimension plot. Move 2.5 m in both directions and demarcate plot boundary with flagging tapes.
- Then, move 5 meters away towards South -West direction from both the end/plot boundary at 225° azimuth and demarcate plot boundary with flagging tapes.
- Use compass for direction, clinometer measuring tape for to measure distance.

1.6.1.3.3 Shrub Sample

1. Shrub is a single or multi-stem woody perennial plant, generally more than 0.5 m and less than 5 m high at maturity without a definite crown.
2. Any tree species of diameter less than 5 cm present in the 5 m x 5 m shrub plot shall be sampled as shrubs.

1.6.1.3.4 Data collection

1.6.1.3.4.1 Sampling

Once the plot is established, record the following general information in the field form (either paper field form or electronic field form No. F14/F18 using description provided in *Table 1.31*, *Table 1.32* and *Table 1.33*).

Table 1.31: Shrub Sampling

No	Data items	Description/Definition	Instruction
1	CP No	Refers to unique identification number given to Cluster Plot. Eg. CP0001	Select correct CPNo from dropdown list (in electronic form). Note: If paper form is used, record the correct CPNo.
2	Dzongkhag	Refers to name of the Dzongkhag in which the cluster plot is located.	Select correct name of the Dzongkhag from dropdown list (in electronic form). If paper form is used, record the correct name of the Dzongkhag.
3	Gewog	Refers to name of the Gewog in which the cluster plot is located.	Select correct name of the Gewog from dropdown list (in electronic form). If paper form is used, record the correct name of the Geog.
4	Crew Leader	Refers to name of the Leader of crew collecting the data.	Select correct name of the Crew Leader from dropdown list (in electronic form). If paper form is used, record the correct name of the Crew Leader.
5	Date of Collection	Refers to the date on which data is collected.	Record the date
6	Scientific or Botanical name	Refers to the scientific name of the shrub which conforms to the International Code of Botanical Nomenclature (ICBN)	Identify and record the botanical name of the shrub species observed within the 5 m x 5 m plot.
7	Cover percent	Refers to percentage of plot area (5 m x 5 m) covered by shrub.	Ocularly estimate the extent of coverage of shrub within 5 m x 5 m plot and express it in terms of percentage. Record the percentage figure.
8	Shrub height	Refers to the predominant height of the shrub in the plot	Measure the height of the shrubs and record predominant height as shrub height. Record the shrub height in meters.

Note: The recording of information on species, cover percent and height shall be repeated for all shrub species found within the plot. This is important for site characterization. Unknown species may be indicated as “Unknown 1”, “Unknown 2” etc. The Crew shall collect shrub samples as follows;

1. After filling the data form above, harvest all the shrubs at ground level within the 5m X 5m plot taking care not to cause damage to herbs and litter. Whether or not the shrub falls IN or OUT of the plot is determined by position of the base or root of the plant, i.e if base of the plant is inside the 5 m x 5 m plot boundary, it is considered IN, but if the base is outside the plot boundary, it is considered OUT even if shrub is partially or fully leaning and found inside the plot boundary.
2. Place all the harvested shrubs in a tarpaulin or a bag of known weight (or tie together by rope).
3. Weigh the collected samples (making sure that mass of tarpaulins or bags or ropes are accounted for).
4. Record the wet weight of the collected shrubs in kilograms (kg) to the nearest one decimal place.
5. If the total wet weight of the shrub sample equals to or is less than 2 kilograms, bring the entire shrub sample to the laboratory for analysis. Then record the percentage of samples taken as 100%.
6. If the wet shrub sample weighs **more than 2 kilograms**, then subsample the shrub. However, minimum weight of the shrub sample must be **2 kilograms** and then accordingly record the percentage of subsample taken from total shrub sample. For instance, if the total wet weight of shrub is 8 kilograms and minimum of 2 kilograms of shrub sample is required to be brought to laboratory for analysis, then the percentage of shrub sample being subsampled is 25%. That is

$$\begin{aligned}
 \text{Total wet weight of shrub sample} &= 8 \text{ kgs} \\
 \text{Minimum weight of subsample} &= 2 \text{ kgs} \\
 \text{Therefore, per cent subsampled} &= (2/8) \times 100 = 25\%
 \end{aligned}$$

Table 1.32: Shrub Sample Weighing

Data Items	Description	Instruction
Total wet weight of the shrub sample	This refers to the gross wet weight of the shrub sample being collected from 5 m x 5 m plot.	Weigh the entire shrub sample Subtract the weights of tarpaulin or rope or bags, used for measuring shrub sample. Record the wet weight in kilograms (kg) to nearest one decimal place. Example: 2.5 Kilograms (kgs)

1.6.1.3.4.2 Subsampling

For subsampling, follow the protocols mentioned below;

1. Remove a representative subsample from harvested shrub sample (that represents the various plant tissues in that sample in an approximate weight-proportional manner). That is, if shrub species A, B and C exist in about 60, 30, and 10% biomass or volume ratios; then take subsample of 60% of A (including stems, branches and leaves of A), 30 % of B (including stems, branches and leaves of B), and 10% of C (including stems, branches and leaves of C) of the shrub samples.
However, in a highly productive site, even this might be too large a subsample to be taken to laboratory. In that case, further subsampling is recommended. Then take 6% of A, 3% of B and 1% of C of subsample in weight-proportional manner.
2. Weigh the subsample (making sure that mass of tarpaulins or bags or ropes are accounted for).
3. Record the wet weight of the subsample in the field form.

Table 1.33: Sub-sampling shrub sample

Data Items	Descriptions	Instructions
Weight of Subsample of shrubs	Refers to the wet weight of the subsample.	Weigh the subsampled samples Record the weight of the subsample in kilogram (kg) to nearest one decimal place.
Percentage of Subsample	Refers to the percentage of subsamples taken from the total gross wet weight of the samples.	Record the percentage of subsample taken

1.6.1.3.4.3 Labeling and Bagging

1. Carefully, bag the subsample of shrubs in muslin bag of 40 cm x 60 cm dimension.
2. It is very important to ensure that the bagged samples are labeled properly and correctly.
For shrubs, follow this standard labeling format: SHRUBS_CPNo. (eg. SHRUBS_CP0001). CPNo. stands for the four-digit cluster plot number unique for each cluster plot of NFI.
3. Additional information stating the date of collection and Collector's ID may be added on the label.
4. Then bag the subsample of shrubs contained in muslin bag, in the polyester sack(s).
5. The polyester sack(s) shall bear CP No., Date of collection, and Crew ID.

1.6.1.3.4.4 Transfer and Processing of Samples

1. Carry the bagged samples to the base camp and store in cool dry tent or a place till it is possible to hand over the sample for laboratory analysis.
2. This representative sample shall then be oven dried in the laboratory and moisture determined to calculate dry mass per area of total shrub wet weight found in that 5 m x 5 m shrub plot



NATIONAL FOREST INVENTORY FIELD FORM
Carbon Data Form
SHRUB SAMPLING

F15/18

Department of Forests and Park Services
 Forest Resources Management Division

1. CP No
2. Dzongkhag (Mention name of the dzongkhag in which the plot is located)
3. Gewog (Mention name of the gewog in which the plot is located)
4. Crew Leader (Mention name of the Crew Leader collecting the data)
5. Date / / (Mention the date on which data is collected)

Shrubs Sampling Data Form (Sample and data to be collected from 5m x 5 m shrub plot)

SN	Scientific name	Cover percent (%)	Shrubs height (m)

6. Total wet weight of the shrub sample (Includes total weight of all shrubs sampled irrespective of species)
7. Wet weight of the shrub sub-sample (The wet weight of the subsampled shrubs)
8. Percentage of subsample taken (Percentage of wet weight subsampled from the total wet weight)

1.6.1.4 Herb Sampling

1.6.1.4.1 Equipment and supplies

The following equipment and supplies are required for sampling herbs;

1. Weighing balance-for weighing herb samples
2. Pruning shears- for cutting herbs
3. Rite-in-Rain notebooks – for recording data
4. Labeling pens – for labelling samples
5. 0.5 Mechanical pencils- for recording data
6. Flagging Tapes- for demarcating boundaries
7. Tarpaulin with grommet- for collecting and weighing samples
8. Stitched Muslin bags (30 cm x 40 cm)- for transporting herb samples
9. Polyester bags- for transporting samples
10. Ropes- for tying and weighing the tarpaulin containing samples and for suspending a scale from the rope to weigh larger masses, as may be necessary.

1.6.1.4.2 Sample plot design

Lay a 1 m x 1 m Herb plot *randomly* within the 5 m x 5 m shrub plot.

1. After collecting shrubs samples, lay a 1 m x 1 m plot within shrub plot. However, it shall be laid in such a way that it is *representative* of entire 5 m x 5 m plot.
2. Correct the slope with slope correction table.
3. Demarcate the plot boundary with flagging tape.

1.6.1.4.3 Herb sample

Herb is any soft-stem plant with height equal to or less than 1 m.

1.6.1.5.4 Data collection

1.6.1.5.4.1 Sampling

Once the herb plot is established, record the following general information in the field form F15/F18 (either paper field form or electronic field form using description provided in Table 1.34, Table 1.35 and Table 1.36).

Table 1.34: Herb sampling

No	Data items	Description	Instruction
1	CP No.	Refers to unique identification number given to the Cluster Plot. Example: CP0001	Select correct CP No. from dropdown list (in electronic form). If paper form is used, record the correct CP No.
2	Dzongkhag	Name of the Dzongkhag in which the cluster plot is located.	Select correct name of the Dzongkhag from dropdown list (in electronic form). If paper form is used, record the correct name of the Dzongkhag.
3	Gewog	Name of the Gewog in which the cluster plot is located.	Select correct name of the Gewog from dropdown list (in electronic form). If paper form is used, record the correct name of the Gewog.
4	Crew Leader	Name of the Leader of crew collecting the data.	Record name of Crew Leader.

5	Date of Collection	Refers to the date on which data is collected.	Record the date.
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NOTE: The recording of information on species, cover percent and height shall be repeated for all major herb species found within the plot. This is important for site characterization. Unknown species shall be indicated as "Unknown 1", "Unknown 2", etc.

The crew shall collect the herb samples as follows;

- Clip all grasses and herbs to ground level (causing least disturbance and compaction to the surface litter or the soil as they shall also need to be sampled).
- Place the clipped samples in a tarpaulin or bag of known weight (or tie with ropes).
- Weigh the herb sample (making sure that mass of tarpaulins or bags or ropes are accounted for).
- Record the wet weight of the clipped herbs in kilograms (kg) nearest to two decimal points.

Table 1.35: Weighing herb sample

No	Data Items	Description/Definition	Instruction
1	Total wet weight of the Herb sample	This refers to the gross wet weight of the Herb sample being collected from 1 m x 1 m plot.	Weigh the entire Herb sample Subtract the weights of tarpaulin or rope or bags, used for measuring Herb sample. Record the wet weight in kilograms (kg) to nearest one decimal places. Example: 2.5 Kilograms (kgs)

Note: Identification of herbs may be useful in the future to determine any species ranges shifts due to climatic variability and change which may have management implications down the road as forested ecosystem components change.

1.6.1.5.4.2 Subsampling

1. If herb sample from the 1 m x 1m plot is small and can be brought in its entirety, take the entire sample to laboratory.
2. Then record the wet weight of the entire sample and also record the percentage of sample taken as "100%" if samples weight upto 2 kgs.

But, if the sample is too large logistically (**more than 2 kilograms**) to transport to the laboratory, then large herb sample shall be subsampled;

1. Remove representative herb tissues (subsample) from the total herb sample.
2. Place the subsample in a tarpaulin or bag of known weights (or tie with ropes).
3. Weigh the subsample (making sure that mass of tarpaulins or bags or ropes are accounted for).
4. Record wet weight in kilograms nearest to two decimal points.
5. Bag the subsample for transport.

Table 1.36: Sub-sampling of herbs

No	Data Items	Descriptions	Instructions
1	Weight of Subsample of herb	Refers to the wet weight of the subsample.	Weigh the subsampled samples Record the weight of the subsample in kilogram (kg) to nearest one decimal places.
2	Percentage of Subsample	Refers to the percentage of subsamples taken from the total gross wet weight of the samples.	Record the percentage of subsample taken

Note: Generally, for Herb, it is expected that subsampling may not be required because in most sites the weight of the herb samples shall not exceed 2 kilograms. If at all there is need for subsampling, the percentage of subsample taken must be clearly reflected.

1.6.1.5.4.3 Labeling and bagging

1. Carefully, bag the subsample of herbs in muslin bag (30 cm x 40 cm)
2. It is very important to ensure that the bagged samples are labeled properly and correctly. For herbs, follow this standard labeling format: HERBS_CPNo. (eg. HERBS_CP0001). CPNo. stands for the four-digit cluster plot number unique for each cluster plot of NFI.
3. Additional information stating the date of collection and Collector's ID may be added on the label.
4. Then bag the subsample of herbs contained in muslin bag, in the polyester sack.
5. The polyester sack shall have CPNo, Date of collection, and Crew ID.

1.6.1.5.4.4 Transfer and processing of samples

1. Carry the bagged samples to the base camp and store in cool dry tent or place till it is possible to hand over the sample for laboratory analysis.
2. This representative sample shall then be oven dried in the laboratory and moisture determined to calculate dry mass per area of total wet weight of herbs found in that 1 m x 1 m herb plot.



NATIONAL FOREST INVENTORY FIELD FORM
Carbon Data Form
HERBS SAMPLING

F16/18

Department of Forests and Park Services
Forest Resources Management Division

1. CP No
2. Dzongkhag (Mention name of the dzongkhag in which the plot is located)
3. Gewog (Mention name of the gewog in which the plot is located)
4. Crew Leader (Mention name of the Crew Leader collecting the data)
5. Date / / (Mention the date on which data is collected)

Herbs Sampling Data Form (Sample and data to be collected from 1m x 1 m herbs plot)

SN	Scientific name	Cover percent (%)	Herbs height (m)

6. Total wet weight of the herbs sample (Includes total weight of all herbs sampled irrespective of species)
7. Wet weight of the herbs sub-sample (The wet weight of the subsampled herbs)
8. Percentage of subsample taken (Percentage of wet weight subsampled from the total wet weight)

1.6.1.5 Surface Organic Litter Sampling

1.6.1.5.1 Equipment and supplies

The following equipment and supplies are necessary for surface organic litter sample collection, namely;

1. 20 cm by 20 cm steel frame- for demarcating plot
2. Ziploc bag- for collecting litter sample
3. Tray-for collecting litter sample
4. Small trowel - for collecting litter sample
5. Pruning shears - for cutting through smaller roots
6. Saw-for cutting bigger roots
7. Battery operated digital balance - for weighing samples
8. Indelible ink markers- for marking the litter samples
9. Polyester sacks- for transporting the litter samples

1.6.1.5.2 Sample Plot Design

1. Randomly lay a 20 cm x 20 cm plot within 1 m x 1 m herb plot for collecting soil and litter samples.
2. Once herb sampling is completed, carefully place the frame within 1 m x 1 m plot that is representative of whole area.

1.6.1.5.3 Organic Litter Sample

For the purpose of carbon assessment, the surface organic litter is defined as surficial organic detritus having diameter less than 1 centimeter, which are un-decomposed or partially decomposed that can be readily identified as plant leaves, twigs, etc.

1.6.1.5.4 Litter Sampling and Data Recording

1.6.1.5.4.1 Sampling

1. Carefully place 20 cm x 20 cm frame randomly within 1 m x 1 m herb plot.
2. Press and drive down the frame manually until it drives in about 2-3 cm depth. Do not compress the organic sample being extracted or the surrounding organic material until an uncompressed depth (*i.e an average of 4 depths of litter measured, one on each side of the square sampling area from top of litter down to the top of mineral soil ensuring no organics are left on the mineral soil surface*) is measured.
3. Collect the entire surface litter sample in a volumetric procedure so that both mass and volume can be determined from the sample collected.
4. Using inward scooping motions, carefully remove the entire litter within the confines of the sampling frame. Discard all woody debris including pine cones, large pieces of bark and wood greater than 1 cm in diameter and also discard any rocks or pebbles encountered.
5. Once all litters are completely collected, measure the depth of litter. Record the readings in centimeter (cm) to **nearest two decimal places. Complete the form F16/F18** using description in *Table 1.37*

Table 1.37: Litter sampling

No	Data	Descriptions	Instructions
1	CP No.	Refers to the unique identification number given to the Cluster Plot. Example: CP0001	Select correct CP No. from dropdown list (in electronic form). If paper form is used, record the correct CP No.
2	Dzongkhag	Name of the Dzongkhag in which the cluster plot falls.	Select correct name of the Dzongkhag from dropdown list (in electronic form). If paper form is used, record the correct name of the Dzongkhag.
3	Gewog	Name of the Gewog in which the cluster plot is located.	Select correct name of the Gewog from dropdown list (in electronic form). If paper form is used, record the correct name of the Geog.
4	Crew Leader	Name of the Leader of crew collecting the data.	Record name of Crew Leader.
5	Date of Collection	Refers to the date on which data is collected.	Record the date.
6	Depth of Litter	Refers to the distance between the surface of the surficial organic litter and the top of the mineral soil.	<ol style="list-style-type: none"> 1. Starting from one side of the frame, using scale, measure from top of litter down to the top of mineral soil ensuring no organics are left on the mineral soil surface. 2. Similarly, repeat from the remaining three sides 3. Take average of four readings 4. Record the average reading to nearest one decimals place in centimeter. This is the depth of litter.

1.6.1.5.4.2 Labeling and bagging

1. Carefully, bag the litter sample in ziploc bag.
2. It is very important to ensure that the bagged samples are labeled properly and correctly.
For litter, follow this standard labeling format: LITTER_CPNo. (eg., LITTER_CP0001). CP No. stands for the four-digit cluster plot number unique for each cluster plot.
3. Additional information stating the date of collection and Collector's ID may be added on the label.
4. Then put the ziploc bag with litter sample in the polyester sack containing shrubs and herbs samples.
5. Polyester sack(s) shall have CPNo, Date, and Crew ID.

Note: This sample does not need to be weighed in the field as the whole sample shall be oven-dried for mass determination in laboratory by area and depth.



NATIONAL FOREST INVENTORY FIELD FORM

Carbon Data Form

LITTER SAMPLING (Litter plot -20 cm x 20 cm)

Department of Forests and Park Services

Forest Resources Management Division

F17/18

1. CP No

2. Dzongkhag

(Mention name of the dzongkhag in which the plot is located)

3. Gewog

(Mention name of the gewog in which the plot is located)

4. Crew Leader

(Mention name of the Crew Leader collecting the data)

5. Date

(Mention the date on which data is collected)

6. Depth of litter

cm

(Measure depth from all four sides of plot)

(Note: For litter all the samples are collected, bagged and brought to the laboratory to obtain dry weight)

1.6.1.6 Mineral Soil Sampling

Mineral soil samples are collected for 0-10 cm, 10-20 cm and 20-30 cm depths of soil pit using 10 cm x 10 cm dimension sampling frame.

1.6.1.6.1 Mineral Soil Horizon (for 0-10 cm, 10-20 cm and 20-30 cm depths)

Soil samples are collected from 10 cm x 10 cm soil sampling frame for Bulk Density and Soil Carbon content analysis.

1.6.1.6.2 Equipment and Supplies

The following equipment and supplies are necessary for soil sampling, namely;

1. 10 cm by 10 cm steel frame- for soil sampling
2. Small trowel- for collecting soil sample
3. Tray-for collecting soil sample
4. Pruning shears- for cutting through smaller roots
5. Saw- for cutting through bigger roots
6. Battery operated digital balance- for weighing soil samples

1.6.1.6.3 Sample Plot Design

Place 10 cm x 10 cm steel frame within the 20 cm x 20 cm frame laid for surface litter carbon determination. The soil sampling has to be done only after surface organic litter is completely collected.

- ✓ Place 10 cm x 10 cm frame in the north-west quadrant of the 20 cm x 20 cm frame.

Cautionary Note: *However, if the plot falls on a rock or stream or water, then shift the plot but within 20 cm x 20 cm frame and collect the samples.*

- ✓ Carefully drive the frame about 2-3 cm depth manually.

1.6.1.6.4 Soil Sampling

1.6.1.6.4.1 Sampling

1. Ensure that surface organic litter is collected completely.
2. Using inward scooping motion, carefully excavate soil with the help of a small trowel.
3. Excavation is done in a volumetric procedure, up to 10 cm depth. Do not throw away rocks if encountered.
4. For rocky, sandy and/or wet soils, follow instruction as defined in 0 1.6.1.6.5 Working with Problem soils.
5. For plot falling in steep terrain, measure 10 cm depth from the center of the plot. The readings on uphill side shall be slightly greater than 10 cm whereas the reading for downhill side shall be slightly less than 10 cm but average depth should be 10 cm.
6. Cut the overlapping roots encountered, using pruning shear or saw from inner surface of the frame.
7. Every scooped soil should be put in the tray
8. Divide the excavated sample into two halves; one for Bulk Density (BD) and other for soil Carbon Content (CC) analysis.
9. Weigh and record the wet weights of the two samples
10. Complete the form F17/F18 with help of description in *Table 1.38*

Table 1.38: Mineral soil sampling

No	Data Items	Descriptions	Instructions
1	CPNo	Refers to unique identification number given to the Cluster Plot. Example: CP0001	Select correct CPNo from dropdown list (in electronic form). If paper form is used, record the correct CPNo.
2	Dzongkhag	Name of the Dzongkhag in which the cluster plot is located.	Select correct name of the Dzongkhag from dropdown list (in electronic form). If paper form is used, record the correct name of the Dzongkhag.
3	Gewog	Name of the Gewog in which the cluster plot falls.	Select correct name of the Gewog from dropdown list (in electronic form). If paper form is used, record the correct name of the Geog.
4	Crew Leader	Name of the Leader of crew collecting the data.	Record name of Crew Leader.
5	Date of Collection	Refers to the date on which data is collected.	Record the date.
6	Wet weight of sample for Bulk Density analysis	Refers to the wet weight of the soils sample taken from 10 cm x 10 cm soil frame for analyzing Bulk Density.	Weigh the wet weight of soil sample for BD. Record the weight in kilograms (kg) to the nearest one decimal places
7	Soil Layer	Refers to the layer (0-10, 10-20 or 20-30 cm depth) from which sample for BD analysis is collected.	Choose 0-10 cm, 10 -20 cm and 20 - 30 cm if the sample has been collected from 0 -10 cm layer, 10-20 cm layer and 20 – 30 cm layer respectively.
8	Wet weight of sample for Carbon Content analysis	Refers to the wet weight of the soils sample taken from 10 cm x 10 cm soil frame for analyzing Carbon Content.	Weigh the other half of the soil sample for CC. Record the weight in Kilogram (kg) to the nearest one decimal place.
9	Soil Layer	Refers to the layer (0-10, 10-20 or 20-30 cm depth) from which sample for CC analysis is collected.	Choose 0-10 cm, 10 -20 cm and 20 - 30 cm if the sample has been collected from 0 – 10 cm layer, 10-20 cm layer and 20 – 30 cm layer respectively.

1.6.4.6.4.2 Labeling and bagging

1. Carefully, bag the soil samples (BD sample and CC samples) into two separate ziploc bags.
2. It is very important to ensure that the bagged samples are labeled properly and correctly.
3. For Bulk Density, follow this standard labeling format: BD_LayerNo_CPNo. (eg. BD_1_CP0001). BD_1 stands for Bulk Density for layer 1 (i.e., 0-10cm depth) and CPNo. stands for the four-digit cluster plot number unique for each cluster plot.
4. For Carbon Content, follow this standard labeling format: CC_LayerNo_CPNo. (eg. CC_1_CP0001). CC_1 stands for Carbon Content for layer 1 (i.e 0-10cm depth) and CPNo. stands for the four-digit cluster plot number unique for each cluster plot.
5. Additional information stating the date of collection and Collector's ID may be added on the label.
6. Then bag these ziploc bags with BD and CC samples into the polyester sack(s) (containing shrubs herbs and litter samples of same plot).

7. Polyester sack(s) shall have CPNo, Date, and Crew ID.

Once sampling for 0-10 cm depth is completed, repeat the process for 10-20 cm and 20-30 cm depths of soil pit.

Note: Always remember to refill the pits after excavating soil and litter samples, before moving on to next plot.

1.6.1.6.5 Working with Problem soils

Rocky soils-One common problem when collecting the soil sample in rocky soils is that larger rocks may extend partially inside and outside your 10 cm x 10 cm x 10 cm volume. In this case you only want to know the mass and volume of the rock inside your excavated hole but not that part of the rock that is outside your volume. If this occurs, try to find another rock from outside your excavated volume that is a close match to the rock volume that extends into your excavated area. Then throw away the larger rock but retain the matched-volume rock and place it in with the rest of the excavated sample. Again, this is an estimate and shall induce an error but there is not much choice.

Sandy soils-The other common problem exists when sampling sandy soils. As you are collecting from inside your 10 cm x 10 cm quadrat, the sides of the excavated hole may collapse. This will induce an error by decreasing your ability to accurately measure the excavated volume. In this case try to insert some kind of walls in the excavated hole to stop the sides from collapsing.

Wetland soils-If plot falls in wetland soil, drive in the sampling frame completely into the soil. Then dig out and remove soil from outside of the frame till the bottom of the frame. Now, drive in the smaller soil frame (10 cm x 10 cm) completely in and excavate soil completely for 0-10 cm depth.

For 10-20 cm and 20-30 cm depths, repeat the process, as being done for 0-10 cm depth. Division of samples for bulk density and carbon analysis is done, as is defined in 0 for normal soil sampling.



NATIONAL FOREST INVENTORY FIELD FORM

Carbon Data Form

SOIL SAMPLING

Department of Forests and Park Services

Forest Resources Management Division

F18/18

1. CP No

2. Dzongkhag

(Mention name of the dzongkhag in which the plot is located)

3. Gewog

(Mention name of the gewog in which the plot is located)

4. Crew Leader

(Mention name of the Crew Leader collecting the data)

5. Date

 / /

(Mention the date on which data is collected)

Soil Sampling Data Form (Sample and data to be collected from 10 cm x 10 cm soil plot)

SN	Soil Layer	Weight of sample for Bulk Density (BD) (in kgs)	Weight of sample for Carbon Content (in kgs)
1	0 – 10 cm		
2	10 – 20 cm		
3	20 – 30 cm		

1.6.2 Sample collection for laboratory analysis

1.6.2.1 Number of Samples

The protocols for sample analysis in the laboratories for both Understorey (shrubs, herbs and litter) and Soil carbon pools are defined separately by respective laboratories (UWICER for shrubs, herbs and litter; and Soil and Plant Analytical Laboratory for Soil)

For the purpose of field work, the following number of samples shall be collected from each plot;

1. One Shrub sample (minimum 2 kgs from productive sites and entire samples if the sites have less than 2 kgs samples)
2. One Herb sample (entire samples are to be sent to laboratory except if the site has samples more than 2 kgs)
3. One Litter sample (Entire samples is to be sent to laboratory)
4. Six Samples for soil sample (3 for Bulk Density and 3 for Carbon Content analysis)

In total, 9 numbers of samples shall be collected and sent to laboratory from each carbon plots for analysis.

1.6.2.2 Sample Status

While it is required to collect samples from every plot, it may not always be possible to get samples from all plots due to various difficult situations in the field. In the event, it is not feasible to obtain samples, the crews are advised to record whether or not sample was collected from a sampling plot. If sample was not collected, record the reasons as follows;

a. Shrub:

1. Not sampled: No Shrub present
2. Not sampled: Too dangerous
3. Not sampled: Other reasons (list reason)

b. Herb

1. Not sampled: No Herb present
2. Not sampled: Too dangerous
3. Not sampled: Other reasons (list reason)

c. Litter

1. Not sampled: No litter present
2. Not sampled: Waterlogged/Water
3. Not sampled: Too dangerous
4. Not sampled: Other reasons (list reason)

1.7 Data Management

This section defines roles and responsibilities of field crew and data managers both at field offices and FRMD. It also provides step-wise flow of data from the field (by field crews) to field offices and then to FRMD (by Field Data Managers), data cleansing (Data Managers at Field Offices and FRMD) and analysis at FRMD.

The job of Inventory crew is not limited to only collecting the data from sample plots assigned to them. NFI Crew also has the responsibility of data management which involve transferring of data from Tablet to Laptop and then to Database Management Systems maintained at Headquarters of Field Offices.

The NFI crew shall collect NFI data using Tablet which has Collect Mobile application. Collect Mobile is an android based application which allows fast, intuitive and flexible data collection from the field. It has features such as geo-location through embedded GPS, on-the-fly validation to improve data quality, handling of large lists of species or other attributes and processes inputs and calculates attributes for quality control in the field.

The data is collected in a survey form or NFI field form designed and developed in Open Foris Collect. The Collect is an easy-to-use solution for managing complex field survey data. It provides a fast, easy, flexible way to set up a survey with a user-friendly interface. It handles multiple data types and complex validation rules, all in a multilingual environment. The Collect is installed on Laptops, where the survey or field forms are designed, exported and then uploaded or imported on to the Tablet using Collect Mobile application. **Note:** *Use of Collect is provided in Bhutan NFI Open Foris Collect User Manual, 2018.*

1.7.1 Data flow and management

The data flow and management are reflected in the *Table 1.39*. The table also shows responsibility assigned against each task.

Table 1.39: Data flow and responsibility

Sl. No	Task	Responsibility
1	Collecting data using Tablet that has Collect Mobile installed.	NFI Crew in the Field
2	Exporting data from Tablet	NFI Crew in the Field
3	Uploading data on Google Drive and storing a copy on laptops	NFI Crew in the Field
4	Sending the data to data center via email or share file via google drive	NFI Crew in the Field
5	Downloading or opening shared file from email or google drive and maintaining a copy of the data in PC hard drive	NFI data manager at Field Offices
6	Uploading or importing data into Collect	NFI Data Manager from Field Offices
7	Verifying whether all data shared by field crew are imported into Collect	NFI Data Manager at Field Offices
8	Exporting NFI data in correct format and .csv format and storing in a folder called raw_data	NFI Data Manager at Field Offices
9	Informing Crew leader for any missing data	NFI Data Manager from Field Offices

10	Submitting a copy of back-up data of step 5 and 8 to FRMD for record	NFI Data Manager from Field Offices
11	Performing data cleansing in Collect	NFI Data Manager at Field Offices
12	Exporting cleansed data in Collect and .csv format and storing in PC or Database system as cleaned data	NFI data Manager at Field Offices
13	Submitting a copy of cleansed data both in Collect and .csv format to FRMD via email or google drive	NFI data manager from Field Offices
14	Downloading the data submitted by field office and storing in PC hard drive or Work Station.	NFI Data Manager at FRMD
15	Uploading or Importing data into Collect	NFI Data Manager at FRMD
16	Verifying whether all data are imported properly	NFI Data Manager at FRMD
17	Performing further data cleaning	NFI Data Manager at FRMD
18	Exporting cleansed data in collect and .csv format and storing in PC or Work Station as cleaned data	NFI Data Manager at FRMD
19	Exporting data as Collect format for data analysis in Calc	NFI Data Manager at FRMD
20	Analyzing the data and generating estimates or NFI results.	FRMD

1.7.2 Exporting data from Tablet

This section explains the responsibility of field crews. After completing data collection in the plot, the field crew shall export the data and submit to Data Managers at their respective offices. Steps to follow in exporting data from tablet are;

- After completing data collection, go back to COLLECT Data Entry page as indicated in Figure 1.10.

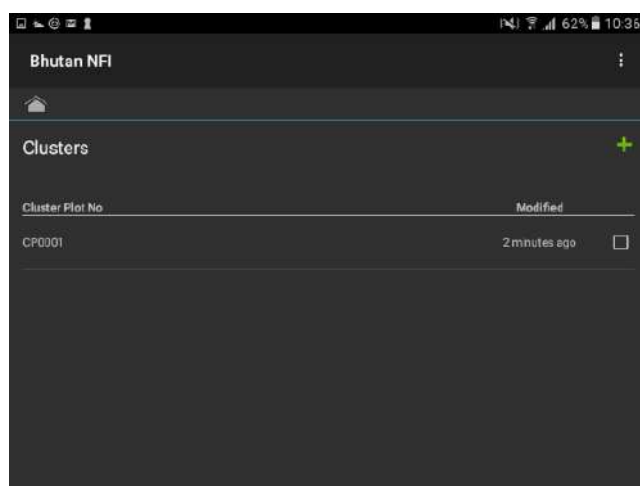


Figure 1.10: Collect data entry page

- b. Then click on *three-dots icon*, at the top right corner of the COLLECT Data Entry page as shown in Figure 1.11

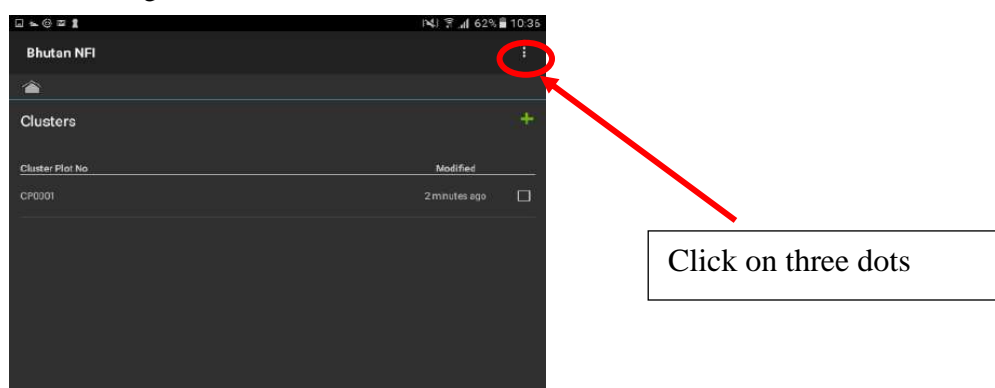


Figure 1.11: Data exporting option

- c. On clicking the *three-dots icon* at the top right corner, Figure 1.12. 3 opens. Then click on *Export* to export the data.

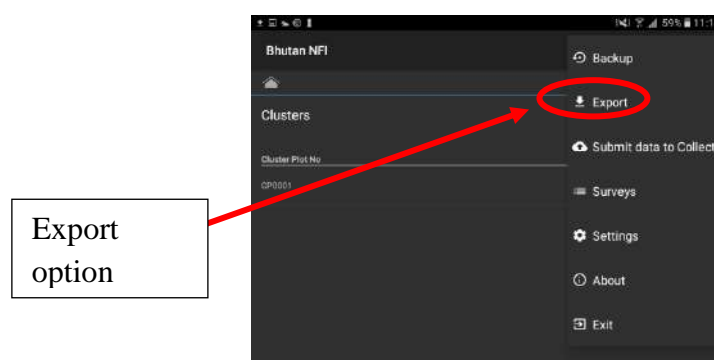


Figure 1.12 Data entry and export option

- d. After that check [☒] *Exclude image files*, if you want to exclude pictures which were taken using the tablet.. Then click on *EXPORT*.

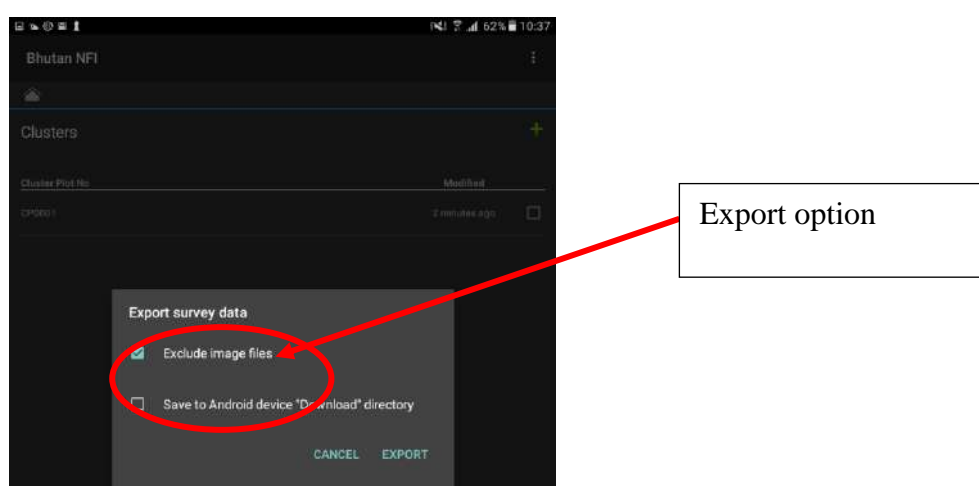


Figure 1.13: Specifying export option

- e. On clicking *EXPORT* button, screen with options to either store or send the data opens. Select *Save to Drive* since we have created Google drive to send/receive NFI data (Refer Figure 1.13 and Figure 1.14)

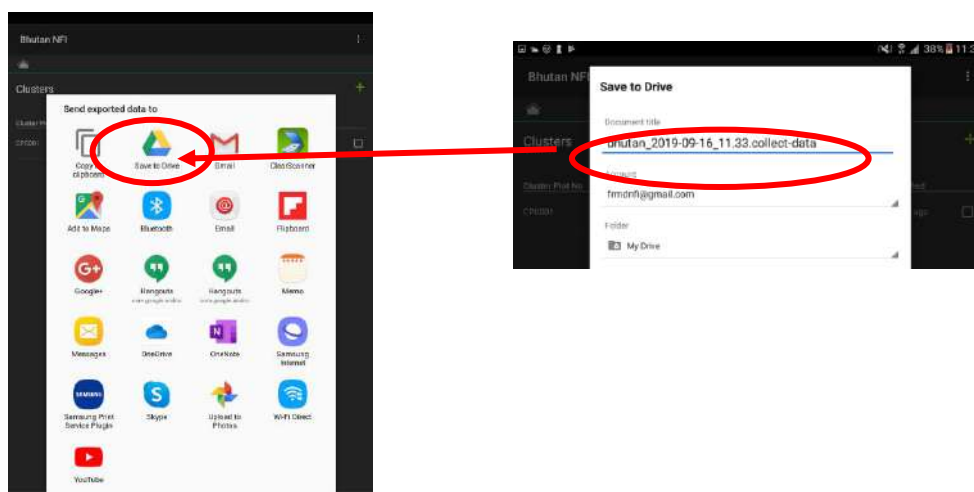


Figure 1.14: Screen with where-to-save or send options.

- f. Then screen with default document title (Bhutan_2019-09-13) is opened automatically which has to be changed.
- g. Change the document title by adding nfi_cp_number in front of the default document title.
Note: The document title “*nfi_cp_number*” shall be in *LOWER CASE* as COLLECT requires file names to be in lower case to import the data into it.
 Here, since the data being exported is from the plot CP0001, we shall provide the document title as nfi_cp0001_bhutan_2019-09-16_11.33.collect-data.
 The ‘_bhutan_2019-09-16_11.33.collect.data’ indicates the data was transferred on 16th September, 2019 at 11:33AM.
- h. Then click on **Save** to save the data on frmd.nfi google drive.
- i. After the file has been successfully saved in google drive using the gmail account created for each office, the data managers can access the data to download and import the data into COLLECT (refer office gmail account *Table 1.40*).

1.7.3 Downloading data from google drive

Once the field staff uploads data onto google drive, data managers of respective offices can access the data and download it and import the data into COLLECT as indicated in Figure 1.15

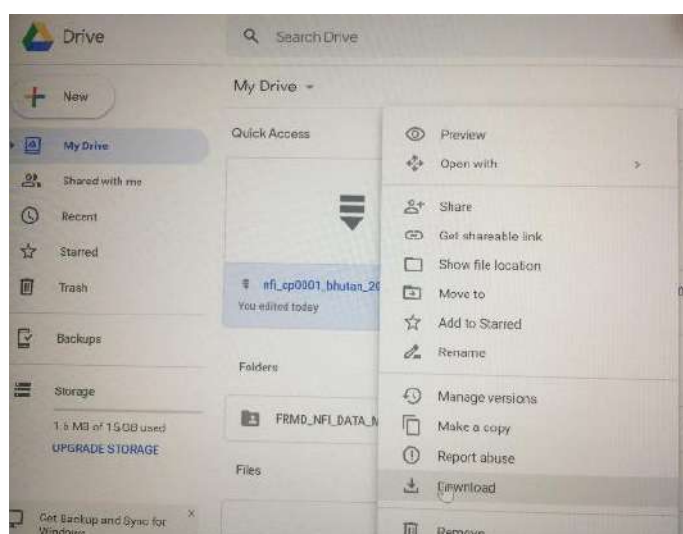


Figure 1.15: Downloading the data from google drive

Table 1.40: List of Gmail Accounts

Name of Office	Office Code	User Name
DFO, Bumthang	BuFD	bumthangdivisionnfi@gmail.com
DFO, Gedu	GeFD	gedudivisionnfi@gmail.com
DFO, Dagana	DaFD	daganadivisionnfi@gmail.com
DFO, Mongar	MoFD	mongardivisionnfi@gmail.com
DFO, Paro	PaFD	parodivisionnfi@gmail.com
DFO, Pemagatshel	PGFD	pemagatsheldivisionnfi@gmail.com
DFO, Samdrup Jongkhar	SJFD	sjongkhardivnfi@gmail.com
DFO, Samtse	SaFD	samtsedivisionnfi@gmail.com
DFO, Sarpang	SrFD	sarpangdivisionnfi@gmail.com
DFO, Thimphu	ThFD	thimphudivisionnfi@gmail.com
DFO, Trashigang	TGFD	trashigangdivisionnfi@gmail.com
DFO, Tsirang	TsFD	tsirangdivisionnfi@gmail.com
DFO, Wangdue	WPFD	wangduedivisionnfi2@gmail.com
DFO, Zhemgang	ZhFD	zhemgangdivisionnfi@gmail.com
Bumdeling Wildlife Sanctuary	BWS	bwsnfi2@gmail.com
Jigme Dorji National Park	JDNP	jdnfnfi@gmail.com
Jigme Singye Wangchuck National Park	JSWNP	jswnfnfi@gmail.com
Jomotshangkha Wildlife Sanctuary	JWS	jwsnfi@gmail.com
Phipsoo Wildlife Sanctuary	PWS	pwsnfi@gmail.com
Royal Manas National Park	RMNP	rmnfnfi@gmail.com
Sakteng Wildlife Sanctuary	SWS	swsnfi@gmail.com
Phrumsengla National Park	PNP	pnpnfi2@gmail.com
Jigme Khesar Strict Nature Reserve	JKSNR	jksnfnfi@gmail.com
Wangchuck Centennial National Park	WCNP	wcnpnfi1@gmail.com

1.8 Data Analysis

Data analysis is also a critical component of any resource assessment. Despite having a robust sampling design and data collection protocols, if inappropriate data analysis method is used, then the entire exercise shall be futile. Therefore, utmost care shall be taken to ensure that the data analysis is done properly with robust statistical proven methods and tools. To the extent possible, most appropriate statistical data analysis programs and techniques shall be used to analyze to ensure that estimates generated are of higher precision. For instance, data analysis for the first NFI was carried out using R (versions 3.2.4 and 3.4.3).

The sampling design of NFI with cluster plots laid at 4 km by 4 km systematic grid is developed considering the estimates to be generated at cluster plot level and not at individual plot level. Hence, estimates such as basal area, volume, biomass, carbon and number of trees etc. shall be generated at cluster plot level, considering the cluster plot as a sampling unit.

1.9 Data Storage

All data generated from the forest resource assessment shall be stored in both digital and hard copies and deposited with FRMD.

1.10 Reports and Publication

The following reports and publication shall be published at the end of every NFI:

1. NFI Report Vol I (Forest Growing Stock):

This report shall provide a summary of the most important findings on the state and the development of Bhutan's forest.

The NFI report Vol I shall provide information on but not limited to:

- a. Stems per hectare and total number of stems
- b. Basal area of hectare and total basal area
- c. Volume per hectare and total volume.

2. NFI Report Vol II (Forest Carbon Stock):

This volume shall provide an account of the total Forest carbon stock, the sum of the quantity of carbon stored in different forest carbon pools. Volume II shall further provide information on the following aspects but not limited to:

- a. Biomass per hectare and total biomass
- b. Carbon per hectare and total carbon
- c. Soil carbon
- d. Increment and growth
- e. Regeneration status
- f. Forest stand structure
- g. Forest biodiversity
- h. Wildlife - presence and absence information
- i. Non-wood forest produce
- j. Types and extent of disturbance

3. Policy and Technical Briefs: Policy and technical briefs on SFM shall also be published to inform forest managers and policy makers.

4. International Reporting: The NFI reports and information shall be used to prepare National Forests Assessment reports to contribute to Global Assessment reports by international organizations such as Food and Agriculture Organization (FAO), United Nations Framework Convention on Climate Change (UNFCCC), UN Forum of Forest, etc.

1.11 Bibliography

Köhl, M., & Marchetti, M. (January 01, 2016). Objectives and Planning of Forest Inventories.

Tomppo, E. O., Gschwantner, T., Lawrence, M., and McRoberts, R. E. (2010). National Forest Inventories: Pathways for Common Reporting, Springer, New York

MacKenzie, D. (2009). What are the issues with Presence-Absence data for wildlife managers?. Journal of Wildlife Management. 69. 849-860. 10.2193/0022-541X(2005)069[0849:WATIWP]2.0.CO;2.



2. Forest Resources Potential Assessment

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2. Forest Resources Potential Assessment

2.1 Background

Forest resources potential assessment (FRPA) is the process of identifying and assessing the potential of the forest resources of Bhutan for sustainable timber production. One major outcome of the process is the identification of potential forest areas for establishment of Forest Management Units (FMU). FRPA is undertaken on a national level (i.e., at a macro-planning level) which forms a broad screening process that is undertaken in response to national demand to increase forest areas to be managed under sustainable forest management.

FRPA is the first step in the planning process for FMUs. It can be considered as a long-term planning process. Once, potential FMUs have been identified, it may be not necessary to repeat the FRPA. It may be valid as long as legal, ecological, technical and economic framework conditions are not significantly changed (adapted from Schindele 2002).

Schindele (2002) provides guidelines on FRPA including the results of the GIS-based analysis for the preliminary identification of potential forest areas to be brought under sustainable management. This section briefly summarizes the overall process and outlines the steps in the GIS-based analysis.

2.2 Objectives

The objectives of the FRPA shall be but not limited to:

- carry out technical and economic feasibility for identification of potential forest production areas for sustainable forest management;
- estimate the growing stock and extent of the potential forest production area; and
- identify and delineate area & boundaries of potential forest production areas

2.3 Responsibility

Forest Resources Management Division (FRMD) shall lead the FRPA in collaboration with the field offices.

2.4 Output

Potential forest production areas that can be brought under sustainable forest management.

2.5 Methodology

FRPA comprise of the three-tier planning approach.

Step 1: GIS-analysis shall provide a preliminary area estimate of forests, which may have potential for sustainable timber production and identifies specific areas, which may be managed as FMU in future.

Step 2: Due to certain limitations of GIS based analysis, the economic potential of these identified areas needs to be verified in more detail through actual field measurement.

Another important aspect of this field check is to verify whether the assumptions and parameters applied in the GIS-analysis are valid. Otherwise, the GIS analysis needs to be adjusted and redone accordingly.

Step 3: Growing stock in the identified potential area needs to be estimated by combining the forest inventory data with the GIS area and forest type statistics.

The FRPA distinguishes between a technical potential and an economic potential for commercial timber use which are defined as follows:

Technical potential:

The technical potential comprises the quantity of timber that can be sustainably produced from the legal, technical, ecological and social perspectives.

Economic potential:

The economic potential comprises the quantity of timber that can be sustainably produced from the economic perspectives by taking into account the prevailing economic condition and future market developments.

The whole three-tier planning process is summarized in *Figure 2.1*

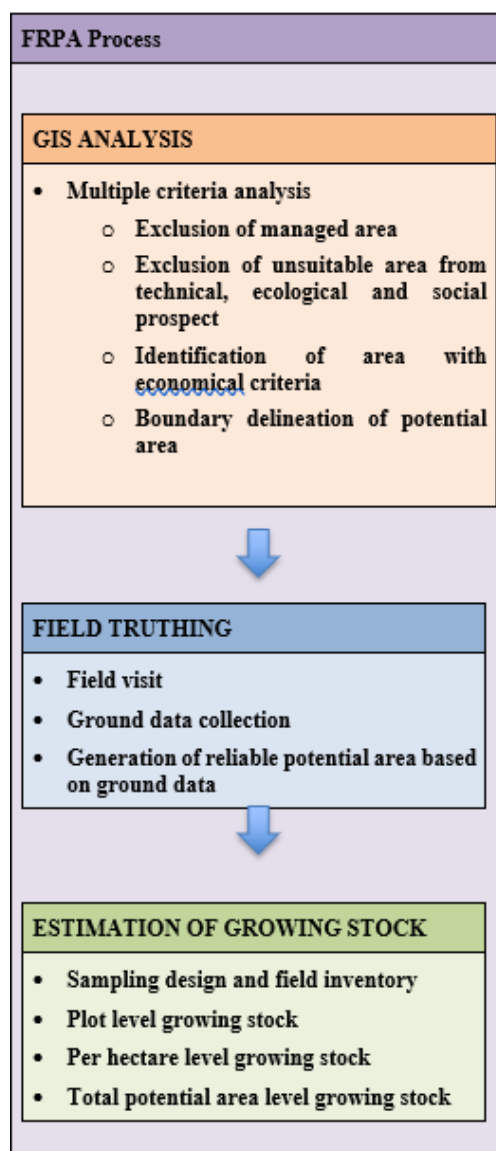


Figure 2.1 FRPA process

2.5.1 GIS Analysis

GIS analysis shall follow the principle of Multi Criteria Analysis (MCA). MCA is a technique which considers many different criteria when selecting the potential area to be brought under sustainable forest management. MCA gives a logical, well-structured process to follow so that different factors can be clearly identified and prioritized. Forest and Nature Conservation Act of 1995 and Forest and Nature Conservation Rules and Regulations of Bhutan 2017 specifies the criteria to be considered for assessing the potential forest area.

During the MCA, firstly, all protected areas and forest areas that are already managed shall be excluded from the analysis, namely Protected Areas (PA), FMUs, RAMSAR sites, Community Forests (CFs), Critical Watersheds and Local use areas (1.5 km of the edge of the settlement).

Then all areas unsuitable for sustainable production from the technical, ecological and social perspectives shall be identified and excluded, namely:

- Non forest areas
- Forest shrub
- Areas above 4000 m.a.s.l
- Inoperable areas (slope > 45°)
- Road buffer (180 meters uphill or 90 meters downhill)
- River buffer (30 meters of the bank or edge of any river, stream and water source)
- Religious sites buffer (500 m).

The remaining areas represent the technically potential forest area for sustainable timber production. For identification of the economic potential area, three criteria are applied, namely:

- (i) present forest condition
- (ii) size of the forest area
- (iii) distance to the nearest road.

Finally, the potential forest area shall be further delineated into smaller production units based on natural features.

2.5.2. Field Truthing

Field visits shall be made to identified potential areas for ground truthing and collection of ground data for validation of desktop GIS analysis. Based on the field observation and analysis of the ground data collected, the identified potential area shall be either accepted or discarded considering the technical and economic criteria.

The objectives of field truthing are to:

- determine the real economic potential for sustainable timber production from preliminary identified potential area;
- determine the ranking (highest to lowest) of preliminary identified potential area for sustainable timber production; and
- provide realistic estimates of the overall economic potential of the forest area.

2.5.3. Estimation of Growing stock

Growing stock is the standing volume of all living trees in a given unit area of the forest. The growing stock for the preliminary identified potential area shall be estimated with following objectives:

- to know the estimated volume available in the area for sustainable harvesting and to forecast Annual Allowable Cut (AAC)
- to know the conditions of the forest

To get an estimate of growing stock of the identified potential area, a minimum of 30 sample plots shall be randomly selected representing each forest type and/or in each ecological zone. Analysis of the data from these sample plots shall indicate the economic feasibility of the potential area.

2.6 Data Storage

All data generated from the forest resource assessment shall be stored in both digital and hard copies and deposited with FRMD.

2.7 Report and Publication

A consolidated Forest Resources Potential Assessment report shall be published.

2.8 Bibliography

- Schindele W (2002) National forest resources potential assessment (FRPA) for Bhutan: Part 1; GIS analysis for the preliminary identification of potential forest areas for commercial timber use GTZ Project Document No. 57.
- FMCB (2004) Forest Management Code of Bhutan, 2004, Department of Forest, Ministry of Agriculture
- Forest Resources Potential Assessment (2013) Forest Resources Potential Assessment of Bhutan 2013, Forest Resource Management Division, Department of Forests and Park Services, Ministry of Agriculture and Forests



3. National Wildlife Survey

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3. National Wildlife Survey

3.1 Background

Bhutan, with a vast expanse of contiguous pristine forest covering 71% of its total land area (FRMD, 2017) and diverse habitat types is a rich repository of both plant and wildlife species. While conservation of biodiversity in all taxa is important, limited resources hinder the survey of species in all taxa. In Bhutan, wildlife surveys at the national level have been done only for few keystone or flagship mammalian species. Mammals are key indicators for measuring anthropogenic impacts on biota (Ceballos & Ehrlich, 2002), and important for the maintenance and functionality of ecosystems through seed and fruit dispersal, pollination, nutrient recycling, and plant succession (Ripple et al., 2014). Mammals also benefit people through the provision of food, recreation, and income. Over 200 mammals are reported from Bhutan (Wangchuk et. al, 2004) and 29 of them are listed in the threatened category of International Union for Conservation of Nature (IUCN) Red List and are of high conservation significance. 29 species of mammals are listed in Schedule I of the Forests and Nature Conservation Act 1995 (RGoB, 1995).

Knowledge on presence and distribution of mammals is crucial for planning and evaluating conservation strategies for a region or country (Tobler et al., 2008), yet, detailed understanding of mammal diversity, distribution, and abundance are lacking in Bhutan (Dorji et al., 2019). Wildlife survey on few select keystone, charismatic animals has, therefore, helped to understand the population status, trends, and viability, habitat quality, conservation threats, and research needs for the target wildlife. Moreover, such national surveys play a great role in understanding the overall biodiversity status of the country through opportunistic encounters and by catch of other wildlife species (Dorji et. al, 2019). Therefore, the Department of Forests and Park Services has identified four flagship species (Bhutan Takin, Tiger, Snow Leopard, and Asian Elephant) for which national survey shall be done. This chapter, will, provide guidance for conducting the National Wildlife Survey (NWS) with special focus to the above four flagship species in Bhutan, whereas, the Biodiversity monitoring protocol (Volume I) shall guide the survey of other wildlife species.

3.2 Objectives

The objectives of any national survey for wildlife species shall be to:

- i. Estimate abundance and density of wildlife species
- ii. Understand population dynamics and behavioral changes
- iii. Estimate abundance and density of major prey species.

3.3 Role and Responsibility

The Nature Conservation Division (NCD) shall lead and liaise with field and other relevant offices to conduct NWS as shown in the Table 3.1. However, the Bhutan Tiger Centre (BTC) should be the lead office for the National Tiger Survey and tiger related researches.

Table 3.1 Roles and Responsibilities

Offices	Roles and responsibilities
NCD	Procure survey equipment and gears Develop/review survey design and protocol Conduct Training of Trainers on field survey methods Compile raw and processed data from field offices Train field offices on data management, data processing, analysis and report writing
BTC (for National Tiger Survey)	Procure survey equipment and gears Develop/review survey design and protocol Conduct Training of Trainers on field survey methods Compile raw and processed data from field offices Train field offices on data management, data processing, analysis and report writing Lead researches on tiger
Field office	Training field staff on conduct of field survey Data Collection Data compilation and processing Data analysis and report writing Submission of copy of data to NCD and the central data repository (CDR).

3.4 Output

The NWS shall provide reliable information on population status, abundance, habitat type and use and distribution of the wildlife species including the major prey species.

3.5 Methodology

Since the NWS shall be conducted periodically at the national level for mobile terrestrial species, field manuals for the conduct of survey shall be developed by NCD or concerned divisions in consultation with relevant agencies and subject specialists, best suited to the species, and changing times. The field manual shall explicitly describe the sampling design, field data collection methods, and data analysis and reporting protocols.

Existing manuals shall be used for survey of those species which were surveyed during the previous national surveys. However, the new edition of the field manual shall not have much deviation from the former edition unless new tools and innovative survey techniques emerge. This is especially important in order to make a comparative assessment to the earlier surveys. The field manual shall be endorsed by the Technical Advisory Committee (TAC) of the Department prior to survey. The field manuals developed for conducting surveys for each species shall form a compendium to this section of the *Code*.

3.5.1 Sampling Design

The NWS shall adopt the National Forest Inventory (NFI) grid of 4x4 km with the elbow plot as the centroid of the sampling frame. Each Protected Area and Divisional Forest Offices (DFO) shall be assigned with grids having unique grid IDs which is the same as NFI Plot ID (Figure 3.1).

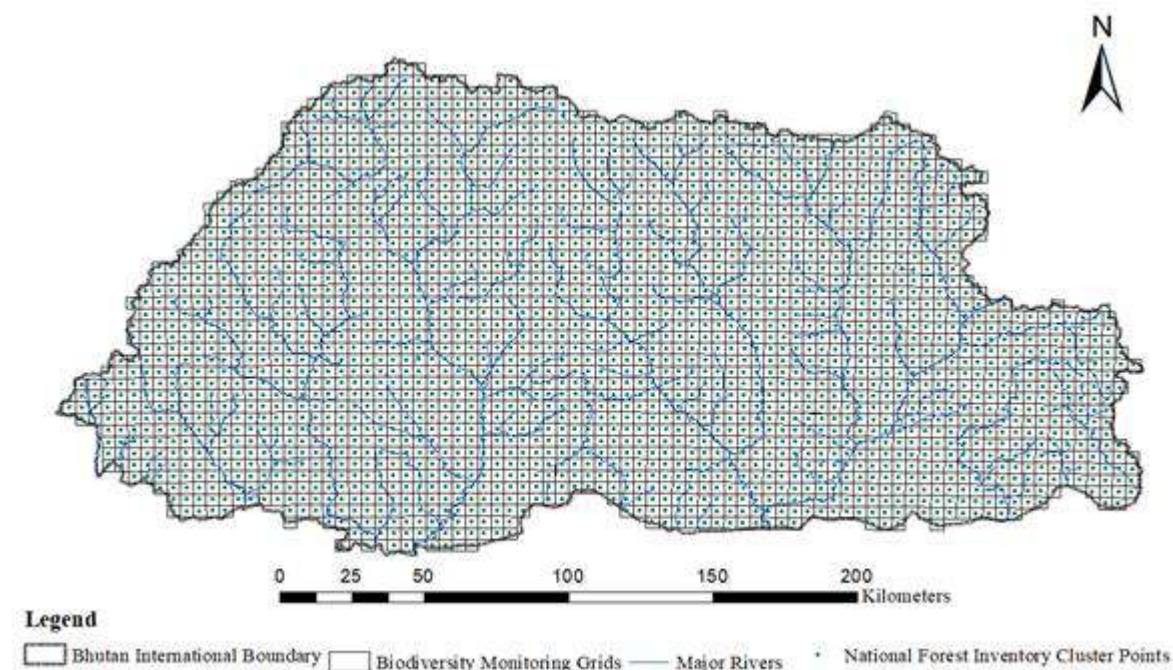


Figure 3.1 BMG and NFI cluster plots for Bhutan

The national survey for a specific species shall be carried out through stratification based on the distribution of the species. For example, the national snow leopard survey shall be confined in the areas above 3500 m.a.s.l while the elephant survey shall be done mostly in the southern foothills. Based on such stratification of the geographical area of Bhutan, survey grids in each DFO and PAs shall be laid for surveying. Sampling methods shall also vary from species to species based on its expected occupancy probability, home range, and other parameters of the species. For example, for tigers which have wide ranging occupancy probability, random selection from the systematic grid can be done to conduct the survey as surveying of all grids may not be feasible due to resource constraints. For elephants with limited occupancy range in Bhutan, all grids in its habitat may be surveyed. Therefore, sampling shall depend on the resource availability, survey objectives, and biology of the species of interest.

Within those sampled grids, transect survey/camera trap survey/ non-invasive genetic sampling or any other wildlife survey method shall be implemented as per details outlined in Volume IV of the *Code*.

3.5.2 Field Data Collection

Once the formation and training of the survey team members are completed, data collection must be carried out in the stipulated season as per the field manual.

3.5.3 Data Analysis

Data analysis shall be done using the statistically proven methods and state-of-the-art data analysis software packages and tools to ensure that the results are of required standard and precision. For the purpose of estimating the population density and abundance, Spatial Capture Recapture (SCR) models (eg. Program SPACECAP), shall be used while occupancy models (eg. Program PRESENCE/ Program UNMARKED) shall be used to understand the extent of area occupied by the species. The ArcGIS/QGIS software shall be used for developing species distribution and occupancy maps.

3.6 Reports and Publication

The National Wildlife Surveys shall generate the following reports and publications;

- a. National Survey Reports for Tiger, Snow Leopard, Takin and Elephant. The national survey reports shall include:
 1. abundance and density of wildlife species
 2. population dynamics and behavioral changes
 3. abundance and density of major prey species.
- b. Other subsidiary reports entailing from the data obtained from the survey (based on requirement).
- c. Policy Briefs and Scientific Papers in peer reviewed journals, wherever possible.

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4. National Wetland Inventory

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4. National Wetland Inventory

4.1 Background

Wetlands include rivers, streams and springs with associated riverine and riparian zones; lake, pond, swamp, marsh, fen and peatland with water that is static or flowing with distinct floral and faunal communities. Functional wetlands are critical segments of the watershed, as they support a high level of biological productivity and diversity. Wetlands provide fundamental ecosystem services, such as water regulation, filtering and purification, climate regulation as well as numerous scientific, cultural and recreational values. Wetlands are also important for maintenance of the broader ecosystem's health. Wetlands in Bhutan are crucial for biodiversity and sustainable economic growth, both at local and regional levels. With Bhutan's economy being highly dependent on hydropower, tourism, agriculture and small-scale industries, it is crucial to protect the wetlands to ensure sustainable supply of water. Recognizing the importance of wetlands and their significance to the existence of a healthy environment, Bhutan joined the Ramsar Convention, as its 161st Contracting Party in 2012.

With rapid modernization and developmental activities occurring, the threat to wetlands are far greater and degradation of wetlands is increasing (Zhang et al., 2008). The ecological consequences are much greater than the economic loss incurred (MEA, 2005). In Bhutan, there are cases of wetlands being drained and persistent reports on drying water sources (springs, lakes, streams), causing problems for local people to obtain water for domestic use and irrigation (WMD, 2019). The drying streams or water sources are also one of the pertinent issues in the watersheds that are assessed and identified as degraded/critical watersheds across the country. However, the rate and extent of loss of these important wetlands in the country are not properly assessed. A National Wetland Inventory (NWI) is, therefore, deemed critical to understand the types of wetlands, their significance, distribution, trends and the threats to wetlands for the purpose of conservation and management. The NWI shall also provide required information to formulate relevant policies & legislations and to fulfil national commitments under the Ramsar Convention on Wetlands. NWI shall also raise awareness on the importance of wetland conservation and garner stakeholders' support for the conservation and management of wetlands.

This chapter shall guide the conduct of the NWI in Bhutan and shall be reviewed, revised and updated with further experience in conducting a wetland inventory.

4.2 Objectives

The purpose of the NWI is to establish a national database for planning, management and support decision-making. The specific objectives are to:

- provide detailed information on the abundance, characteristics and distribution of wetlands in the country;
- establish a national database system for understanding the status of wetlands and to monitor the extent and rate of change in physical and ecological character of wetlands;
- determine vulnerability status of wetlands; and
- support implementation of wetland legislation and policies.

4.3 Outputs

The main output from the NWI shall be the national database on wetlands and the NWI Report. The report shall provide information on:

- a. Classification, abundance, location and spatial extent of wetland.
- b. Status and trends of wetlands.
- c. Vulnerability status of wetlands.

4.4 Roles and Responsibility

Watershed Management Division (WMD) shall coordinate and provide technical backstopping to field offices for carrying out the NWI. The detailed roles and responsibilities are provided in Table 4.1.

Table 4.1 Roles and Responsibilities

Offices	Roles and Responsibilities
WMD	<ul style="list-style-type: none"> Design survey forms in the <i>Collect</i> platform, download and install in identified field enumerators computers Clean, sort and analyse data Conduct quality assurance of the data collected by visiting at least 5 % of total enumerated wetlands. Provide training related to NWI methodology.
Field Offices	<ul style="list-style-type: none"> Identify and nominate field enumerators and data managers Collect field data using <i>Collect Mobile</i> or hard copies of the survey forms (if android devices are unavailable) Transfer the data from <i>Collect Mobile</i> to Google drive shared by WMD Collect and submit data on wetland vulnerability assessment to WMD Participate in data cleaning, sorting and analysis with WMD Maintain backup data

4.5 Methodology

The Ramsar Convention's wise use Handbook 13 and 15, 2010 provides a recommended framework for the establishment and implementation of NWI. The steps recommended by the Ramsar Convention have been adapted and shall be used for the NWI as explained in the following sections.

The NWI shall follow a stepwise approach involving stocktaking and mapping of wetlands using remote sensing technologies followed by field work for validation and additional data collection. Specifically, the NWI shall involve the following steps (Figure 4.1).

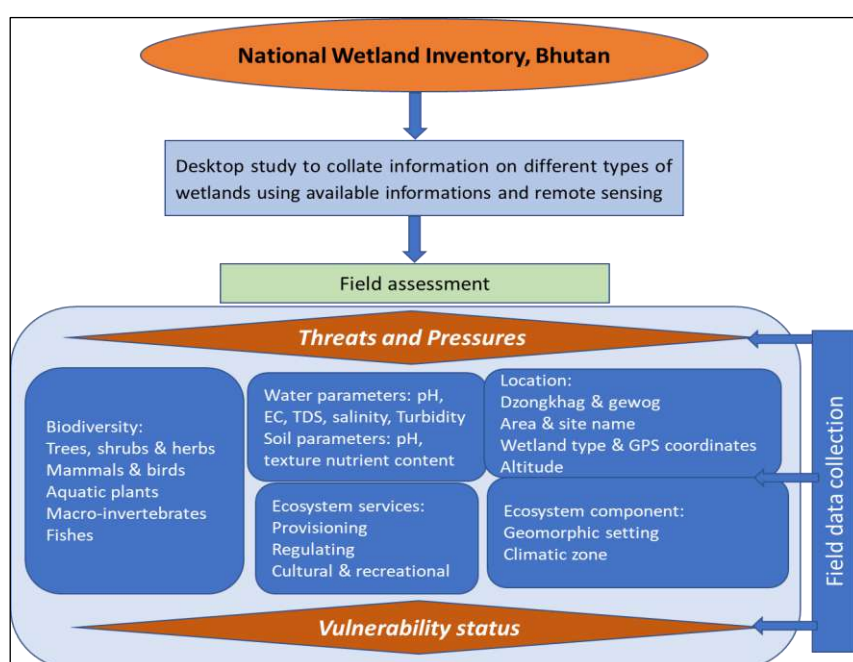


Figure 4.1 National Wetland Inventory methodology

4.5.1 STEP 1: Stocktaking & Desktop Assessment

The desktop based stocktaking exercise shall include the gathering of the available data sources, such as Land Use and Land Cover (LULC) maps, localized assessments and inventory carried out by different agencies within Bhutan. Wetlands in the country shall be mapped Dzongkhag wise using remote sensing to find out the possible types of wetlands, location and their distribution. The stocktaking exercise shall be done through 1) Gathering available information, 2) Mapping of wetlands using available satellite images and 3) Community consultation meetings.

4.5.1.1 Gathering available information

Most of the major river systems and perennial streams in Bhutan have been already assessed and data on these are available. All the available information from relevant agencies shall be collated and used. A report on the existing data sources and information shall be generated.

4.5.1.2 Mapping of wetlands using satellite images

Remote sensing is the most useful tools in acquiring spatial information of earth surface. Different sensors like aerial photo, multispectral imageries, hyperspectral imageries, radar and LiDAR are widely used to map the wetlands. Freely available multispectral satellite imageries like Landsat and Sentinel-2 shall be used to map the wetlands. Object based classification approach shall be used to classify and map the wetland. Ground truthing shall be carried out by physically visiting the site, wherever accessible, and high-resolution image (Google Earth) shall be used in inaccessible sites.

4.5.1.3 Community Consultation

In addition, community consultation meetings shall be organized to take stock of those wetlands which are not captured by the remotes sensing images. During the community consultation, all such significant wetlands shall be recorded with the help of the traditional knowledge of the local communities. This is also to create awareness and encourage community participation in wetland management and conservation.

4.5.2 STEP 2: Field data collection and validation

The data generated from the stocktaking exercises under STEP 1 shall be used as inputs to field data collection. The field data collection shall include ground truthing and validation of data or maps generated from the stocktaking exercise and to collect the required wetland parameters. In order to ensure that the data are collected, presented and available for analysis in a prescribed consistent format, a standard attribute data table (Table 4.2) shall be used for data collection and all the wetlands inventoried should be named/identified in a proper format. The format of the attribute data reflects the elements required to describe the ecological character of any wetland in Bhutan, including ecosystem components, processes and services. The concept of “ecosystem services” has been utilized in order to show the true value of wetlands and other ecosystems to people so that they can be effectively included in development decisions.

4.5.2.1 Data Collection Modality

Locating the wetlands

Each wetland shall be provided with unique wetland ID and coordinates generated in STEP 1 (0). The wetland shall be located through the use of the hand-held GPS devices or using local knowledge.

Field data recording

Once the wetland is located, the inventory crew shall start collecting the data as per the format provided in Table 4.2. The data recording shall be done using electronic field forms loaded on the tablet.

NOTE: In case, the Tablet fails to function, the crew shall record the measurements or data on the paper data form with a pencil. The crew leader shall ensure that writing is clear, neat and legible. Over-writing shall be avoided at any cost. Instead, the data recorder shall cancel any wrong entry with single strike line and corrected entry written at the side. Data managers shall manually enter data which are collected in paper form.

General parameters: The inventory crew shall collect the information as per the parameters provided in Table 4.2. The wetland shall be provided with the unique ID in advance. The site name could be name of the wetland which can be local name (if available).

Site description: The inventory crew shall use the format provided in Table 4.2 for description of the wetland. Area determination in the field shall be only for those wetlands which were not captured by the remote sensing method. The area shall be determined by tracking the wetland area using the GPS.

Biodiversity: In this step, listing of biodiversity shall be done. No requirement of laying plots. The listing of the biodiversity shall be done in the wetlands and the surrounding areas following guidelines in Table 4.2.

NOTE: If the plants cannot be identified by either Scientific name or local name or common name, then the plant shall be recorded as "UNKNOWN 1,2,3,4....." for that wetland. A photo of the plant (with clear dorsal and ventral side of leaves with leaf margins) may be taken and in bracket record the photograph number. While naming the unknown species follow the following naming protocol – Wetland ID Unknown1, 2,3...., e.g First unknown plant found in Wetland ID 01 shall be Wetland ID_01_Unknown1.)). Same protocol shall be followed for unknown species of shalltrees, shrubs, herbs and saplings. The photo of the plant shall consist of shoot, leaf (dorsal & ventral side with clear leaf margins), flowers and whole plant where possible to aid identification.

Soil and water parameters: The water parameters to be recorded are pH, salinity, electrical conductivity (EC) and turbidity. Water testing kits shall be used for testing the pH, salinity and EC, while the turbidity shall be assessed visually. The water parameters shall be recorded from the appropriate site within the wetlands.

Soil parameters to be recorded are pH, soil texture and soil color and shall be collected from the site of the wetland (marshes only). The measurement shall be done and recorded on site only.

Table 4.2 Standard data collection format

Parameters	Data field	Description
General	Date	Date of data collection
	Dzongkhag	Administrative area
	Gewog	Block name
	Wetland ID	Wetland ID provided
	Site name	Known name/local name
	Landuse/Forest types (<i>Refer Table 1.11 For forest types</i>)	Forest types
	Enumerator	Name, designation, office, contact number, email ID
	Land tenure and administrative authority	Whether SRF (FMU, CF, LFMP, PA, others) or private land
	Conservation and management status of the wetland	Presence of management interventions or action- past or existing (<i>specify the activities</i>)
	Pressures and threats	Pollution, encroachment, invasive species, etc. (<i>for details, refer Table 4.18</i>)
Site description	General wetland category	<ul style="list-style-type: none"> • Fresh water perennial lakes/ponds • Marshes with flowing streams • Marshes without flowing streams • Rivers and perennial streams
	Area ¹	Hectares
	Latitude / Longitude	Decimal degree
	Elevation	m.a.s.l.
Ecosystem components	Biogeographical region	Freshwater Ecoregions of the World/Himalayan highlands
	Climatic zones of Bhutan (<i>for details, refer Table 4.3</i>)	Alpine, Temperate, Subtropical
	Geomorphic setting (<i>for details, refer Table 4.4</i>)	<ul style="list-style-type: none"> - Basins - Channel - Flats - Slope - Hill/highlands
Biodiversity ²	Ground vegetation (<i>refer Table 1.23</i>)	identify the species as per the list in Collect software
	Tree Vegetation (<i>refer Table 1.19: Tree species list and species code</i>)	identify the species as per the list in Collect software
	Aquatic flora (<i>Table 4.5</i>)	identify the species as per the list in Collect software
	Birds, mammals, fishes (<i>refer Table 1.25, Table 1.27 and Table 4.6</i>)	identify the species as per the list in Collect software
Soil and water parameter	Water quality parameter	pH, salinity, electrical conductivity, temperature, total dissolved solids and turbidity
	Water/flow discharge (<i>for details, refer Table 4.7</i>)	water discharge to be measured at the exit of lakes and all streams
	Soil parameter	pH, soil texture (<i>refer Table 4.8</i>), color (<i>refer Figure 4.3 and Figure 4.2</i>)

Ecosystem services (for details, refer Table 4.9)	Provisioning services	Fresh water, Food, Natural medicines or pharmaceuticals, etc.
	Regulatory services	Air quality regulation, climate regulation (local), Flood hazard regulation, Storm hazard regulation, Erosion regulation, water purification, pollination, fire regulation, etc.
	Cultural and recreational services	Cultural heritage, recreation and tourism, aesthetic value, spiritual and religious value, education and research, etc.

Note: ID of the wetlands shall be provided for field data collection

¹ Area shall have to be tracked via GPS or remote sensing. However, only for those wetlands which were not captured by remote sensing techniques.

²Record whatever visible in the area. Laying plots is not required

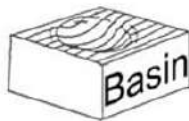
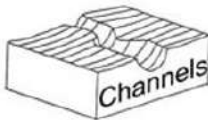
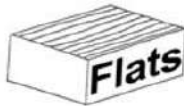
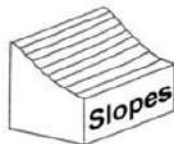
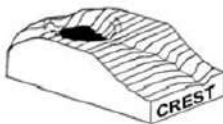
Data transfer: Upon the completion of field data collection in *Collect* platform, the data shall be downloaded and transferred to the shared Google drive. The data from the Google Drive shall then be uploaded to the *Collect* Platform on the desktop by the Data Manager and used for data cleaning and analysis. A copy of the data should be stored as a backup.

Table 4.3 Climatic zones of Bhutan

Climatic Zones	Altitude Range (m.a.s.l)	Annual rainfall (mm)	Temperature Range (°C)
Alpine	Above 4000	< 650	
Temperate	2000-4000	650-850	15 to 26 during monsoon season, -4 to 15 during winter season
Subtropical	200-2000	850-5,500	15-20

**NEC, 2011*

Table 4.4 Categories of landforms that are host to wetlands

Landform	Definition	
Basins	Basins are depressed basin shaped areas in the landscape with no external drainage. They may be shallow or deep and may have flat or concave bottoms. They usually have clearly defined margins.	
Channels	Channels refer to any incised water course. They may be shallow or deep but always have clearly defined margins.	
Flats	Flats have a slope of less than 1%. Little or no relief and diffuse margins. Flats can be incised by a channel thereby giving rise to the term 'channeled flats'.	
Slopes	Slopes are areas with a gradient of greater than 1% which may be concave or convex.	
Hills / highlands	Hills / highlands are generally convex areas on the top of mountains, hills or similarly raised areas.	

*AWI manual

Table 4.5 Families and orders of macroinvertebrates of Bhutan (Dorji, U. & Gurung, D. B. (2017))

Order	Family	Order	Family
Coleoptera	Dytiscidae	Odonata	Epiophlebiidae
	Elmidae		Gomphidae
	Gyrinidae		Libellulidae
	Helodidae	Oligochaeta	Tubificidae
	Psephenidae		Oligochaeta
	Hydrophilidae	Plecoptera	Chloroperlidae
	Haliplidae		Capniidae
	Dryopidae		Nemouridae
	Eulichadidae		Leuctridae
	Scirtidae		Peltoperlidae
Diptera	Ceratopogonidae		Perlidae
	Chironomidae		Perlodidae
	Psychodidae	Tricoptera	Brachycentridae
	Limnionidae		Glossosomatidae
	Pediciidae		Hydropsychidae
	Limniidae		Philopotamidae
	Tipulidae		Rhyacophilidae
	Simuliidae		Stenopsychidae
	Elmidae		Hydrobiosidae
	Tabanidae		Lepidostomadidae
	Athericidae		Limnephilidae
	Empididae		Limnacentropodidae
	Culicidae		Phryganeidae
Ephemeroptera	Baetidae		Ploycentropodidae
	Ephemerellidae		Barbarochthonidae
	Ephemeridae	Hemiptera	Naucoridae
	Heptageniidae		Gerridae
	Leptophlebiidae		Nepidae
	Calopterygidae		Saldidae
	Cordulegasteridae		Aphelochiridae
	Prosopistomatidae	Megaloptera	Corydalidae
	Caenidae	Odonata	Aeshnidae
	Isonychidae		Blephariceridae
	Oligoneuridae		Protoneuridae
	Baetiscidae		Euphaeidae
	Polymitarcyidae		Gomphidae
Tricladida	Dugesidae		Epiophlebiidae
	Planariidae		Lestidae
Annelida	Hirudinea		Libellulidae
Lepidoptera	Crambidae		Coenagrionidae
	Pyralidae		Chlorolestidae
Anura	Ranidae		Chlorocyphidae

Trombidiformes	Hydrachnellae		Cordulegasteridae
Gastropoda	Physidae	Planaria	Planaridae
		Amphipoda	Gammaridae

Table 4.6 List of fishes (NBC 2017)

#	Scientific name	English name
1	<i>Aborichthys elongatus</i>	Striped sand loach
2	<i>Aborichthys garoensis</i>	Loach
3	<i>Aborichthys kempi</i>	Not known
4	<i>Acanthocobitis botia</i>	Mottled zipper loach
5	<i>Ailia coila</i>	Gangetic ailia
6	<i>Amblyceps apangi</i>	Not known
7	<i>Amblyceps cerinum</i>	Not known
8	<i>Amblyceps laticeps</i>	Not known
9	<i>Amblyceps mangois</i>	Not known
10	<i>Anguilla bengalensis</i>	Mottled eel
11	<i>Aspidoparia jaya</i>	Not known
12	<i>Aspidoparia morar</i>	Morari
13	<i>Badis badis</i>	Blue perch/blue badis
14	<i>Badis dibruensis</i>	Not known
15	<i>Bagarius bagarius</i>	Devil catfish
16	<i>Balitora brucei</i>	Gray's stone loach
17	<i>Bangana dero</i>	Kalabans
18	<i>Barilius barna</i>	Hamilton's barila
19	<i>Barilius bendelisis</i>	Barila
20	<i>Barilius shacra</i>	Not known
21	<i>Barilius vagra</i>	Not known
22	<i>Batasio batasio</i>	Not known
23	<i>Batasio fasciolatus</i>	Batasio
24	<i>Batasio merianiensis</i>	Bengal tiger fish
25	<i>Botia almorhae</i>	Pakistani loach
26	<i>Botia dario</i>	Bengal Loach
27	<i>Botia lohachata</i>	Reticulate loach
28	<i>Catla catla</i>	Catla
29	<i>Chaca chaca</i>	Chaka
30	<i>Chagunius chagunio</i>	Chaguni
31	<i>Channa amphibeus</i>	Borna snakehead
32	<i>Channa gachua</i>	Dwarf snakehead
33	<i>Channa melanostigma</i>	Snakehead
34	<i>Channa punctata</i>	Spotted snakehead
35	<i>Channa stewartii</i>	Golden snakehead
36	<i>Channa striata</i>	Striped snakehead
37	<i>Cirrhinus cirrhosus</i>	Mrigal carp
38	<i>Cirrhinus mrigala</i>	Mrigal
39	<i>Clarias gariepinus</i>	African sharptooth Catfish
40	<i>Clarias magur</i>	Magur
41	<i>Crossocheilus latius</i>	Stone roller/Gangetic latia
42	<i>Ctenopharyngodon idella</i>	Grass carp
43	<i>Cyprinion semplotum</i>	Assamese kingfish
44	<i>Cyprinus carpio</i>	Common/European carp
45	<i>Danio assamila</i>	Danio
46	<i>Danio dangila</i>	Moustached danio
47	<i>Danio rerio</i>	Zebra fish

48	<i>Devario aequipinnatus</i>	Giant danio
49	<i>Devario assamensis</i>	Devario
50	<i>Esomus danricus</i>	Meesa parava
51	<i>Exostoma labiatum</i>	Burmese bat catfish
52	<i>Gagata cenia</i>	Clown catfish
53	<i>Garra annandalei</i>	Tunga garra
54	<i>Garra arunachalensis</i>	Not known
55	<i>Garra arupi</i>	Not known
56	<i>Garra bimaculacauda</i>	Not known
57	<i>Garra birostris</i>	Not known
58	<i>Garra gotyla</i>	Gotyla
59	<i>Garra lamta</i>	Not known
60	<i>Garra lissorhynchus</i>	Khasi garra
61	<i>Garra parastenorhynchus</i>	Not known
62	<i>Garra quadratirostris</i>	Not known
63	<i>Glossogobius giuris</i>	Bar eyed Goby
64	<i>Glyptothorax botius</i>	Striated Belly sucker Catfish
65	<i>Glyptothorax cavia</i>	Heart Throat Catfish
66	<i>Glyptothorax striatus</i>	Not known
67	<i>Glyptothorax telchitta</i>	Copper catfish
68	<i>Gogangra viridescens</i>	Not known
69	<i>Heteropneustes fossilis</i>	Asian stinging catfish
70	<i>Hypophthalmichthys molitrix</i>	Silver carp
71	<i>Hypophthalmichthys nobilis</i>	Bighead carp
72	<i>Labeo boga</i>	Bogabata
73	<i>Labeo dyocheilus</i>	Not known
74	<i>Labeo pangusia</i>	Not known
75	<i>Labeo rohita</i>	Roho labeo
76	<i>Lepidocephalichthys guntea</i>	Scavenger loach
77	<i>Macrognathus morehensis</i>	Not known
78	<i>Mastacembelus armatus</i>	Zigzag eel
79	<i>Mystus bleekeri</i>	Day's mystus
80	<i>Mystus dibrugarensis</i>	Not known
81	<i>Mystus vittatus</i>	Asian striped catfish
82	<i>Nandus nandus</i>	Gangetic leaf fish
83	<i>Neoeucirrhichthys maydelli</i>	Not known
84	<i>Neolissochilus dukai</i>	Not known
85	<i>Neolissochilus hexagonolepis</i>	Copper mahseer
86	<i>Neolissochilus hexasticus</i>	Mahseer
87	<i>Olyra kempi</i>	Not known
88	<i>Olyra longicaudata</i>	Asian fighting catfish
89	<i>Olyra praestigiosa</i>	Fighting catfish
90	<i>Ompok pabda</i>	Pabdah catfish
91	<i>Oncorhynchus mykiss</i>	Rainbow trout
92	<i>Oreichtys crenuchoides</i>	Not known
93	<i>Oreochromis mossambica</i>	Mozambique mouthbrooder
94	<i>Oreoglanis insignis</i>	Not known
95	<i>Pangio pangia</i>	Cinnamon Loach
96	<i>Paracanthocobitis abutwebi</i>	Zipper loach
97	<i>Parachiloganis bhutanensis</i>	Khaling torrent catfish
98	<i>Parachiloganis hodgarti</i>	Torrent catfish
99	<i>Pethia conchonicus</i>	Rosy barb
100	<i>Pethia ticto</i>	Two spot barb
101	<i>Pseudecheneis sirenica</i>	Not known

102	<i>Pseudecheneis sulcata</i>	Brahmaputra Sucker throat
103	<i>Pseudolaguvia ferula</i>	Not known
104	<i>Pseudolaguvia ribeiroi</i>	Dusky long cat
105	<i>Psilorhynchus balitora</i>	Torrent minnow
106	<i>Psilorhynchus homaloptera</i>	Torrent stone carp
107	<i>Pterocryptis barakensis</i>	Not known
108	<i>Puntius chola</i>	Chola barb
109	<i>Puntius sarana</i>	Olive barb
110	<i>Puntius sophore</i>	Pool barb/stigma barb
111	<i>Raiamas bola</i>	Indian trout
112	<i>Rasbora daniconius</i>	Black line rasbora
113	<i>Salmo trutta-fario</i>	Brown trout/river trout
114	<i>Schistura inglisi</i>	Stone loach
115	<i>Schistura multifasciata</i>	Not known
116	<i>Schistura reticulofasciatus</i>	Not known
117	<i>Schistura scaturigina</i>	Stone loach
118	<i>Schizothorax molesworthi</i>	Blunt-nosed snow trout
119	<i>Schizothorax progastus</i>	Dinawah Snow trout
120	<i>Schizothorax richardsonii</i>	Common snow trout
121	<i>Tetraodon cutcutia</i>	Ocellated pufferfish
122	<i>Tor putitora</i>	Golden mahseer
123	<i>Tor tor</i>	Tor mahseer
124	<i>Triplophysa stoliczkai</i>	Tibetan stone loach
125	<i>Xenentodon cancila</i>	Freshwater garfish

Table 4.7 Method for measuring flow discharge

(i) Velocity Area method

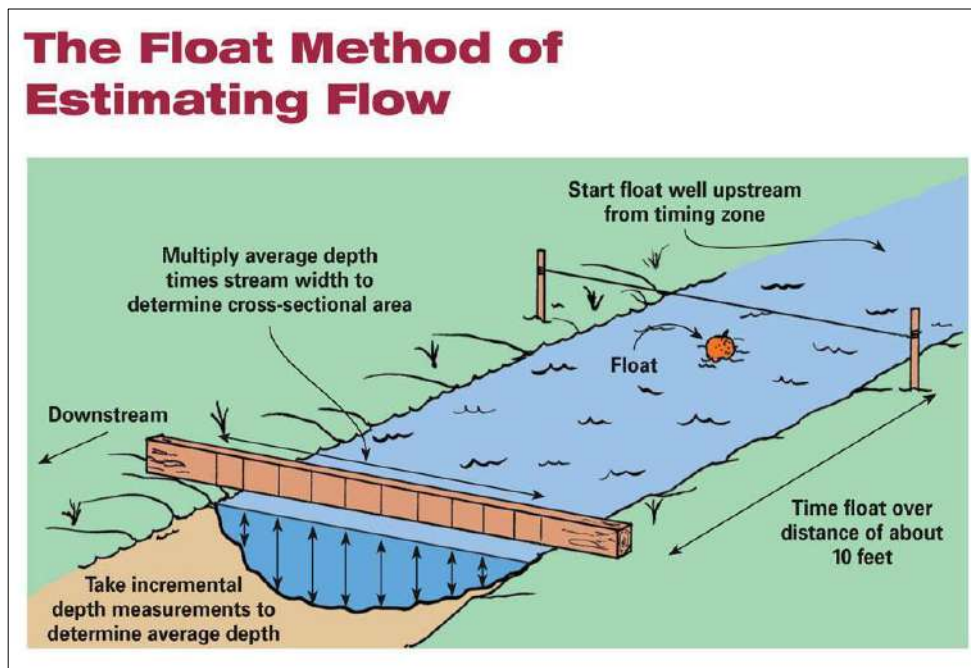
Velocity Area method is an inexpensive and simple discharge measurement method. This method measures surface velocity. Mean velocity is obtained using a correction factor. The basic idea is to measure the time that it takes the object to float a specified distance downstream.

$$V_{\text{surface}} = \text{travel distance} / \text{travel time} = L/t$$

Because surface velocities are typically higher than mean or average velocities

$V_{\text{mean}} = k V_{\text{surface}}$ where k is a coefficient that generally ranges from 0.8 for rough beds to 0.9 for smooth beds (0.85 is a commonly used value)

Step 1. Choose a suitable straight reach with minimum turbulence (ideally at least 3 channel widths long)



Step 2. Mark the start and end point of your reach

Step 3. If possible, travel time should not exceed 20 seconds.

Step 4. Drop your object into the stream upstream of your upstream marker.

Step 5. Start the watch when the object crosses the upstream marker and stop the watch when it crosses the downstream marker.

Step 6. You should repeat the measurement at least 3 times and use the average in further calculations.

Step 7. Measure the cross-sectional areas at the start and end point of your reach. Average your cross-sectional areas: Using the average area and corrected velocity, you can now compute discharge, Q . Correction factors to convert surface velocity to average velocity typically range from 0.8-0.9. Many times, 0.85 is used, which is also adopted by WMD. In mountain streams with lots of roughness elements, the value may be much lower e.g. ~ 0.67. With an estimate of cross-sectional area, discharge can be computed as $Q = VA$ where V is average velocity.

(ii) Volumetric method

The simplest way to estimate small flows is by direct measurement of the time to fill a container of known volume. The flow is diverted into a channel or pipe which discharges into a suitable container such as oil drum or bucket, and the time to fill is measured by stopwatch. For flows up to about 4 l/s, a bucket of 10 l capacity is suitable and will fill in 2½ seconds. For larger flows, an oil drum of 200 l can handle flows up to about 50 l/s. The time to fill must be measured accurately, especially when it is only a few seconds. The variation between several measurements taken in succession will give an indication of the accuracy of results.

Table 4.8 Determination of soil texture in field

Soil Texture	Feel to fingers and visual	Ball formation		Stickiness	Ribbon formation
		When dry	When moist		
Sand	Very gritty and individual grains visible, free flowing when dry	Does not form ball (falls apart when pressure is released)	Does not form ball (ball crumbles when lightly touched)	Does not stain fingers	No ribbon formation
Sandy Loam	Moderately gritty (sand characteristic predominates)	Forms a ball which falls apart when lightly touched	Forms ball but easily broken	Stains the fingers	No ribbon formation
Loam	Neither very gritty not very smooth	Forms ball but easily broken	Forms firm ball	Stains the fingers	No ribbon formation
Silt Loam	Smooth or slick “buttery” feel	Forms ball but easily broken and has soft flour like feel	Forms firm ball	Stains the fingers	Slight tendency to ribbon to ribbon with flaky surface
Silt	Smooth feel	Forms firm ball	Forms firm ball		Slight tendency to ribbon with flaky
Clay Loam	Slightly gritty feel	Moderately hard ball	Forms firm ball which can be handled freely	Stain fingers	Ribbons on squeezing but ribbon breaks easily
Clay	Very Smooth	Forms firm ball without breaking	Forms firm ball which can be handled freely and cannot be crushed with fingers	Stain fingers	Squeezes out at right moisture into long ribbons

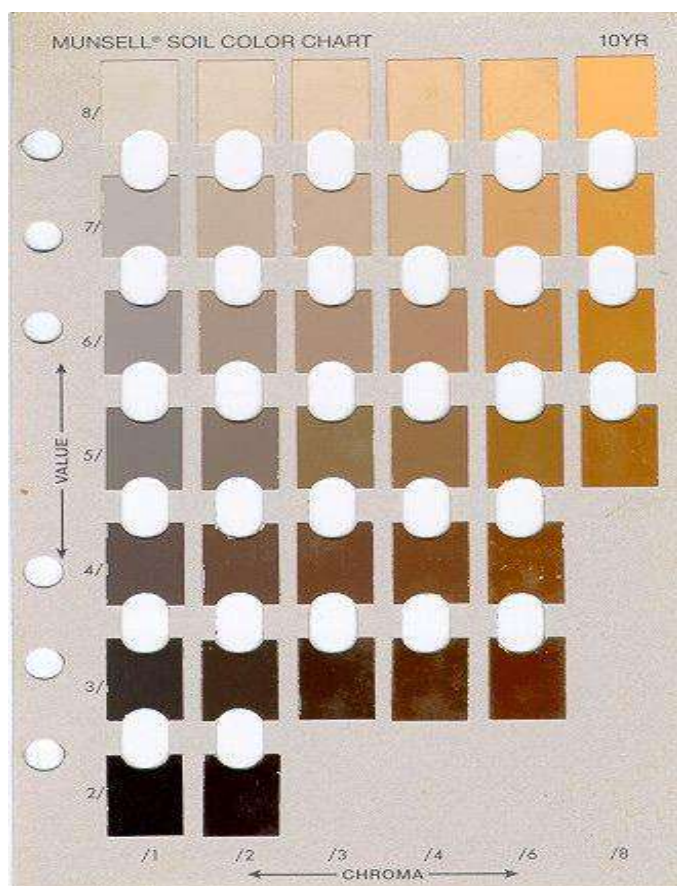


Figure 4.3 Munsell Soil Color Chart (source: NSSC, DoA, Thimphu)

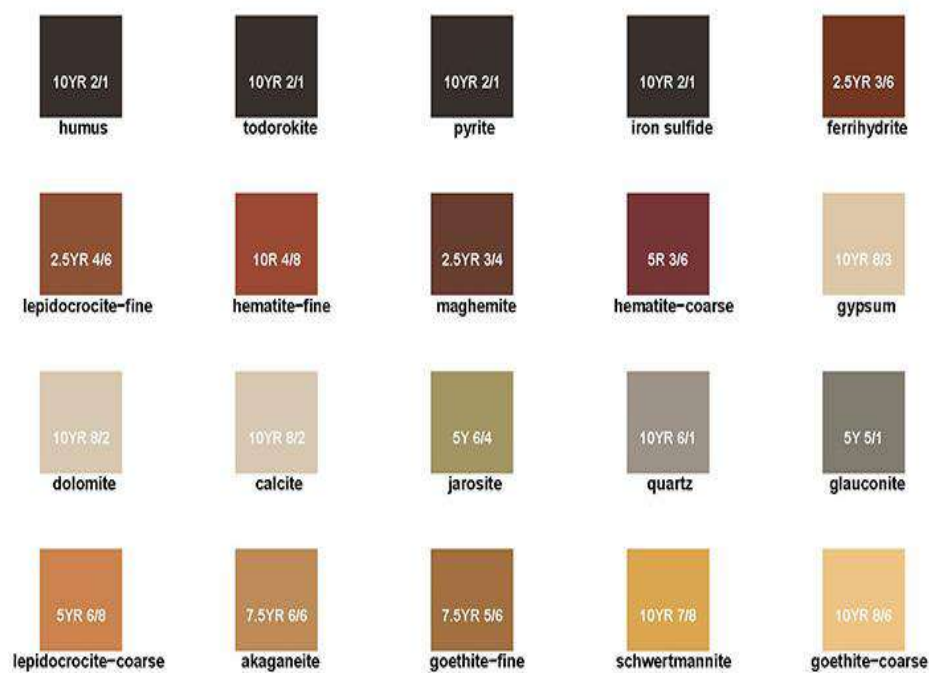


Figure 4.2 Most common pigmenting agents and their soil colors (source: NSSC, DoA, Thimphu)

Table 4.9 Ecosystem services and some examples

Ecosystem Services	Services	Examples
Provisioning services	Provision of fresh water	Water used for domestic drinking supply, for irrigation, for livestock, etc.
	Provision of food	Crops, fruit, fish, etc.
	Provision of fuel	Fuelwood, peat, etc.
	Provision of fibre	Timber for building, wool for clothing, etc.
	Provision of natural medicines and pharmaceuticals	Plants used as traditional medicines, etc.
	Clay, mineral, aggregate harvesting	Sand and gravel extracted for building use, clay extracted for brick-making, etc.
	Waste disposal	Dumping of solid waste, discharge of waste water, etc.
	Energy harvesting from natural air and water flows	Water wheels driven by flowing water, windmills driven by the wind, etc.
Regulatory services	Air quality regulation	Removal of airborne particles from the exhaust of cars, chimneys of industry, dust from agricultural land, etc.
	Local climate regulation	Regulation of the local microclimate, through shading, reducing air temperature, etc.
	Global climate regulation	Regulation of the global climate through control in greenhouse gas emissions, the sequestration of carbon, etc.
	Water regulation	Regulation of flows of surface water during high and low flows, regulation of recharge of groundwater, etc.
	Flood hazard regulation	Regulation and storage of flood water, regulation of intense rainfall events, etc.
	Storm hazard regulation	Regulation of tidal or storm surges, regulation of extreme winds, etc.
	Erosion regulation	Regulation of energy environment to reduce risk of erosion, presence of dense vegetation protecting soils, etc.
	Water purification	Cleaning of water, improvement of water quality, deposition of silts, trapping of contaminants and pollutants, etc.
	Pollination	Pollination of plants and crops by pollinators such as bees, butterflies, wasps, etc.
	Fire regulation	Providing physical barriers to the spread of fire, maintaining wet conditions to prevent fires spreading, etc.
	Noise and visual buffering	Wetland trees or tall reeds absorbing and buffering the impact of noise.
Cultural services	Cultural heritage	Importance of the wetland for historical or archaeological value, as an example of traditional uses or management practices, as a cultural landscape, etc.
	Recreation and tourism	Importance of the wetland for providing a location for recreation such as fishing, watersports or swimming, or as a tourism destination, etc.
	Aesthetic value	The wetland is overlooked by properties, is part of an of known area of natural beauty, is used as a subject for painters and artists, etc.

	Spiritual and religious value	The wetland holds plays a role in local religious festivals, the wetland is considered as a sacred site, the wetland forms part of a traditional belief system, etc.
	Inspiration value	Presence of local myths or stories relating to the wetland, traditional oral or written histories about the wetland or wetland animals, creation of different art forms associated with the wetland, development of distinct architecture based on the wetland, etc.
	Social relations	Presence of fishing, grazing or cropping communities which have developed within and around the wetland.
	Educational and research	Use of the wetland by local school children for education, site of long-term research and monitoring, site visited by organized educational study tours, etc.

4.5.3 STEP 3: Detailed Assessment of Selected Wetlands

After the completion of the data collection using Table 4.2, sample wetlands shall be selected based on the number of wetlands inventoried and taking into consideration the following criteria:

1. Representative from the type of wetlands
2. Representative of the Climatic zones in which the wetlands are located
3. Severity of threats and pressures to the wetland
4. Significance of the ecosystem services from the wetlands

The selected sample wetlands shall be assessed for tree/ground vegetation, macroinvertebrates, fishes, water and soil quality parameters and their vulnerability status using the survey methods described in section 4.5.3.1 and 4.5.3.2. The sample plots shall be pegged and tagged following NFI methods for future monitoring. The data shall be recorded using the standard data format (Table 4.10). The survey methods are designed depending on the type of wetlands and the data collection forms are listed below.

Table 4.10 Detailed data collection format

Parameters	Data field	Description
General	Date	Date of data collection
	Dzongkhag	Administrative area
	Gewog	Block name
	Site name	Known name
	Landuse/Forest types (Refer Table 1.11)	Forest types
	Wetland ID	From Table 4.2 Standard data collection format
	Enumerator	Name, designation, office, contact number, email ID
	Land tenure and administrative authority	Whether SRF (FMU, CF, LFMP, PA, others) or private land
	Conservation and management status of the wetland	Presence of management interventions or action- past or existing (<i>specify the activities</i>)
	Pressures and threats	Pollution, encroachment, invasive species, etc. (<i>for details, refer Table 4.18</i>)
Site description	General wetland category	Lake/pond

		Marshes with flowing streams Marshes without flowing streams Rivers/streams
	Area	Hectares
	Latitude / Longitude	Decimal degree
	Elevation	m.a.s.l.
Ecosystem components	Biogeographical region	Freshwater Ecoregions of the World/Himalayan highlands
	Climatic zones of Bhutan (<i>for details, refer Table 4.3</i>)	Alpine, Temperate, Subtropical
	Geomorphic setting (<i>for details, refer Table 4.4</i>)	- Basins - Channel - Flats - Slope - Hill/highlands
Biodiversity survey	Ground vegetation (For list of herbs, refer <i>Table 1.23: Herb list and species code</i>)	Inside the plot with radius 0.57 m, plot number, inclination, aspect, species, height (cm), coverage (%)
	Sapling (1.3-0.5m); Seedling <0.5m	Inside the plot with radius 3.57 m, species, height (cm), age
	Tree Vegetation (<i>refer Table 1.19: Tree species list and species code and Table 1.21</i>)	Inside the plot with radius 12.62 m, species, DBH, height (m)
	Birds, mammals, fishes, macroinvertebrates species (<i>refer Table 1.25: Mammals of Bhutan and Table 1.27: Birds of Bhutan</i>)	Inventory list
Soil and water parameter	Water quality parameter	pH, salinity, electrical conductivity, temperature, total dissolved solids and turbidity
	Water/flow discharge (<i>for details, refer Table 4.7</i>)	water discharge to be measured at the exit of lakes and all streams
	Soil parameter	pH, soil texture (<i>refer Table 4.8</i>), color (Figure 4.3 and Figure 4.2), moisture, organic matter, carbon, nitrogen, phosphorus, potassium
Ecosystem services (<i>for details, refer Table 4.9</i>)	Provisioning services	Fresh water, Food, Natural medicines or pharmaceuticals
	Regulatory services	Air quality regulation, climate regulation (local), Flood hazard regulation, Storm hazard regulation, Erosion regulation, water purification, pollination, fire regulation
	Cultural and recreational services	Cultural heritage, recreation and tourism, aesthetic value, spiritual and religious value, education and research

4.5.3.1 Assessment of biodiversity, soil & water quality

Locating the wetlands

The selected wetlands shall be provided with unique wetland ID and coordinates which shall be generated in 0 (STEP 1) and 0 (STEP 2). The wetland shall be located through the use of the hand-held GPS devices or using local knowledge. Once the wetland is located, the detailed assessment of biodiversity, soil and water shall be done as per the design provided below.

4.5.3.1.1 Vegetation survey design

For all types of wetlands sampled for detailed enumeration, vegetation data shall be collected through 4 circular plots laid in cardinal direction (Figure 4.4 Vegetation survey design). Following the National Forest Inventory (NFI) design, each circular plot shall be of 12.62m radius with an area 0.05 hectare for collecting tree data. Two other sub-plots shall be laid in concentric manner for collection of regeneration and herb data. Regeneration data plot should have a diameter of 3.57 meters whereas herb data plot shall have a radius of 0.57m (Refer 1.5.4 Field Data Collection and Protocols, National Forest Inventory for detail description of data collection methodology).

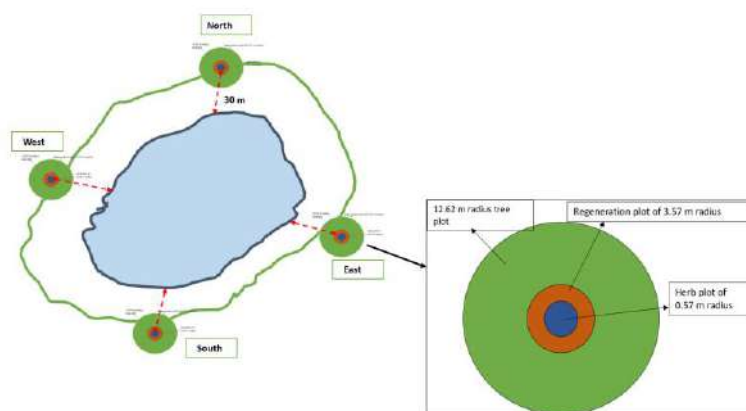


Figure 4.4 Vegetation survey design

Setting up the Plot Center (PC) and Data collection

Once the wetland is located, the crew shall determine the edge of the wetland. The PC shall be set at a distance of 30 meters from the edge of the wetland. First, set up the PC in the east direction and then follow clock-wise direction for other three plots.

After monumenting the PC with Iron Stake, the crew shall establish a circular plot of 12.62 m radius around the PC. The edge of the circular plot may be identified using the Hypsometer or Rangefinder. The crew leader shall stand at the PC and using the hypsometer or measuring tape, determine the edge of 12.62 m radius circle boundary. The plot boundary shall be marked by moving in a clockwise direction, starting from North (360°/0°). Use measuring tape to determine the boundary of the circular plot, where the vegetation is too dense. If measuring tapes are used, then slope correction must be done for the distance measured.

Within plot, establish a regeneration sub-plot having 3.57 m radius. This subplot shall be the regeneration plot. After establishing regeneration plot, the regeneration data shall be collected prior to collection of other data to avoid trampling of seedling. Likewise, a subplot of radius 0.57 m shall be established for collecting the herb.

Table 4.12 Data Sheet for sapling (0.5-1.3 m) and seedling <0.5m

[illegible]

Tree vegetation data: The main aim of collecting tree data is to come up with species richness and diversity within the wetland complexes. The richness and the diversity index shall help in determining the overall health of the individual wetlands. Therefore, in each plot, data on tree species, DBH (cm) and tree height should be recorded for all species falling within the radius of 12.62 m and whose height is more than 1.3 meters should be recorded.

For shrub data collection, shrub is defined as a single or multi-stem woody perennial plant, generally more than 0.5 m and less than 5 m high at maturity without a definite crown.

4.5.3.1.2 Freshwater Fishes and Macroinvertebrates

Freshwater lakes/ponds

Fresh water fishes and macro-invertebrates should be collected within a 1x1m plots in the four geographic cardinal directions, 3 m away from the litho-aqua interphase into the lake/pond (Wangdi, 2013). Two additional plots have to be laid, one each at the entry and exit of water of the lake/ponds, to get the representative data as the water quality and the discharge amount may differ greatly at the two sites (Figure 4.5). The fishes should be sampled using appropriate fishing gear (Electro shocker/Cast net) to minimize error (NCD, 2020).

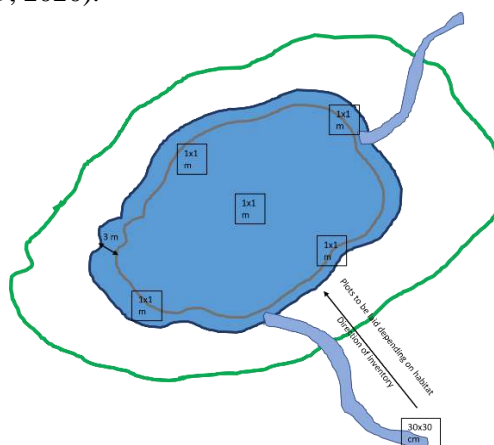


Figure 4.5 Survey design for marshes with streams

Marshes with flowing streams

The wetlands such as marshes shall exhibit unique microhabitats depending on its location along the elevational gradient and forest types. As such each wetland shall support a varying diversity of freshwater fish and macro-invertebrates. Usually the best sampling season for freshwater fish and macroinvertebrates is during the spring and autumn seasons (Shah et al. 2011) as it is during this seasons that species diversity shall be least affected by monsoon floods or cold winter temperatures.

Sampling of fish require identification of different habitat such as impoundment in marshes, and free flowing streams on the outlet of the marshes. Using appropriate fishing equipment, 10 efforts for each habitat or stream reach should be sampled. While electrofishing may be preferred in the free-flowing streams, its efficiency in wetland habitats is often reduced because fishes are lost or not visible in dense vegetation. In such cases, drop traps and throw traps may be useful (Kaller et al. 2013).

For the macroinvertebrates, in addition to the survey design applied for freshwater ponds and lakes, additional 1x1 m plot should be laid at the center of the marsh to conduct the survey. Furthermore, on the free-flowing stream emerging from the marsh, survey should be conducted along the sampling stretch that is 10 times the width of the stream. The width of stream shall be determined by taking a mean of stream width measured at three locations each measured 30 meters apart. In the determined sampling stretch, sampling should be conducted in different habitats such as pool, run, riffle, and the cascade and such habitats should be determined through visual observation. There should be no major tributaries discharging into the stream at the sampling stretch and the site should be at least 100 meters away from the road or settlement to prevent the alteration in the physical and chemical properties of the water flowing from the wetland. Area of the sampling unit for sample collection corresponds to the size of the kick net (30 x 30cm). Systematically, approach the microhabitats from downstream and proceed to upstream as to avoid disturbances (DoFPS, 2020).

Table 1.14 Data Sheet for Aquatic flora and fauna

Location:		Cardinal direction:
Date:		Plot no.:
Recorder:		Plot size:
Wetland ID:		
Sl. No.	Scientific name	Local name

4.5.3.1.3 Water quality

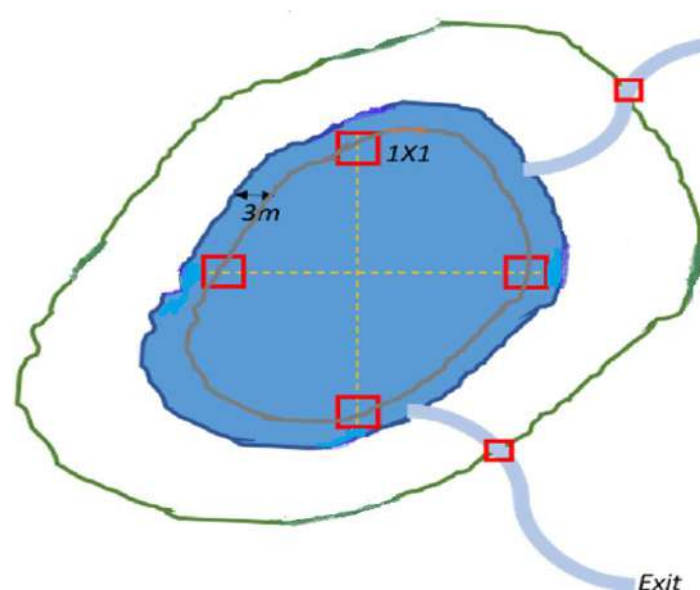


Figure 1.6 Water quality testing plots

Data on conductivity, temperature, pH, salinity, and total dissolved solids and turbidity should be recorded using a water quality tester. Water parameters should be recorded from the 6 plots laid (4 cardinal directions and 2 at entry and exit, if available) for lakes/ponds (Figure 1.6).

For *marshes with flowing streams*, the above water quality parameters should be recorded from all the streams present in the wetland at inlet and outlet, and in case of *marshes without flowing streams*, it should be recorded at the outlet, if available.

Table 4.15 Data Sheet for soil and water parameters

Location (Dzongkhag/Geog):	Cardinal direction:		
Date:	Plot no.:		
Recorder:	Plot size:		
Wetland ID:			
Water parameters data collection sheet:			
Water Parameters	Readings		
pH			
EC			
TDS			
Temperature			
Salinity			
Turbidity			
Soil parameters data collection sheet			
Soil Parameters	Readings	Soil Parameters	Readings
pH		Soil texture	
Soil carbon		Colour	
Organic matter		Moisture	
Nitrogen			
Phosphorus			
Potassium			

4.5.3.1.4 Soil sampling for field and lab analysis

Soil samples shall be collected from the 1x10 m plot from every circular plot at depth of 0-10 cm, 10-20 cm and 20-30 cm (*refer section 1.6.1.6*) for the lab testing of soil carbon, organic matter, nitrogen, phosphorus, potassium. The soil texture, color, moisture and pH have to be tested in the field.

Equipment and supplies

The following equipment and supplies are necessary for soil sampling, namely;

- 10 cm by 10 cm steel frame- for soil sampling
- Small trowel- for collecting soil sample
- Tray-for collecting soil sample
- Pruning shears- for cutting through smaller roots
- Saw- for cutting through bigger roots
- Battery operated digital balance- for weighing soil samples

Process for collection

- Ensure that surface organic litter is collected completely.
- Drive in the sampling frame completely into the soil. Then dig out and remove soil from outside of the frame till the bottom of the frame. Now, drive in the smaller soil frame (10 cm x 10 cm) completely in and excavate soil completely for 0-10 cm depth
- Using inward scooping motion, carefully excavate soil with the help of a small trowel.
- Excavation is done in a volumetric procedure, up to 10 cm depth. Do not throw away rocks if encountered.

- Cut the overlapping roots encountered, using pruning shear or saw from inner surface of the frame.
- Every scooped soil should be put in the tray
- Carefully, bag the soil samples into the ziploc bags.
- It is very important to ensure that the bagged samples are labeled properly and correctly.
- For Carbon Content, follow this standard labeling format:
CC_LayerNo_WetlandIDNo_Plot No.
- Additional information stating the date of collection and Collector's ID may be added on the label.
- Then bag these ziploc bags with CC samples into the polyester sack
- Polyester sack(s) shall have Wetland ID, Crew Name

Once sampling for 0-10 cm depth is completed, repeat the process for 10-20 cm and 20-30 cm depths of soil pit. Always remember to refill the pits after excavating soil samples, *before* moving on to next plot.

Rocky soils-One common problem when collecting the soil sample in rocky soils is that larger rocks may extend partially inside and outside your 10 cm x 10 cm x 10 cm volume. In this case you only want to know the mass and volume of the rock inside your excavated hole but not that part of the rock that is outside your volume. If this occurs, try to find another rock from outside your excavated volume that is a close match to the rock volume that extends into your excavated area. Then throw away the larger rock but retain the matched-volume rock and place it in with the rest of the excavated sample. Again, this is an estimate and shall induce an error but there is not much choice.

Sandy soils-The other common problem exists when sampling sandy soils. As you are collecting from inside your 10 cm x 10 cm quadrat, the sides of the excavated hole may collapse. This will induce an error by decreasing your ability to accurately measure the excavated volume. In this case try to insert some kind of walls in the excavated hole to stop the sides from collapsing.

4.5.3.1.5 Faunal Assessment

Record of any faunal species in the wetland and surrounding areas of the wetlands.

Mammal(s): Information on mammals in the catchment of wetlands should be collected based on direct sightings, signs or any other evidences and personal communications with the local communities in the area (Table 4.16).

Bird(s): Data on birds should be collected based on direct observations or acoustics throughout the survey period (Table 4.16).

Herpetofauna: Information on any reptiles or amphibian species in the catchment should also be recorded through direct sightings, signs or any other evidences (Table 4.16).

Table 4.16 Data Sheet for Terrestrial Fauna

Location (Dzongkhag/Geog):		
Date:		
Recorder:		
Wetland ID:		
Sl. No.	Scientific name	Local name

4.5.3.2 Vulnerability Assessment

Wetland Vulnerability assessment is carried out to assess the services provided by the wetland and the pressures/threats the wetland faces. The assessment highlights those wetland services that are important for livelihood, but are vulnerable and thus help in prioritizing conservation activities and also identify wetlands that need further conservation and management. For the purpose of the vulnerability assessment, the method developed (which is widely used) by Stratford et al. (2011) shall be used. The vulnerability assessment method consists of four main steps:

4.5.3.2.1 Assessment of wetland values

The values are split into four categories (ecological, economic, hydrological and social), and within each category there are pre-defined values as well as spaces for additional values (Table 4.17). Each value is given two “scores”—the first score relates to the dependence on the value and the second relates to the magnitude of the value. The two H/M/L scores are then brought together using the assessment matrix (Figure 4.7) to give a single H/M/L value that reflects both the dependence and magnitude of each value. The scoring for the assessment of wetlands values is shown in Table 4.17.

		Axis 1		
		Low	Medium	High
Axis 2	Low	L	L	M
	Medium	L	M	H
	High	M	H	H

Where;
H = High
M = Medium
L = Low

Figure 4.7 Assesment Matrix

Table 4.17 Assessment sheet for wetland values and scoring

Assessment Sheet for Wetland Values						
Wetland values score	Axis 1		Axis 2			
	Endangered species or habitat (description)	Score	Presence in region (description)	Score	Combined score	Scoring remarks
1. Ecological values						
Aquatic fauna						Axis 1: Endangered or critically endangered=High, Vulnerable=Medium, Near Threatened=Low Axis 2: Only present within wetland complex=High, present within wetland complex and surrounding sub-basin=Medium, present within wetland complex and throughout river basin=Low)
Aquatic flora						
Terrestrial fauna						
Terrestrial flora						
Habitat						
Biodiversity						
Other ecological values						
2. Economic values	Percentage of wetland derived income provided by value	Score	Percentage of community involved in value	Score	Combined score	Scoring remarks
Tourism						Axis 1 & 2: >40% = High, 10-40% = Medium, <10%=Low
Fisheries						
Agriculture						
Additional goods and services						
Other economic values						
3. Hydrological values	Size of population benefitted from value	Score	Feasibility of alternative provision of value	Score	Combined score	Scoring remarks
Provision of water for HEP						Axis 1: Large=High, Medium=Medium, Small=Low Axis 2: Difficult=high, Medium=Medium, Easy=Low
Provision of water for irrigation						
Reducing downstream flooding						
Maintenance of flow during lean periods						
Provision of potable water supply						
Other hydrological values						
4. Social values	The Importance of the value	Score	Uniqueness of site for value	Score	Combined score	Scoring remarks
Religious importance						Axis 1: Global=High, Regional=Medium, Local=Low Axis 2: Unique=High, Rare=Medium, Widespread=Low
Cultural importance						
Other social values						

4.5.3.2.2 Assessment of threats to wetland

As with the values, a list of pre-defined threats is given and spaces are left to enter additional values (Table 4.18). For each threat, a brief description of the nature and cause should be given and H/M/L scores for the likelihood of occurrence and severity shall be assigned. The two H/M/L scores are then brought together in the same combination matrix where severity of threat is Axis 1 and likelihood of occurrence is Axis 2. Severity of threats gives an indication of the magnitude of the impact of the threat if it occurred and likelihood gives an indication of how likely the threat is to occur.

Table 4.18 Assessment sheet for threats to wetlands and scoring

Threats to wetlands score	Axis 1		Axis 2			
Threats to wetlands	Severity of threats	Score	Likelihood of occurrence	Score	Combined score	Scoring remarks
Pollution – pesticides						Axis 1: Critical=High, Medium=Medium, Low=Low Axis 2: Frequent=High, Periodic=Medium, Rare=Low
Pollution – nutrients						
Pollution – industrial						
Pollution - urban/domestic						
Pollution - Organic wastes						
Siltation/sedimentation						
Encroachment-Urban/housing						
Encroachment-Agriculture						
Flow regime change-reduced flow						
Flow regime change-increased flooding						
Invasive aquatic species-floral						
Invasive aquatic species-faunal						
Invasive terrestrial species-floral						
Invasive terrestrial species-faunal						
Other threats						

4.5.3.2.3 Links between wetland values and threats to wetland

This determines how the threats are likely to impact on the values. A scoring of H/M/L is given to each interaction. If no interaction occurs, then N is entered into the matrix. This table has already been populated with default values (Table 4.19) but can be customized by reflecting on the knowledge of the site (Table 4.20).

Table 4.19 Impact of threats on wetland values with default values

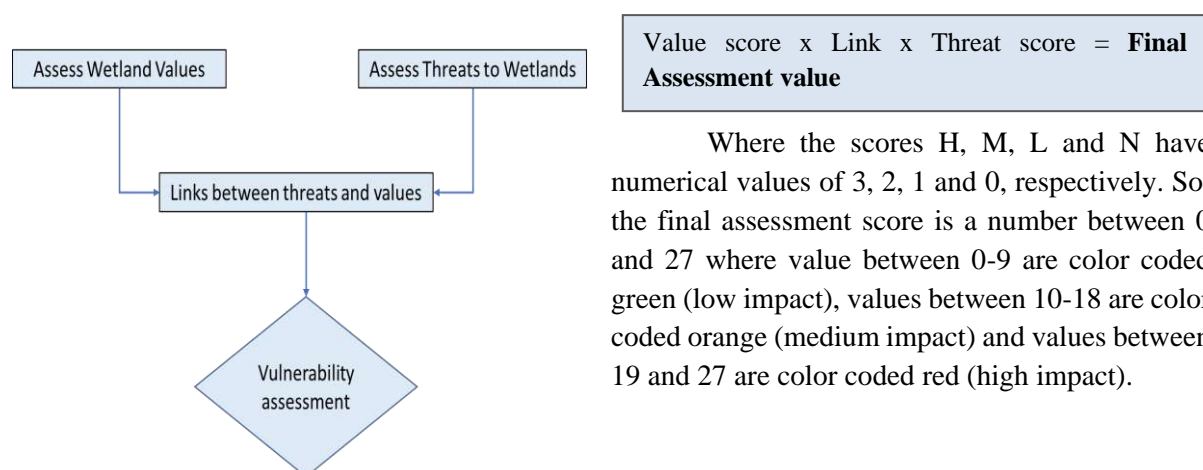
THREAT ON IMPACT MASTER CROSS REFERENCE														
	Pollution - pesticides	Pollution - nutrients	Pollution - industrial	Pollution - urban/domestic	Pollution - organic waste	Siltation/sedimentation	Encroachment - urban/housing	Encroachment - agricultural	Flow regime change - reduced flows	Flow regime change - increased flooding	Invasive aquatic species - floral	Invasive aquatic species - faunal	Invasive terrestrial species - floral	Invasive terrestrial species - faunal
Ecological Impact														
Loss of rare fauna (aquatic)	H	H	H	H	H	M	L	L	L	L	L	H	N	N
Loss of rare flora (aquatic)	H	H	H	H	H	M	L	L	L	L	H	M	N	N
Loss of rare fauna (terrestrial/avian)	M	M	M	M	M	L	L	L	L	L	N	N	L	H
Loss of rare flora (terrestrial)	M	M	M	M	M	L	L	L	L	L	N	N	H	M
Loss of important habitat	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Loss of biodiversity	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Other ecological impact														
Other ecological impact														
Other ecological impact														
Economic Impact														
Loss of tourism	L	L	L	L	L	M	L	L	L	L	L	L	L	L
Loss of fisheries	H	H	H	H	H	M	L	L	L	L	L	H	N	N
Loss of agriculture	M	M	M	M	M	M	M	N	M	M	N	N	M	M
Loss of additional goods and services	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Other economic impact														
Other economic impact														
Other economic impact														
Hydrological Impact														
Loss of HEP	N	N	N	N	N	M	L	L	H	N	L	N	N	N
Loss of irrigation	M	M	M	M	M	L	L	L	H	N	L	N	N	N
Increase in downstream flooding	N	N	N	N	N	M	M	M	N	H	N	N	N	N
Reduced flows in lean period	N	N	N	N	N	M	M	M	H	N	N	N	N	N
Loss of potable water supply	H	M	H	H	H	M	L	L	M	N	L	L	N	N
Other hydrological impact														
Other hydrological impact														
Other hydrological impact														
Social Impact														
Degradation of religious site	L	L	L	L	L	M	L	L	L	L	L	L	L	L
Loss of cultural heritage	L	L	L	L	L	M	L	L	L	L	L	L	L	L
Other social impact														
Other social impact														
Other social impact														

Table 4.20 Threat/Impact value Matrix

Impact Values/Threats	Pollution pesticides	Pollution Nutrients	Pollution Industrial	Pollution—urban/domestic	Pollution Organic waste	Siltation/Sedimentation	Encroachment-Urban/housing	Encroachment-Agriculture	Flow regime change-reduced flow	Flow regime change-increased flooding	Invasive aquatic species-floral	Invasive aquatic species-faunal	Invasive terrestrial species-floral	Invasive terrestrial species-faunal
Ecological impact														
Loss of rare fauna (aquatic)														
Loss of rare flora (aquatic)														
Loss of rare fauna (terrestrial/avian)														
Loss of rare flora (terrestrial)														
Loss of important habitat														
Loss of biodiversity														
Other ecological impact(s)														
Economic Impact														
Loss of tourism														
Loss of fisheries														
Loss of agriculture														
Loss of additional goods and services														
Other economic impact(s)														
Other economic impact(s)														
Hydrological impact														
Loss of HEP														
Loss of irrigation														
Increase in downstream flooding														
Reduced flows in lean periods														
Loss of potable water supply														
Other hydrological impact(s)														
Social Impact														
Degradation of religious sites														
Loss of cultural heritage														
Other social impact(s)														

4.5.3.2.4 Vulnerability assessment

Once all the input values are entered, the vulnerability assessment result can be produced. The final stage combines all of the values in a matrix and gives a single value for each value and threat intersect. The assessment clearly presents the main values that the wetland provides, the threats that the wetland is under, and shows which threats impact on which values (Table 4.21).



This coding system provides the basis for developing interventions by addressing critical issues. It highlights the values that are under most threat, and the threats that are impacting on the most values. The final assessment has the following color codes and symbols used:

Colour/code	Assessment information
Green	Low impact of threat on a value
Amber	Medium impact of threat on a value
Red	High impact of threat on a value
0 (zero)	No impact/effect of threat
///	Impact of both threat/value unknown

Table 4.21 Final assessment score

Table 12.1 Final assessment score

Assessment Table		Threats													
		Pollution pesticides	Pollution Nutrients	Pollution Industrial	Pollution—urban/domestic	Pollution Organic waste	Siltation/Sedimentation	Encroachment-Urban/housing	Encroachment-Agriculture	Flow regime change-reduced flow	Flow regime change-increased flooding	Invasive aquatic species-floral	Invasive aquatic species-faunal	Invasive terrestrial species-floral	Invasive terrestrial species-faunal
Ecological values	Ecological impact														
Aquatic fauna	Loss of rare fauna (aquatic)														
Aquatic flora	Loss of rare flora (aquatic)														
Terrestrial fauna	Loss of rare fauna (terrestrial/avian)														
Terrestrial flora	Loss of rare flora (terrestrial)														
Habitat	Loss of important habitat														
Biodiversity	Loss of biodiversity														
Other ecological values	Other ecological impacts														
2. Economic values	Economic Impact														
Tourism	Loss of tourism														
Fisheries	Loss of fisheries														
Agriculture	Loss of agriculture														
Additional goods and services	Loss of additional goods and services														
Other economic values	Other economic impacts														
3. Hydrological values	Hydrological impact														
Provision of water for HEP	Loss of HEP														
Provision of water for irrigation	Loss of irrigation														
Reducing downstream flooding	Increase in downstream flooding														
Maintenance of flow during lean periods	Reduced flows in lean periods														
Provision of potable water supply	Loss of potable water supply														
Other hydrological values	Other hydrological impacts														
4. Social values	Social Impact														
Religious importance	Degradation of religious sites														
Cultural importance	Loss of cultural heritage														
Other social values	Other social impacts														

The assessment shall be done using Microsoft excel based tool developed by Stratford *et al* (2011).

4.6 Data Management

All data collected during the field work shall be compiled and analyzed in electronic files (Microsoft excel, Collect format, GIS maps, etc). For data management system, *Open Foris* collect software shall be used for collecting, sorting and analysis of data. For the vulnerability assessment, the data should be collected using Microsoft excel sheets. The following sections describe the data flow from field data collection to statistical analysis.

4.6.1 Data Sorting and Analysis

The migrated data are then launched in the *Collect* platform if the data are collected using *Collect Mobile* but have to be entered manually for the data collected through paper forms. From the *Collect* platform, the data shall be exported as comma separated values (.csv) files. These csv files shall be

cleaned, sorted and prepared for final analysis. The data validation shall be executed in *Collect* platform with a set of validation rules developed in Collect survey design itself. The data analysis shall be done using *Calc* or any other relevant software.

4.6.2 Data Quality Assurance

It is imperative to ensure that wetland data collected are in conformity with the data collection format of the NWI. A committee within WMD shall be formed to check the data quality and visit at least 5-10% of the total enumerated wetlands. The data collected by the field offices and the committee shall be compared and then the errors shall be corrected accordingly to improve the quality of data.

4.7 Reporting and Publication

The main reports and publications from the NWI shall be the NWI Report. The report shall provide information on:

- Classification, abundance, location and spatial extent of wetland
- Status and trends of wetlands
- Vulnerability status of wetlands

4.8 Periodicity of NWI

In order to understand the status and trend of wetlands in the country, the NWI should be reviewed, updated and analyzed every 10 years. However, individual wetlands monitoring should be carried out regularly along with other area-based management plans.

4.9 Bibliography

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