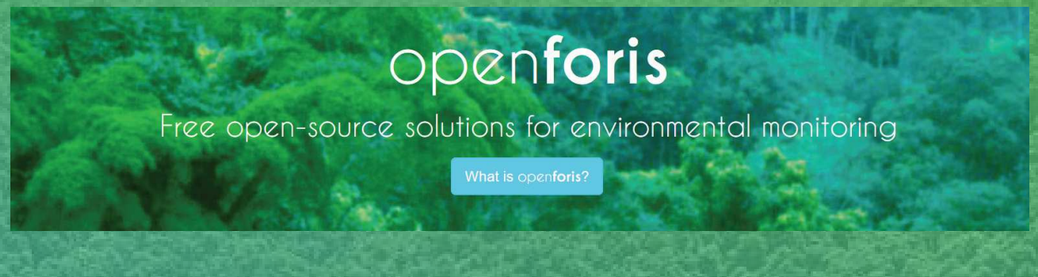
National Forest Inventory Data Management

Bhutan NFI Open Foris Collect User Manual



Collect

Easy and flexible survey design and data management

Collect Mobile

Intuitive data collection and validation in the field

Collect Earth

Innovation land assessment through freely available satellite imagery

Calc

Efficient and collaborative data analysis and result dissemination

Geospatial Toolkit

Powerful commandline utilities for processing geospatial data

Forest Resources Management Division
Department of Forests and Park Services, Thimphu

Declaration

This Open Foris Collect user guide has been developed for exclusive use for Bhutan's National Forest Inventory. Most of the contents are abstracted from Open Foris User Manual 2014, 2016 and Handbook 2018. Therefore, some text in this manual may appear exactly the same as it is in the manuals and handbook published by FAO. This manual printed with financial support from REDD Readiness project funded by Forest Carbon Partnership Fund (FCPF) for World Bank . The Cover page illustration is directly used from open foris website.

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Disclaimer

The content in this manual and illustrations are valid as of June 2018. Since Open Foris Collect is constantly updated by Food and Agriculture Organization of United Nations, the functions, features and status are likely to change in future. Although, all efforts are made to make this manual as comprehensive as possible, user are strongly recommended to use this manual along with Open Foris Collect Handbook (2018) and/or later versions, as and when it is updated.

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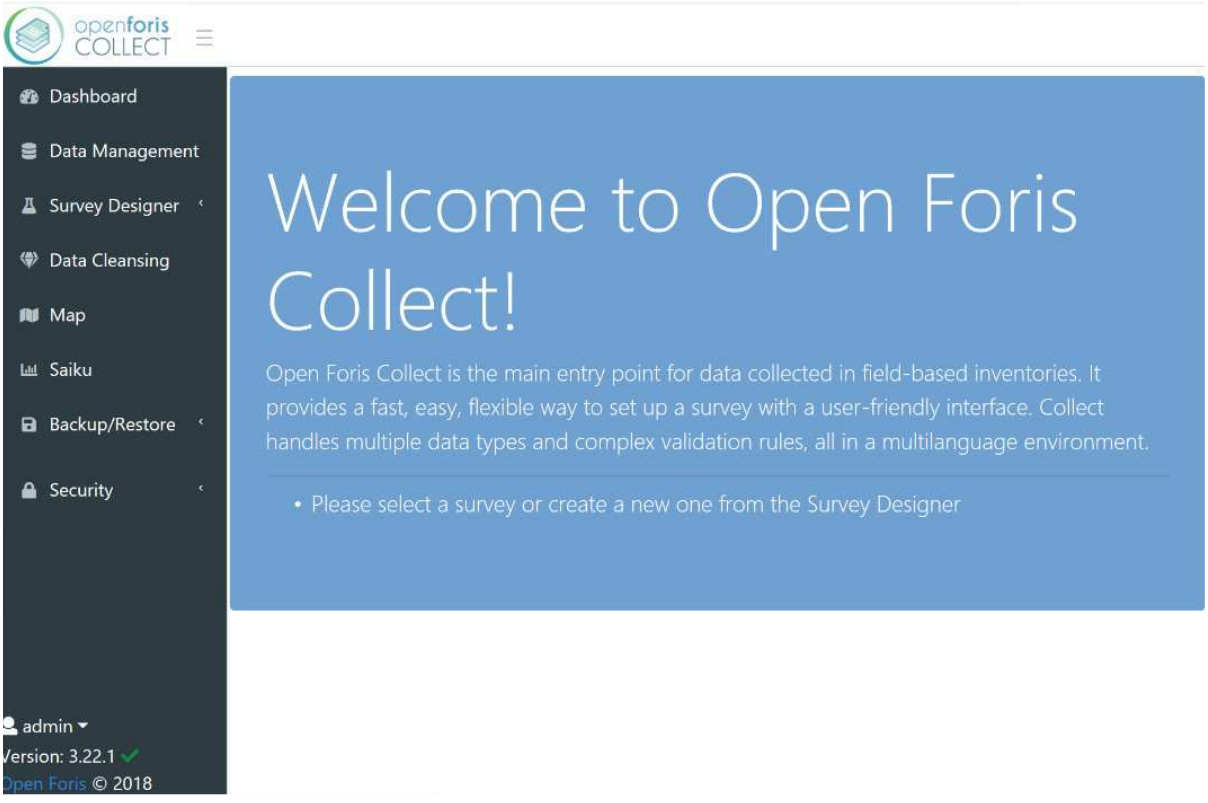

Version 1.0

Forest Resources Management Division
Department of Forests and Park Services, Thimphu

Foreword

National Forest Inventory (NFI) have collected massive amount of data and information from 1685 accessible cluster plots from across the country. This warrants development of independent data management system with capability of storing, processing, analyzing and generating desired information on forests and its resources. The development of independent data management system for NFI with analytical functionality had been kept on halt on premise that the FAO has developed open sources stand-alone software called 'Collect' under Open Foris Initiative.

The Collect has capability for designing the survey forms, storing data, data back up as well as to generate summary statistics of information collect. The Collect tool is currently used for NFI data management including cleansing and generating summary statistics of information collected from the field. Therefore, this manual has been developed to guide and aid whosoever is coordinating the periodic NFI in future. This manual is very important as field works for next NFI is going to be decentralized and primary processing of data are expected to happen in field offices.

This manual provides a step by step illustrations from designing survey forms, importing and exporting data into and out of the Collect system, data cleaning process and generating summary statistics for information collected from the field. Since Open Foris Collect is constantly updated, this manual will be revised as and when required to incorporate the changes made in the collect system and NFI survey designs.

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01 Background

National Forest Inventory Data was collected using Trimble Juno Global Positioning System (GPS). These data were migrated to Open Foris Collect for data entry, cleansing and management while data analysis was done with R package and Open Foris Calc. This document provides step-wise illustration for designing NFI forms using customized standalone version of Open Foris Collect. The Open Foris Collect-Handbook, 2018 , Food and Agriculture Organization of United Nations (FAO) is available online at Open Foris website http://www.openforis.org/.

02 Overview of Open Foris toolkit

Open Foris Toolkit is a set of free and open-source software that facilitates flexible and efficient data collection, analysis and reporting (google openforis for details). These tools are developed by the Food and Agriculture Organization (FAO) of United Nations in 2009 and are continuously being updated. Currently, Open Foris toolkit comprise of Collect, Collect Mobile, Collect Earth, Calc and Geospatial toolkit (Figure 1).

Figure 1: Overview of Open Foris toolkit

03 Downloading, installation, starting collect, shutdown and update

3.1 Browse Open Foris website

Browse Open Foris website http://www.openforis.org/ and click on the Collect as indicated in Figure 2.

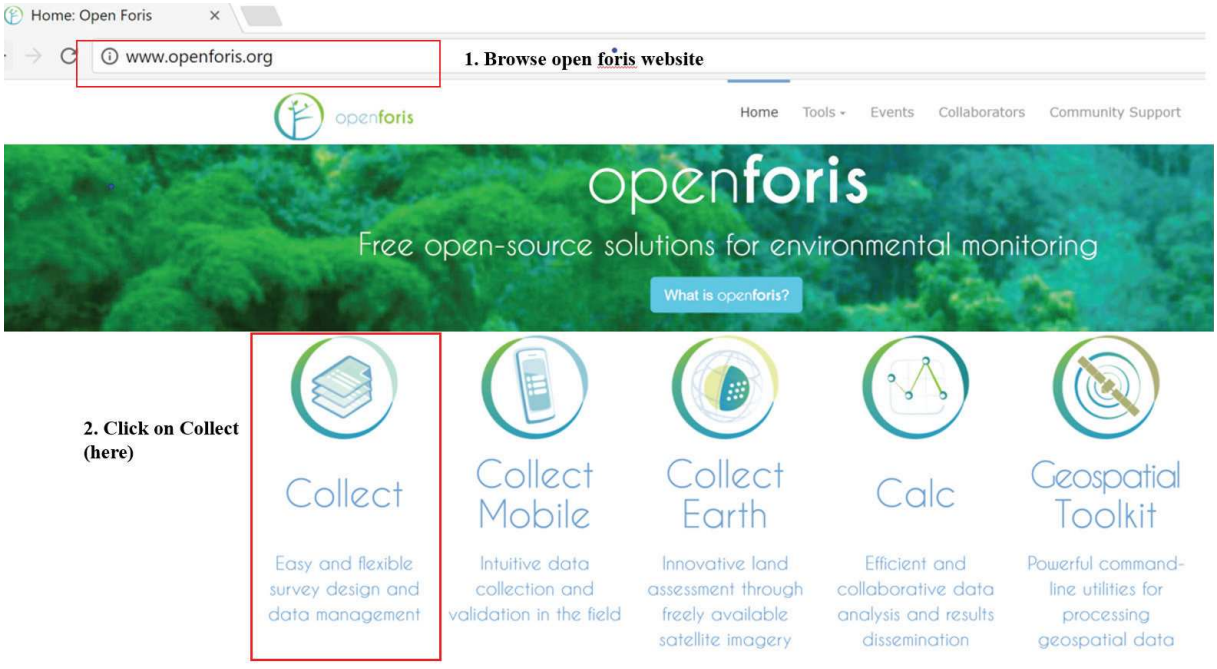


Figure 2: Browsing Open Foris website

3.2 Downloading the Collect installer

From the download link, download appropriate version of Collect based on operating system of your PC (Windows or Linux or Mac OS X version). In our case, we have downloaded the windows version of the Collect as illustrated in Figure 3.

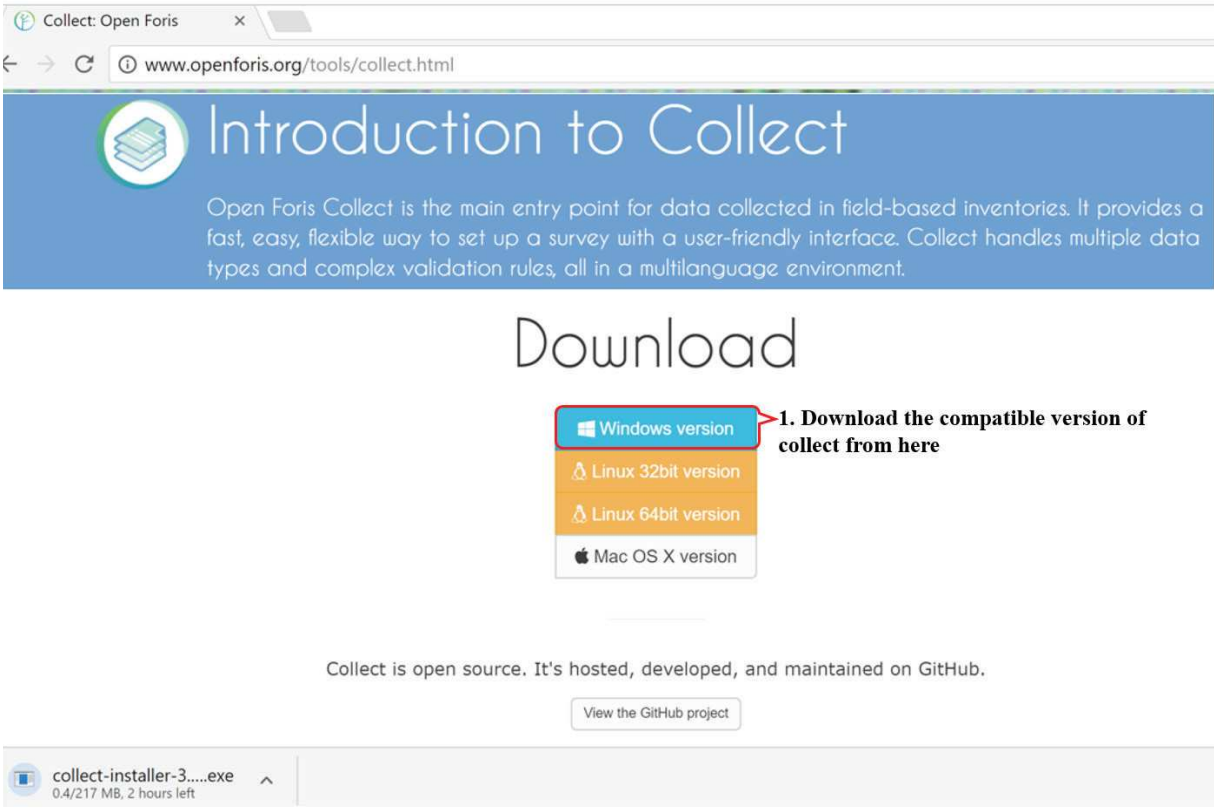


Figure 3: Downloading windows version of Collect

3.3 Installation of Collect

Run collect-installer-3.22.1-windows.exe from your download directory as an administrator and follow on screen instruction. Do not change the file directory. The Collect will be installed by default into C:\opt\openforis\collect (Figure 4).

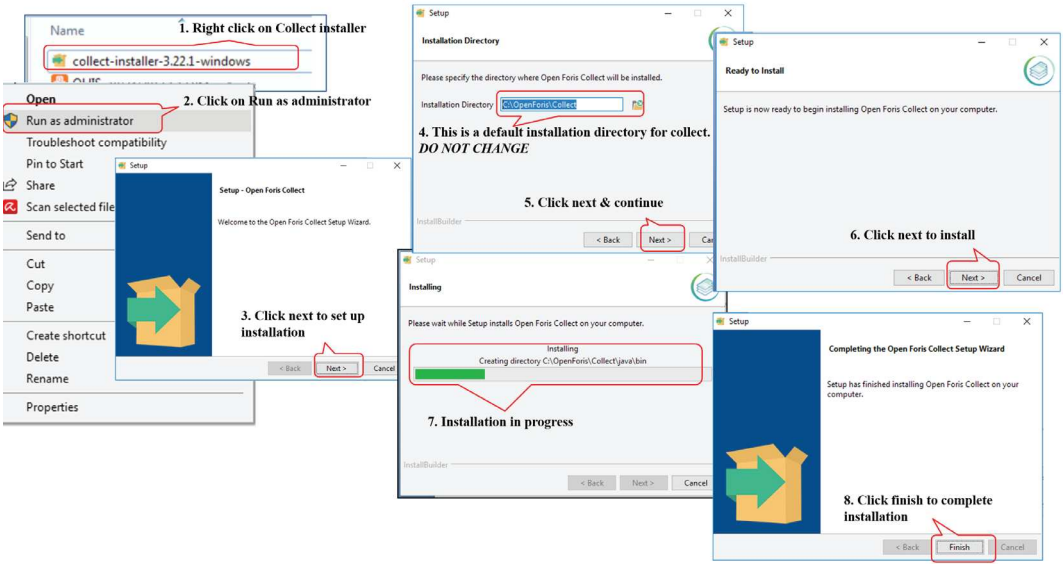


Figure 4: Installing the Collect

3.4 Starting Collect

From start menu, select "All programs", then go to Open Foris Collect folder and click on the drop-down button followed by the Open Foris Collect. A Collect Control Panel will open with the message '**Starting up 'DO NOT CLOSE!' .** Do not close this control panel, and wait until message changes to 'Running!'(Figure 5). Then Collect will open in a web-browser (google chrome is recommended) with a login page. You can also open collect by typing Collect in search option at the start menu and then clicking on Open Foris Collect.

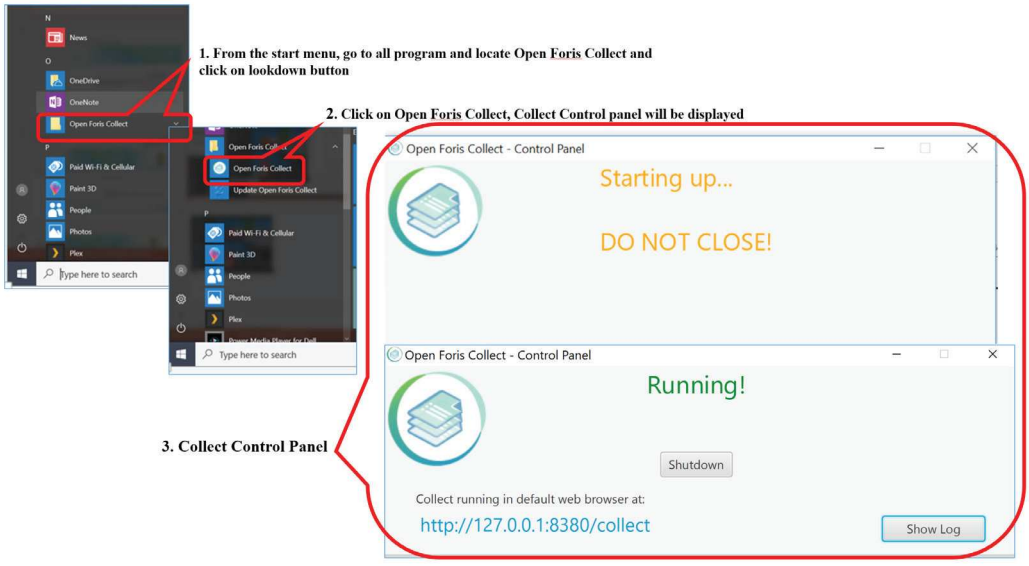


Figure 5: Collect Control Panel

3.5 Collect Login

Collect browser should automatically start up once collect control panel changes from starting up to running. If not started, follow description in section 3.4. Then, login into collect using default username and password (admin/admin) (Figure 6*)*

Note: Do not close the Collect control panel while using Collect. However, you can minimize it to taskbar)

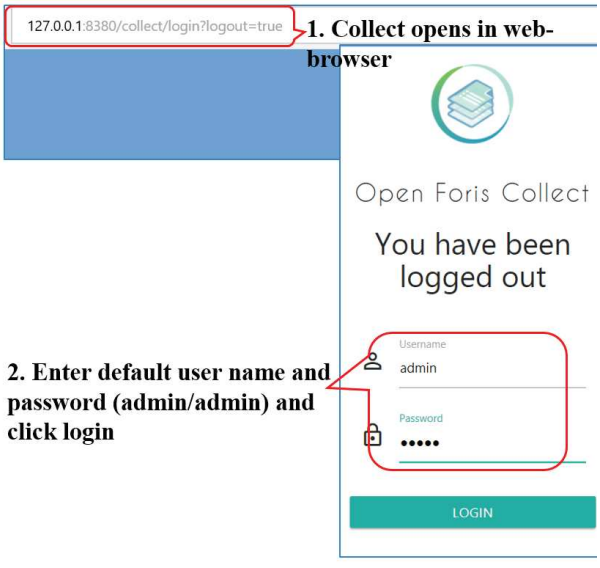


Figure 6: Collect Login

3.6 Shutting down Collect

Close the browser using Collect and close the Collect control panel by clicking the shutdown button (Figure 7).

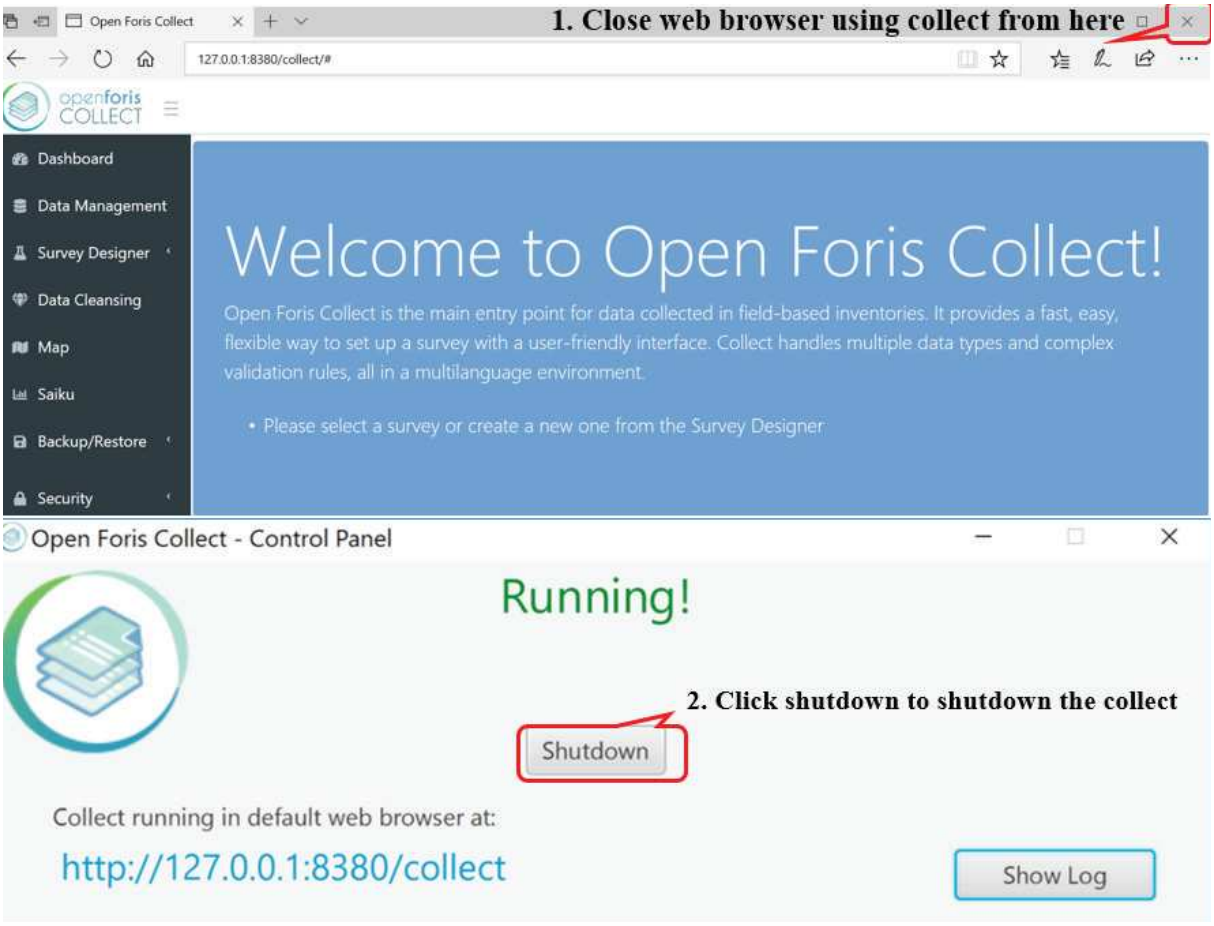


Figure 7: Shutting down the Collect

3.7 Updating Collect

When a newer version of Collect becomes available, automatic message will appear on screen to update your Collect. This can also be done from Start Menu as illustrated in Figure 8. Go to start menu, all programs, click on Open Foris Collect and select Update Open Foris Collect. A new window will popup. In the new window, follow onscreen instruction or click 'Next', a new window will open, again click 'Next'. A new pop-up window will open showing whether a new version of collect is available or not. If new version is available, click 'Next' to download and update the Collect.

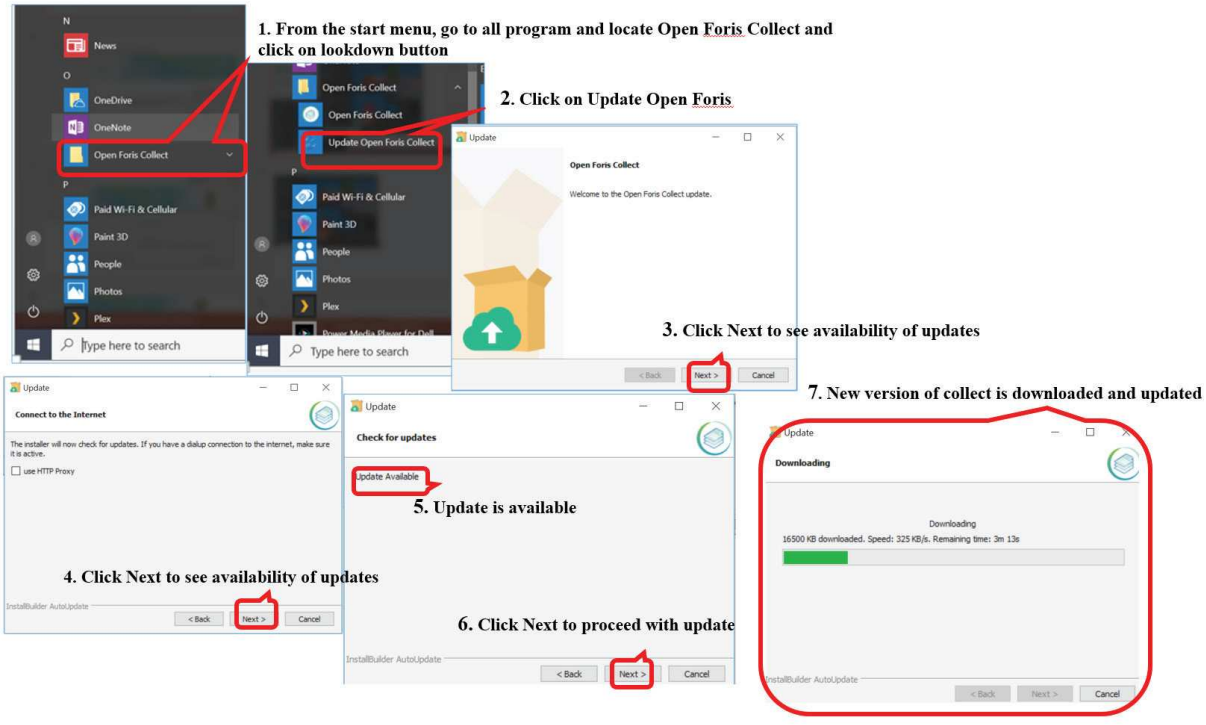


Figure 8: Updating Collect to newer version

3.8 Collect Home Page

Once you login into the Collect, Collect home page will be displayed. There are nine features namely Dashboard, Data Management, Survey Designer, Data Cleansing, Map (beta), Saiku, Backup/Restore, Users Accounts and Settings (Figure 9). Each component has specific functions:

i. Dashboard provides overview of existing surveys and data collection process
ii. Data Management for data entry, cleansing and data management
iii. Survey Designer starting point for designing surveys
iv. Backup/Restore for backup and store of data and surveys
v. Saiku (Beta) for simple analysis (tables and graphs)
vi. Users accounts for defining the label of user (at data entry level, cleansing level and analysis level
vii. Settings to change the graphical elements of collect, etc.
viii. Map to view sampling points on map
ix. Security for administrative authority

The detail description of each feature of the Collect interface can be found in Collect Handbook developed by FAO and it is available online at www.openforis.org

Figure 9: Collect home page

04 Creating New Survey for Bhutan NFI

In Collect, we can either use an existing templates to create a survey or start from scratch. For the purpose of NFI, we have started the survey design from scratch.

4.1 Creating survey name

Since we are designing a new survey, click **Survey Designer** on the Collect home page. There are three options of **List of Surveys, New Survey and Import Survey**. Click on **New Survey**. A table to type the name of the survey will open on the screen, which contains information such as Name, Template, Default Language and User Group. Type **'bhutan'** as the Name of the survey, select blank from the dropdown list in the template row, select 'English' as default language and 'Default Public Group or Private Admin' as User Group and click on **New** as illustrated in Figure 10 to save the survey name. A new window (survey designing window) will be displayed as illustrated in Figure 11. ***Please note that the survey name should be always in lowercase.***

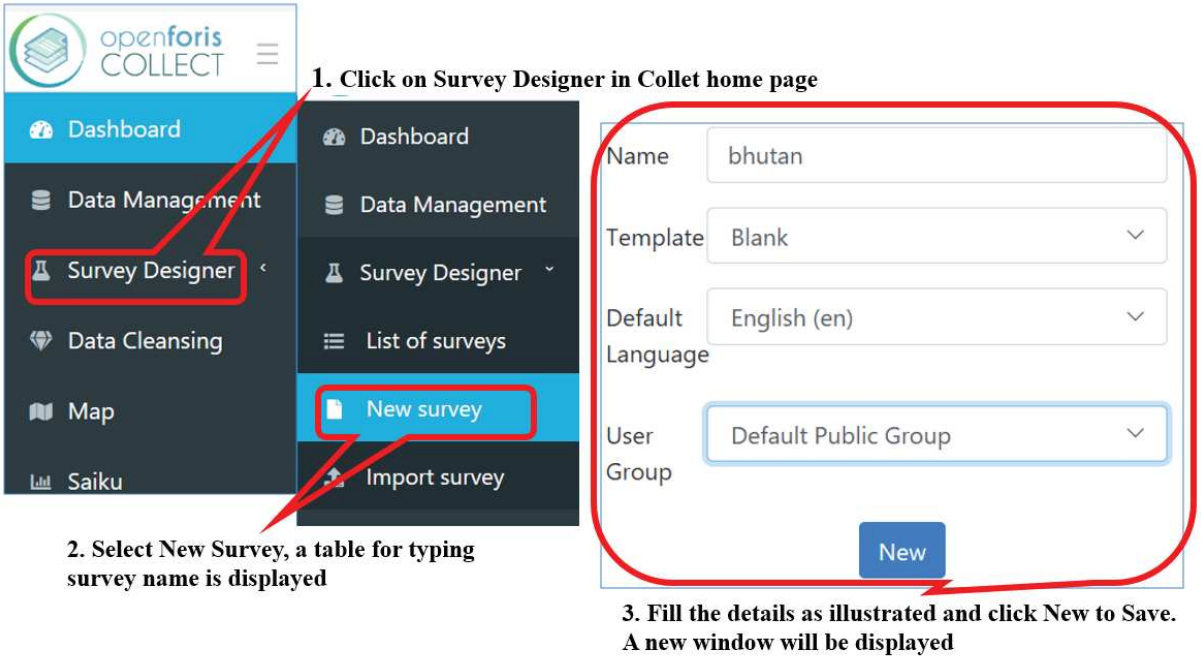


Figure 10: Creating a new survey

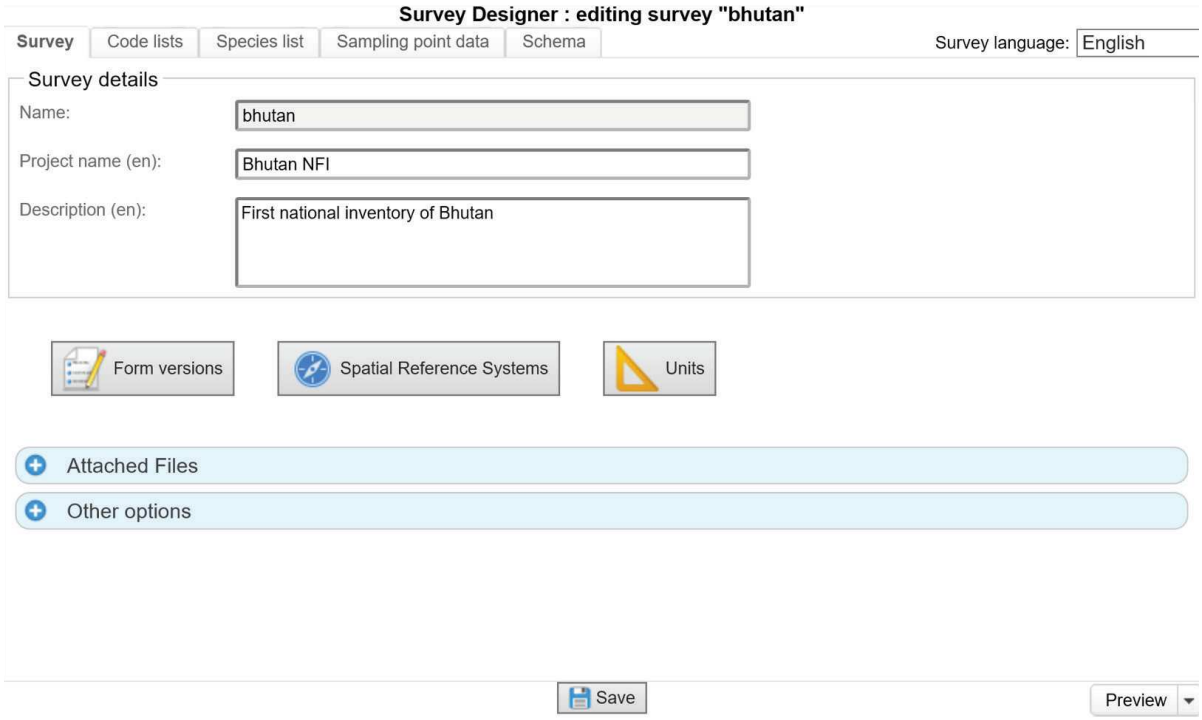


Figure 11: Survey Designer Window

4.1.1 Survey Designer Window

There are five tabs in survey designer window viz. Survey, Code lists, Species list, Sampling point data and Schema (Figure 12).

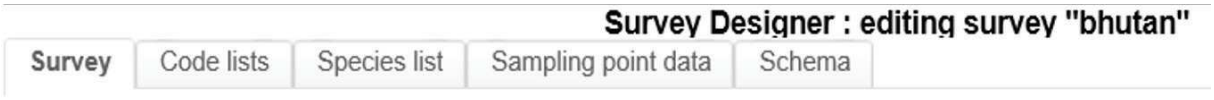


Figure 12: Survey design tabs

4.1.2 Describing and creating a survey

Click on the Survey tab to see Survey details (usually auto-selected as in Figure 12). Type the Project name as 'Bhutan NFI' and Description as 'First national inventory of Bhutan' as illustrated in Figure 13.

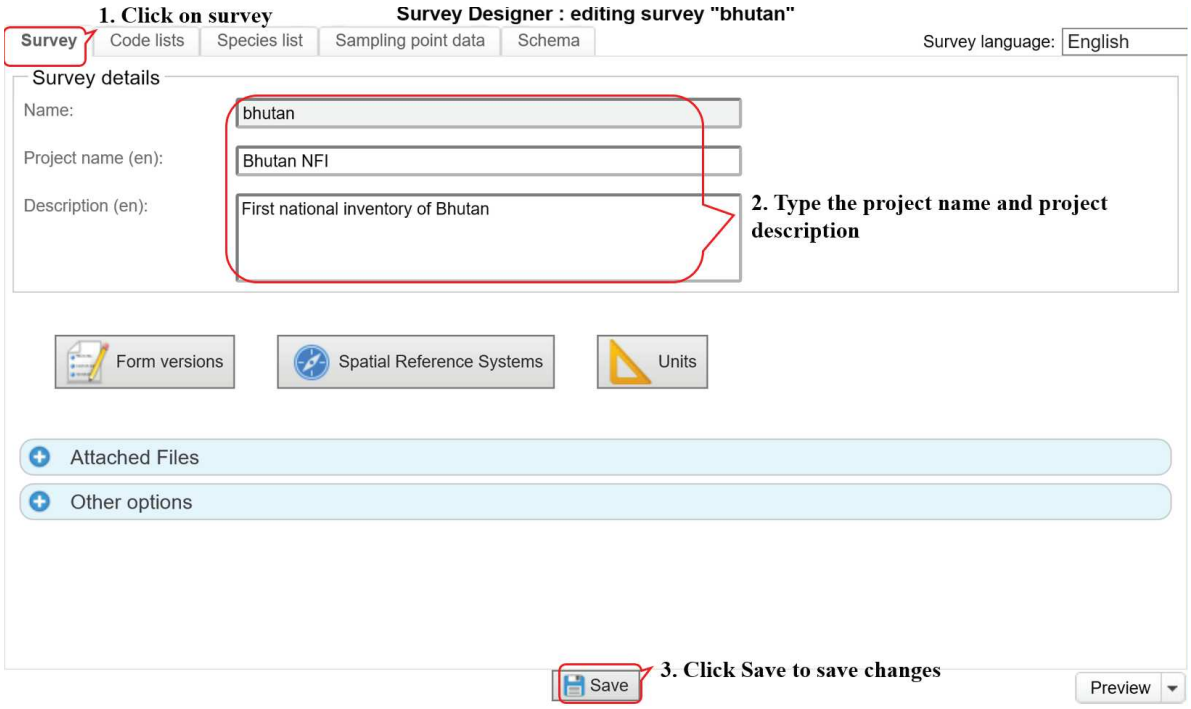


Figure 13: Project naming and description of survey

Note: If you already have a copy of survey design (exported from collect), you can directly import the survey into Collect (refer Section 11)

4.1.3 Adding form versions

Form Versions is the version of our survey. You can either ignore or add a version to survey. To add version to your survey, click on **form version**. A new window will pop-up. Click on **green +** [ ] to add form version number. A new window will pop-up and filled as illustrated in Figure 14.

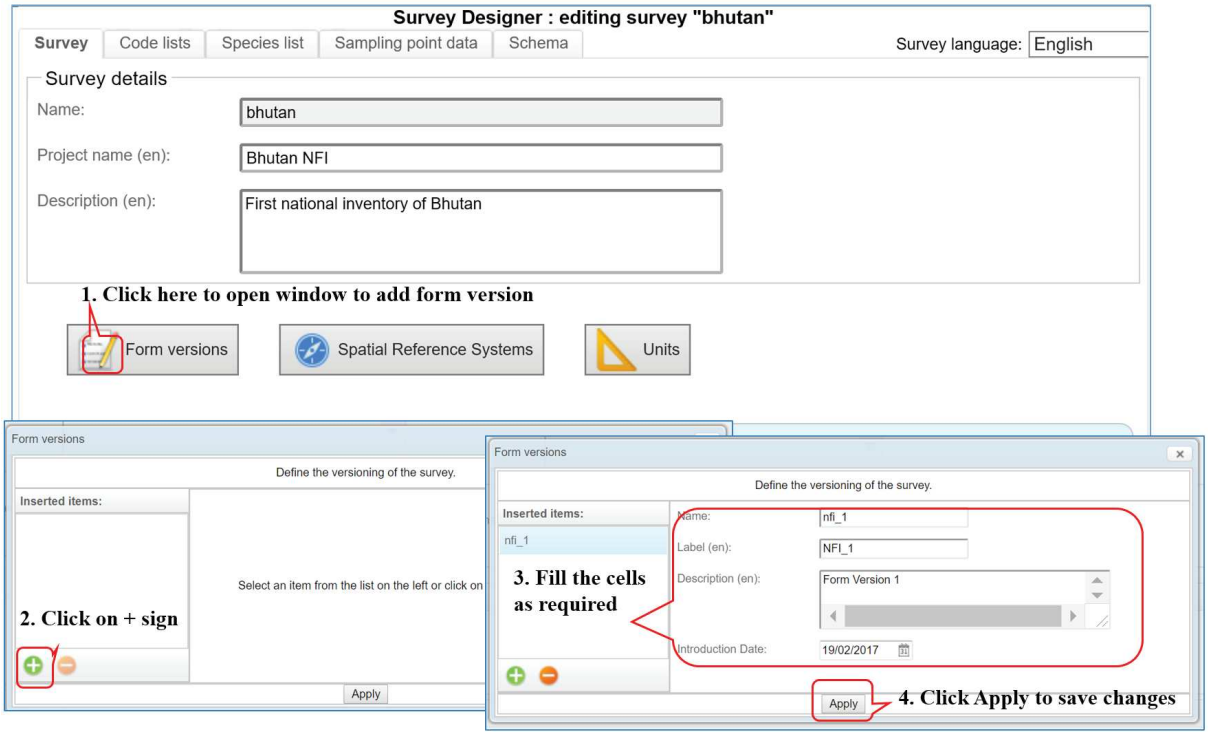
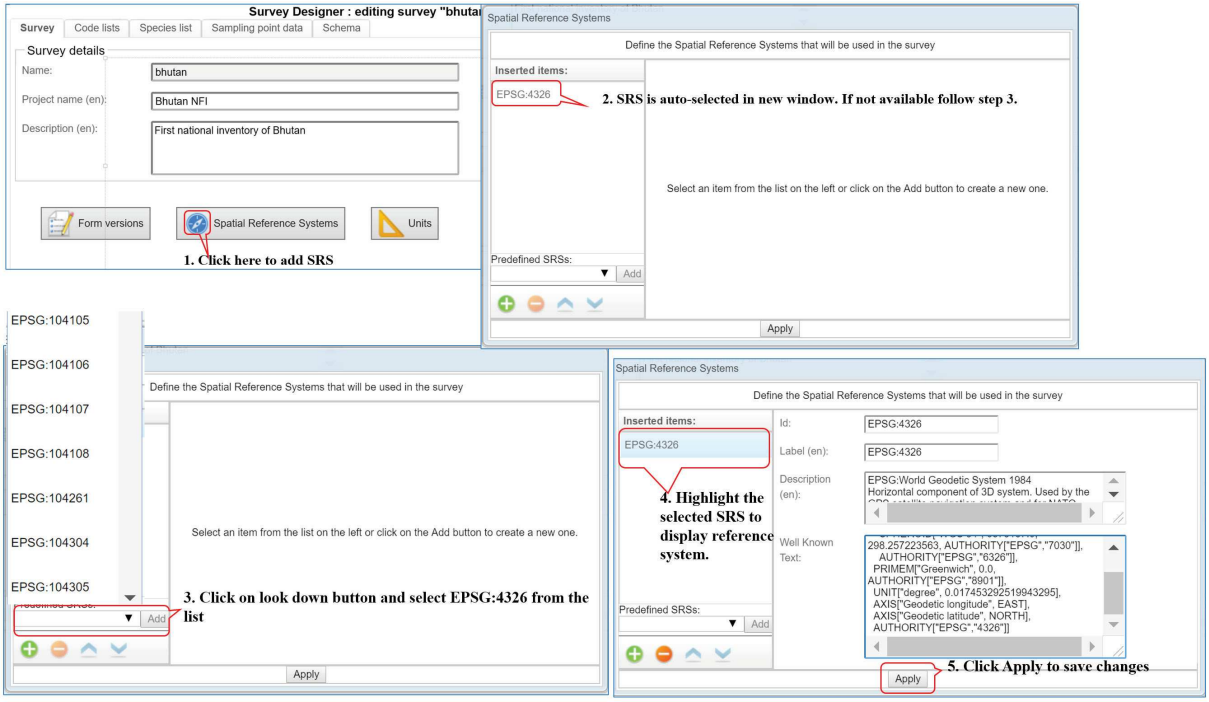


Figure 14: Adding form version to survey

4.1.4 Adding spatial reference system (SRS)

Spatial Reference System (SRS) is a field used for specifying the geospatial settings used in the survey by selecting a predefined SRS from the list. To add SRS click on **spatial reference system**, a new window will pop-up. In this new window, select **EPSG: 4326 (for Bhutan)** from the dropdown list (if not auto-selected), highlight the selection and geographical reference will be displayed. Click apply to save spatial reference system as illustrated in Figure 15.



4.1.5 Adding units

Units are the measurement units which are/ will be used throughout the Survey designing. A set of predefined units are automatically loaded in the system. If predefined units are not enough, then add additional unit by clicking on **Units**. A pop-up window will appear, click on **green** + [ ] to add units, add description and click apply to save changes as illustrated in Figure 16

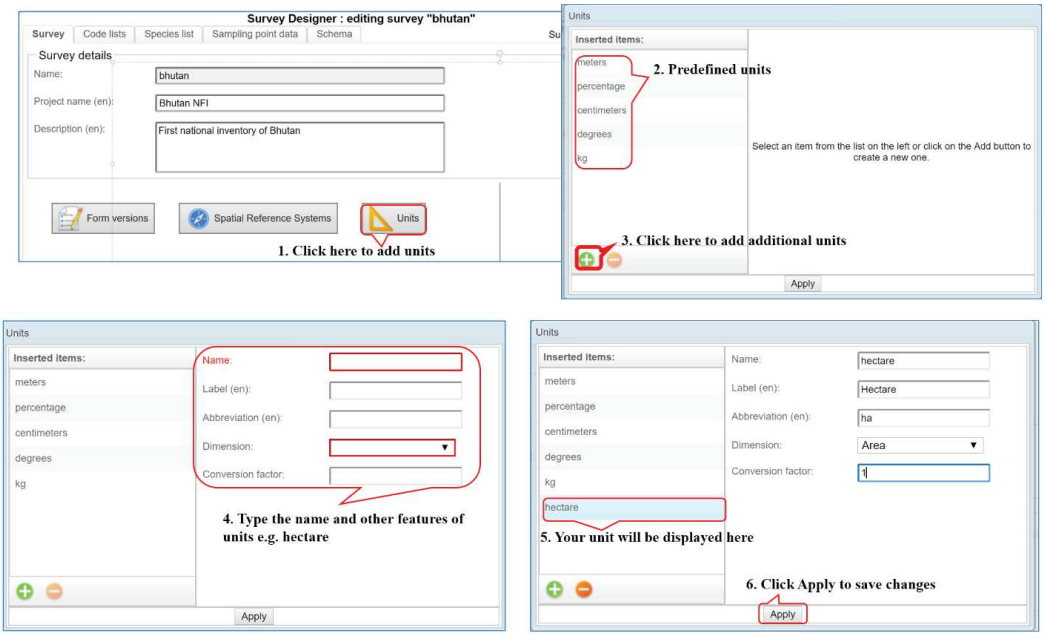


Figure 16: Adding units

4.2 Adding codes for entities and/or attributes

In the Survey Designer window, we have a tab called **Code lists**. This tab is used for adding codes for entering codified information during field data collection. In current NFI, we have coded land use, forest type, dzongkhags, aspects, etc. to appear as coded attribute. Codes can be added **manually** one by one by typing in the relevant field or can be imported as a **batch file** (csv. and zipped folder).

4.2.1 Adding code manually

To add code manually, click on code list tab on the survey designer window, then click on **green** + [ ] button to open fields for adding codes. In the newly opened field, provide description of parameters to be coded as illustrated in Figure 17, then click on **green** + [ ] button to define code, a pop-up window will appear, define code in this pop-up window and click Apply to save changes. You can also import codes for individual parameters by clicking Import button.

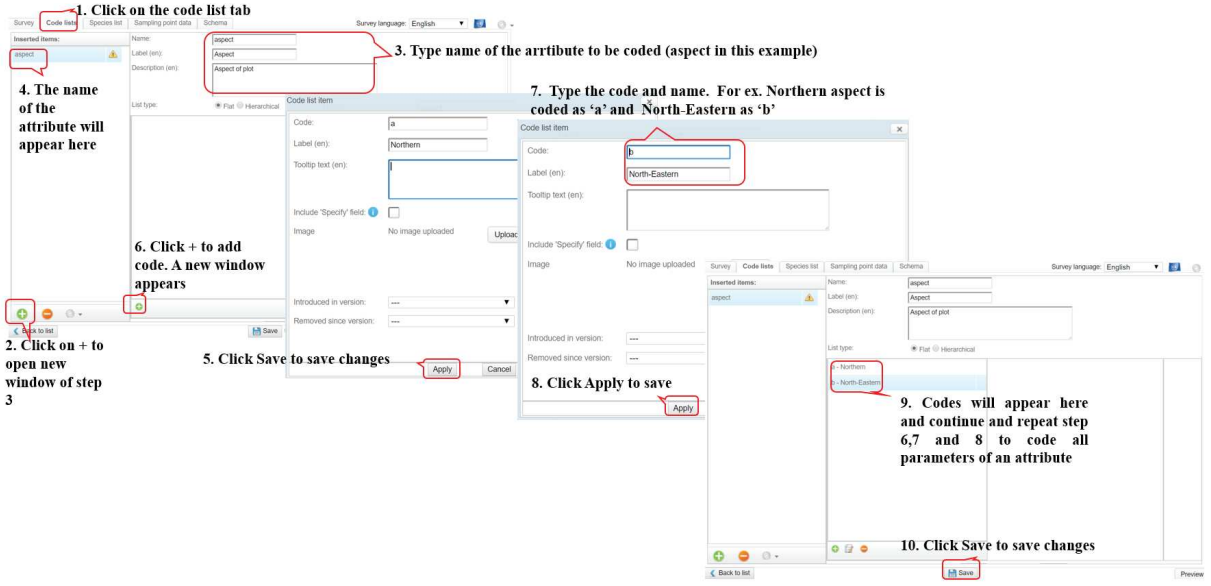


Figure 17: Adding codes manually

4.2.2 Adding codes as batch file

To add code automatically by importing as batch file, prepare list parameters and codes for each parameters in separate excel sheet, save as CSV file, compile code file in one folder and compress or zip it. Then on code list tab on the survey designer window, click on drop down menu, you will see two option '***batch import and batch export***' , click on '**Batch Import**', a new window opens, select relevant zipped folder containing code (e.g bhutan_code_lists.zip), then, click open, upon which the import process begins automatically, and the imported code appear in the code list. Highlight any parameter to view codes and click save button to save the imported codes (Figure 18). To export codes as zipped folder, we can click on batch export from an existing survey.

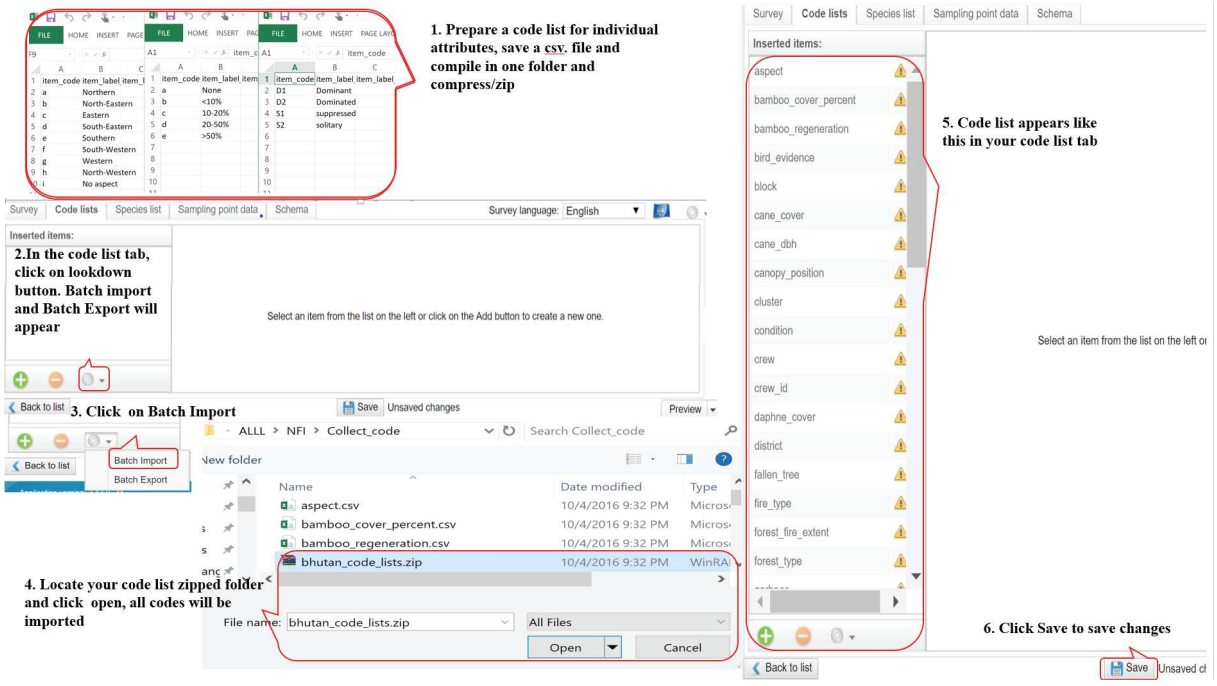


Figure 18: Importing code as batch file

4.3 Adding species list

4.3.1 Preparing species list

This is a place where we add the list of species of trees, shrubs, herbs, birds, mammals, reptiles, etc. based on our requirement. Therefore, we need to prepare list of species that will be used as reference during the field work and survey designing. To prepare a species list, we can download an example file for species list and prepare our list in the same format. The format contain information on code assigned, family and scientific name, local name of the specie and it is saved as CSV file (Figure 19).

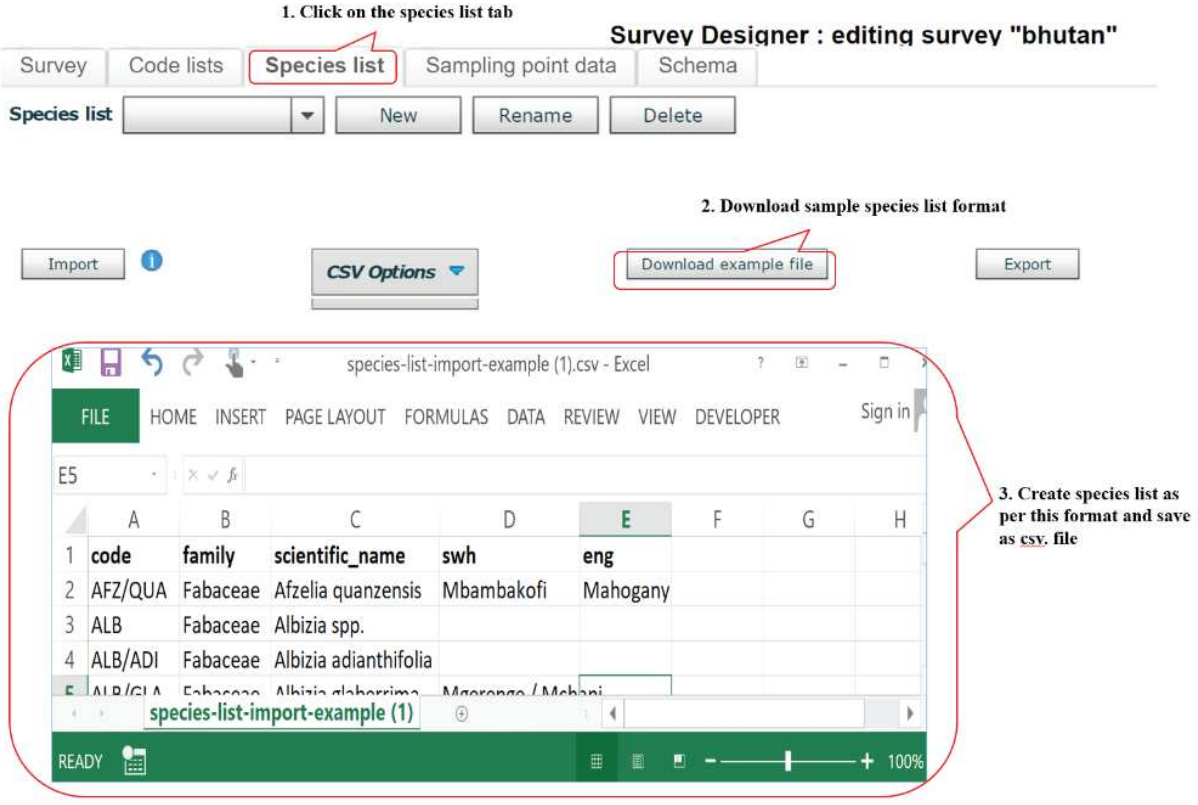


Figure 19: Preparing species list

4.3.2 Creating species list name in survey

Now create species list name in the Collect, viz. trees, herbs, shrubs, birds, mammals, reptiles, etc. by **clicking species list tab** in the Survey Designer window. Click on **'New'** button and type 'trees' in the species list name and click Ok to save the species list name. **Repeat** the procedure to add other species list name such as 'herb, shrubs, birds, etc.' as illustrated in Figure 20.

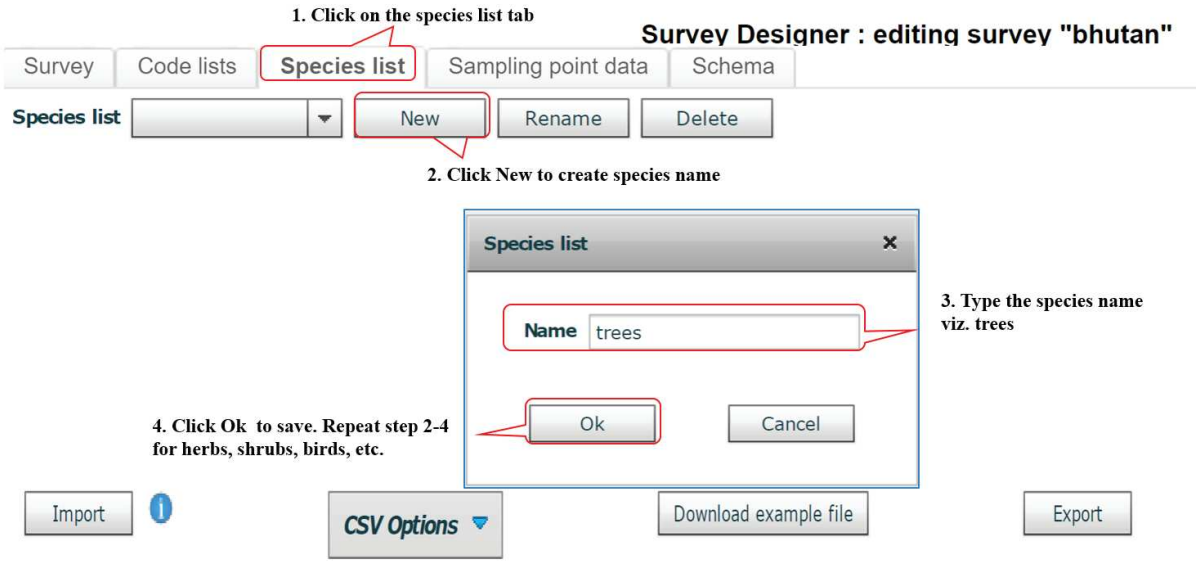


Figure 20: Creating species list name in survey

4.3.3 Importing species list

The species list CSV file have to be imported one by one for different species list. From the species list tab select **species list name** (e.g tree), a blank screen will appear, on the bottom of the blank screen click on **import**, select CSV file to be imported and click **open,** species list get imported as illustrated Figure 21. The example is illustrated for tree species list. This procedure is replicated for shrub, herb, birds, NWFP, mammals and reptiles.

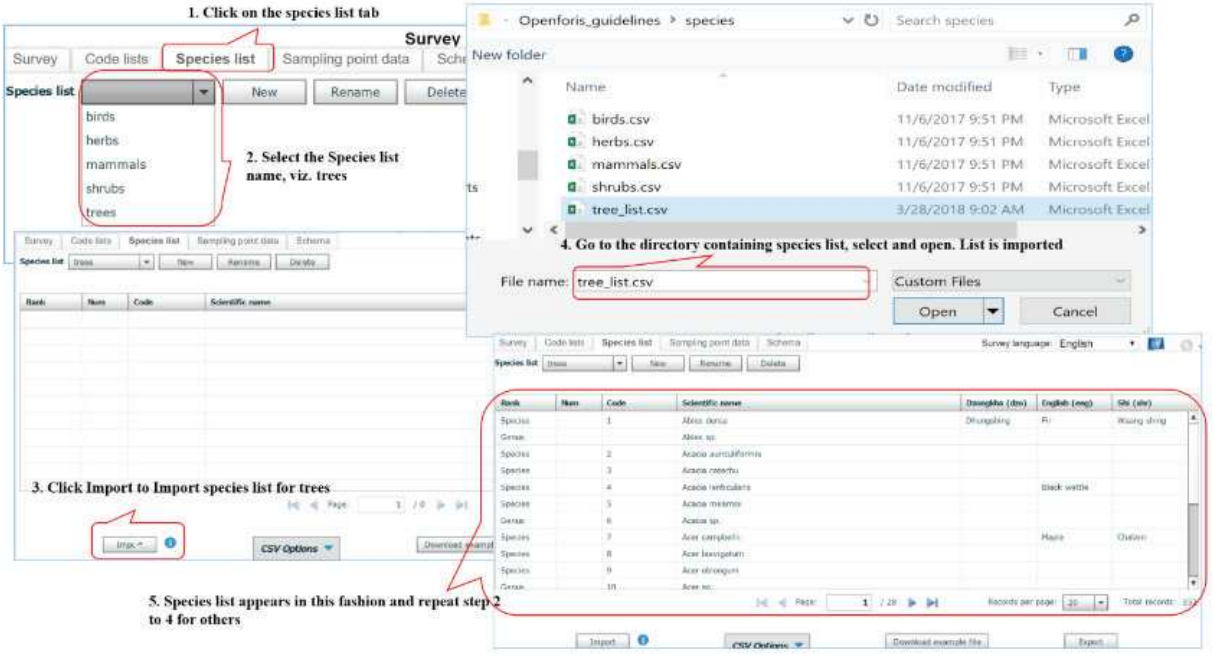


Figure 21: Importing file containing species list

4.4 Adding sampling design/point data

4.4.1 Preparing sampling point coordinates

Here we add the coordinates of sampling point location in a survey design. To do sampling points coordinates, click on **sampling point data** on Survey Designer tab and download example file to prepare coordinates of sampling points. The example is illustrated in Table 1. Save the table as CSV file.

Table 1: Example of sampling point coordinates

level1_code	level2_code	x (Easting)	y (Northing)	srs_id
CP0001		89.7931317	28.2115797	EPSG:4326
CP0001	E	89.7936408	28.2115803	EPSG:4326
CP0001	L	89.7931317	28.2115797	EPSG:4326
CP0001	N	89.7931308	28.2120308	EPSG:4326
CP0002		89.8338775	28.2116353	EPSG:4326
CP0002	E	89.8343867	28.2116358	EPSG:4326
CP0002	L	89.8338775	28.2116353	EPSG:4326
CP0002	N	89.8338767	28.2120864	EPSG:4326

4.4.2 Importing sampling point coordinates

Now import .csv file (created in 4.4.1) containing the coordinates of sampling points as illustrated in Figure 22. Click on **Sampling point data**, click on **import,** select and open .csv file containing coordinate point. Click OK to complete after the sampling points gets imported.

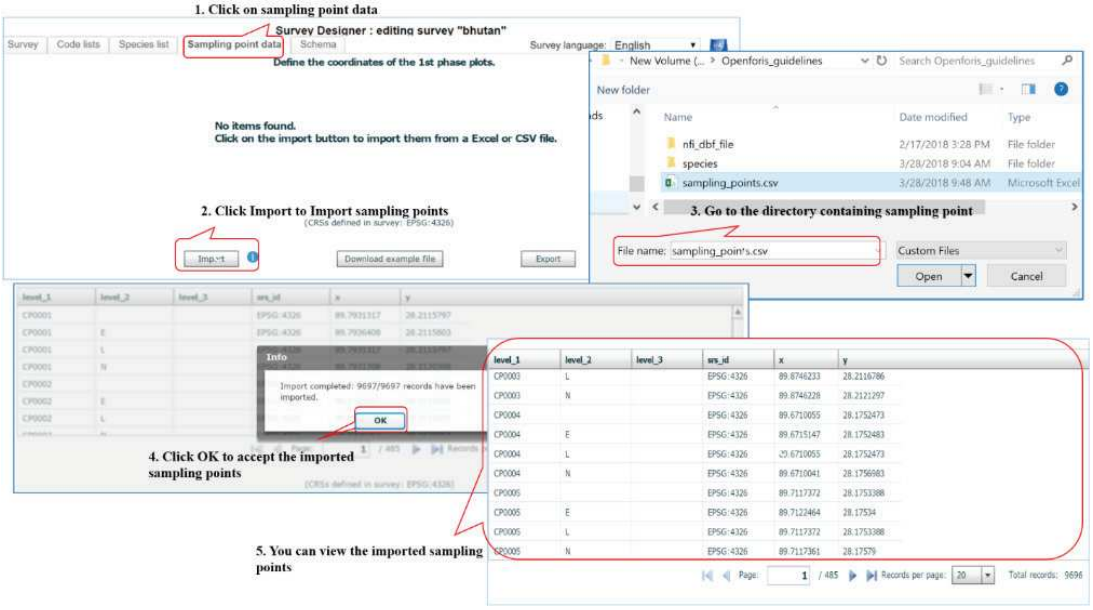


Figure 22: Importing Sampling point coordinates

4.5 Schema

Schema is the core of the survey design and it is the main page where all forms are designed. In this stage, survey designer defines every item (entity) and related attributes, which are to be measured in the field. Therefore, one should have clear idea on the logical structure of the survey, a detail list of the variables to be measured/recorded during the field work and clear decision on methods of measuring variables. Main steps in designing survey forms are described below.

4.5.1 Define sampling unit

Define one or more sampling unit or record type (the highest level of the hierarchical structure of sampling design). In case of **NFI, Cluster** which contains subplots is the highest in the hierarchy of sampling design. The plots which contains information on trees, sapling, shrubs, herbs, etc, and carbon plots constitute lower hierarchical level. To start form designing, first: click on Schema, change the sampling unit name as cluster by clicking ( ), a pop-up window will appear, then click Apply to save changes. Select the form version name as developed earlier and follow the steps illustrated in Figure 23.

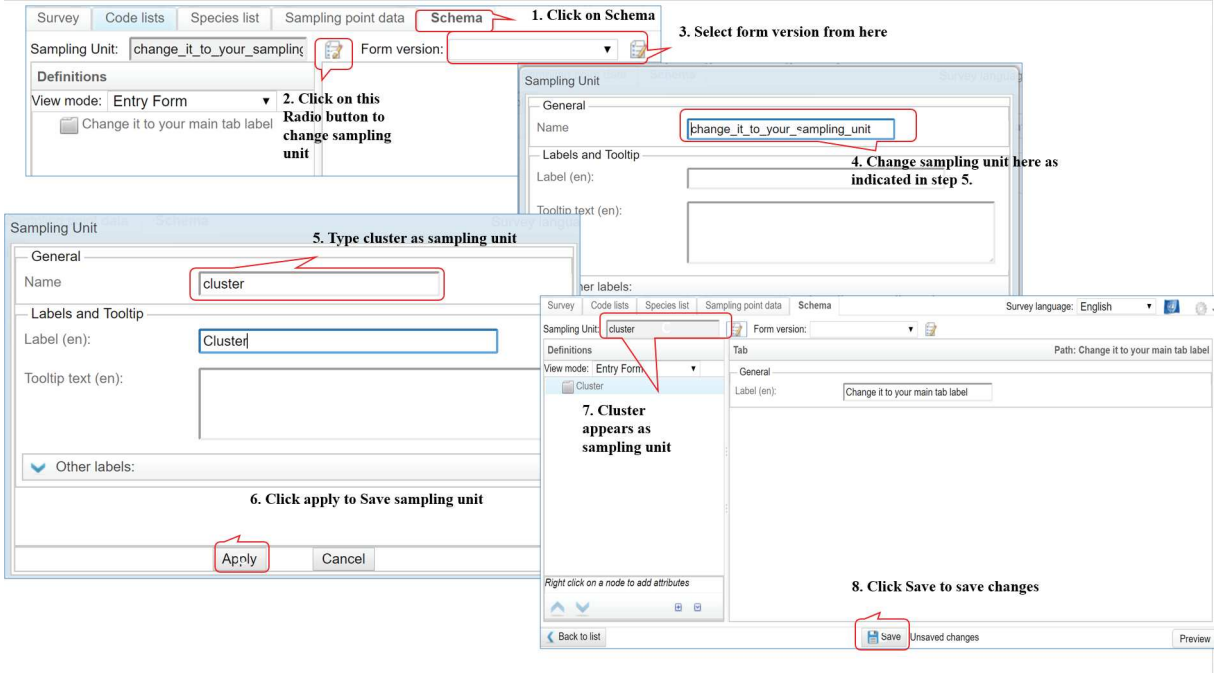


Figure 23: Defining sampling unit

4.5.2 Changing label name or record type

To change the label name, click on the **Cluster** or change it in your tab label as indicated in Figure 24. A new data tab will open and change the name required (e.g Cluster Plot Form).

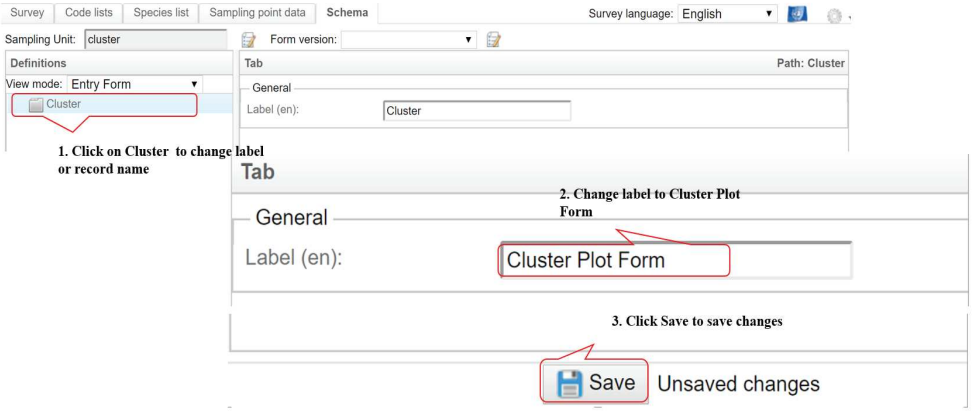


Figure 24: Changing label /record name

4.5.3 Adding additional record

To add additional **Record type**, right click anywhere in the blank area below the existing record type (Cluster Plot Form in our case), Add tab [Add tab] menu will appear, click on Add tab [Add tab], a new record type '**Label not specified'** will appear, then click on the label not specified record type and rename as **Plot and Carbon data** for NFI as separate record**.** The step by step instruction is illustrated in Figure 25 for creating plot record. The procedure is repeated for carbon data.

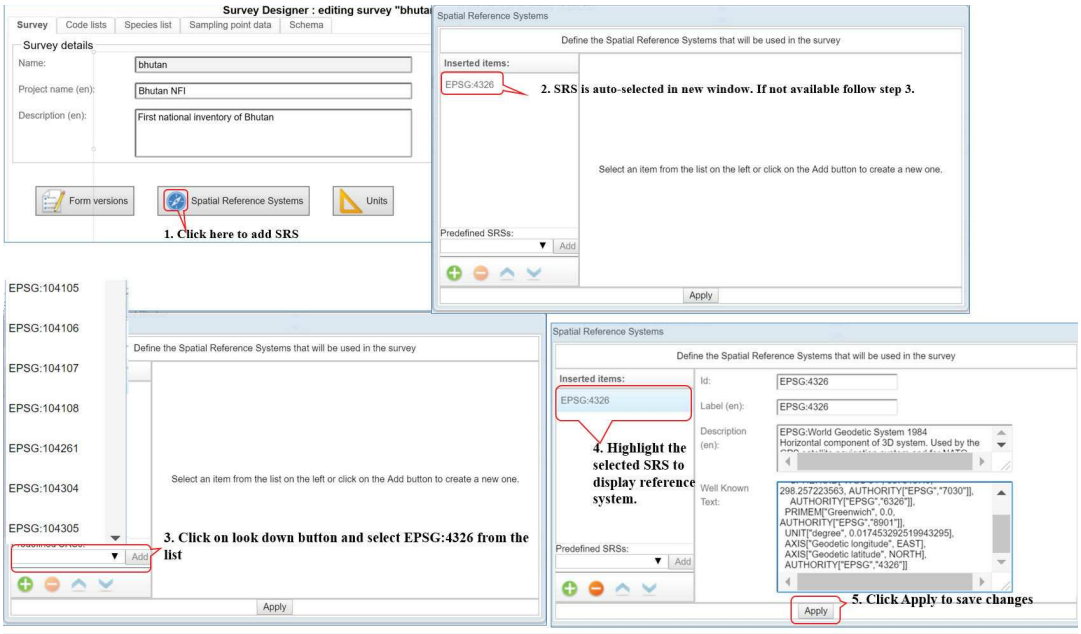


Figure 25: Adding new records

4.6 Entity and attributes

Entity is name of table or forms, while **attributes** is information within the entity. For example, tree is an entity while tree location, height, diameter, conditions, etc. are attributes of the entity called tree.

4.6.1 Entities

When adding an Entity, the user can choose among three types of enity: Single (grouping), multiple (form layout) or multiple (table layout). Single (grouping) entity is used to record an item (variable) that will appear only once (with a relationship 1:1 with its parent Entity e.g date of enumeration). Multiple (Form or Table layout) entity are used when the relationship is 1: N meaning that there will be more instances of that entity are related to the parent entity, e.g relationship between plot and trees, tree and tree species. In general, entities appear as file name while attributes appear as column heading. However, when entities are added as single (grouping), they do not necessarily constitute a file name.

4.6.2 Attributes

Attributes are always added in relation to an Entity and it defines the way in which the data is recorded. Attribute types are the following type.

Boolean	:	check/un-check (e.g yes/no)
Code	:	coded attributes (see code lists)
Coordinate	:	allows to enter geographical coordinates
Date	:	entered in dd/mm/yyyy format
File	:	allows to upload a file (e.g. photos, notes, etc.)
Number	:	numeric value (integer or real)
Range	:	allows to define a numerical range
Taxon	:	allows to add a record from a previously added species list
Text	:	allows to add free text
Time	:	entered in hh:mm format

4.7 Parameters used for adding entity or attributes

There are many parameters in Collect, to be checked, entered while adding entity or attribute to a record or entity in the process of designing the survey forms. The list of these parameters from Collect User Manual 2014 are provided in Table 2.

Table 2: Description of parameters of entity and attribute

Parameters	Descriptions
Name	Attribute's or Entity's name in lower case. Should be quite short and simple as functions within the survey use this name.
Type	For Boolean (Y/N/Blank or Y/Blank); for Number (numerical type: integer / real); for Text (text box style: short= one row / memo= text box)
Multiple	Allows multiple entries for this attribute
Min count	Fixes minimum number of entries allowed
Max count	Fixes maximum number of entries allowed
Required	If checked, the record can be saved only if a valid value is entered for this attribute
Required when	Expression that specifies when the attribute is required (when "Required" is not checked)
Relevant when	Function that determines under what conditions the field is applicable
Hidden when not relevant	If checked, the field will be hidden in the data entry form when the condition is not verified
Is key	If checked, this attribute serves as a unique identifier
Code list	Select a code list already created or create one
-strict	If checked, once code list is defined, no additional code options can be added
Calculated	If checked, the input field won't be editable and the value will be generated at runtime according to the specified Default Value
Maximum size MB	Defines max allowed size for file upload
Allowed extension	Defines allowed extension types for file upload
Species list	Select a species list
Highest rank	Defines highest rank in species taxonomy (family, genus, species, subspecies, variety)
Auto-complete group	(Only for text attributes) if specified, text auto complete will retrieve entries from the list of previously digitized values
Show row number in tables	If checked, it allows to show row number in tables
Show count in record summary list	If checked, it allows to Show count in record summary list
Units of measurement	Only for numerical attributes
Is default	Specifies which unit of measure is default
Unit	Select from the list of unit of measurement
Decimal digits	Control number of decimal digits that will be displayed

Parameters	Descriptions
Labels and descriptions	
Single instance	Label if single instance
List heading	Label if multiple instances
Field number	Additional labeling field
Description	Free text description
Versioning	
Introduced in version	Allows to keep track of the survey version in which a specific Entity/Attribute has been added to the schema.
Removed since version	Allows to keep track of the survey version in which a specific Entity/Attribute has been removed from the schema.
Layout	
Column	Determines the position of the node (entity/attribute) in the field form layout.
Column span	Determines the number of columns that the node (entity/attribute) should span across *** (click 'i' button to view an example)
Width	Sets the width of the column ((blank=default)
Label width	Sets the width of the label ((blank=default)
Default value	Used to determine how to handle empty values when a record is submitted from data entry phase to data cleansing phase
Constant value	Value that will replace empty field
Expression	Expression that will calculate the value to replace empty field
Apply when	Sets the condition for when the replacement should occur
Checks	Used to automatically flag errors during field data collection (using Collect Mobile) or during data entry. Using checks greatly minimizes data entry mistakes and facilitates data cleansing
Type	Comparison - checks the value entered against a value or range of values Custom - freely customizable check with an expression Distance - (only for coordinate attributes) checks that the coordinate entered is within previously specified limits Pattern - (only for text attributes) checks that the text is entered according to a predefined format Uniqueness - checks that the entered values is unique (not repeated) within a specified group of values
Severity	Error - blocks the data entry user from submitting the record to data cleansing Warning - assigns a warning flag to the record but does not prevent submission to data cleansing
Message	Message to be displayed to flag error/warning
Apply when	Allows to specify when the check is applicable
Expression	Expression that defines the logic of the check

05 Designing forms/ adding entity or attributes

5.1 Designing Cluster Plot Form

From the National Forest Inventory Manual, we have Cluster Plot Form as illustrated in Figure 26 which is used as reference point for names of the columns (attributes) in the cluster form and the type of information to be recorded (attribute type). This form is used as guiding document for adding attributes for cluster plot. All information to be recorded constitute an independent attribute (which are recorded in column in database) and attributes are added as any one of the 10 attribute types described in 4.6.2 above. Please note that additional attributes are also added in Collect in this design. The Table 3 show the name and type of attributes to be added for Cluster Plot Form. Individual attributes are added one by one and there is no shortcut to add multiple attributes at the same time. The step wise approach for adding different attribute types are illustrated in the following pages and these illustrations can be used for adding same type of attribute , e.g Date, Time, Text, Number, etc. appearing in other inventory forms in the later part of survey design. The detail approach is described for all attributes for cluster plot form as an example and this level of details will not be provided for other records and entities.

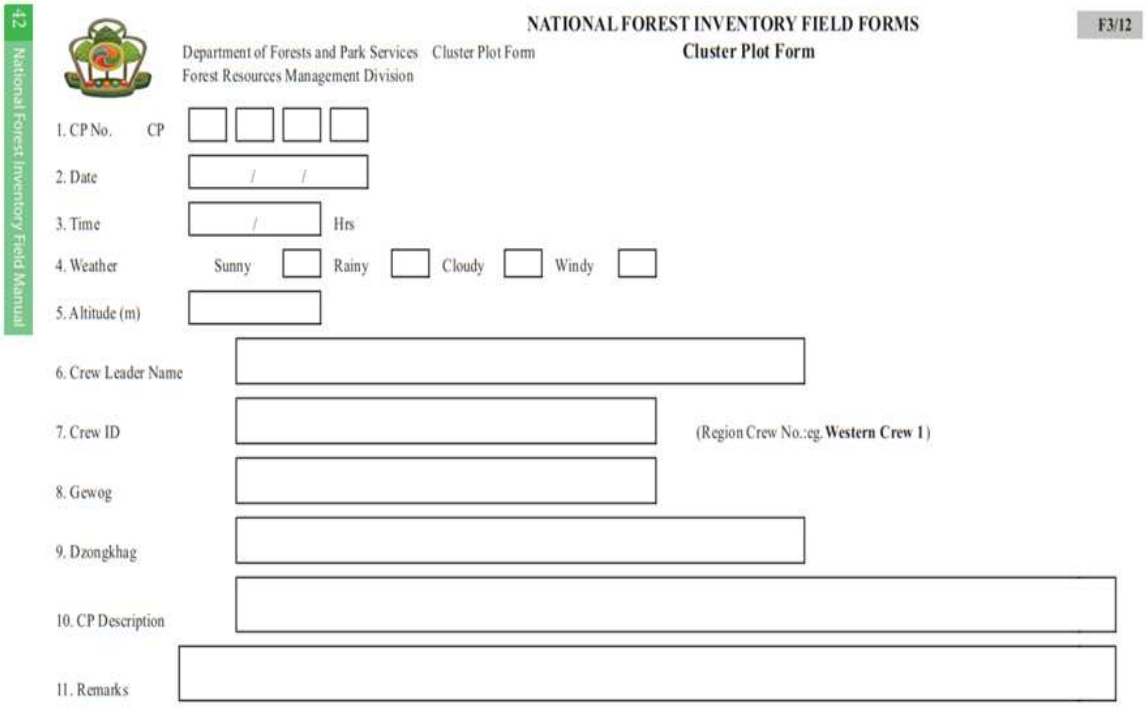


Figure 26: Cluster Plot Paper Form

Table 3: Name and type of attributes for cluster plot form

Sl. No.	Name of Cluster Plot Attributes	Attribute Type
1	cluster_plot_no	Code/Text
2	cp_enumeration_date_year cp_enumeration_date_month cp_enumeration_date_day	Date
3	cp_enumeration_time_hour cp_enumeration_time_minute	Time
4	cp_location_srs cp_location_x cp_location_y	Coordinate
5	expected_cp_location_srs expected_cp_location_x expected_cp_location_y	Coordinate
6	expected_cp_location_distance	Number
7	expected_cp_location_distance_unit_name	Text
8	enumerated	Code
9	weather	Code
10	altitude	Number
11	altitude_unit_name	Text
12	crew_leader	Code
13	crew_id	Code
14	block	Code/Text
15	district	Code/Text
16	region	Code/Text
17	cp_accessible	Code
18	cp_description	Text
19	cp_remarks	Text

5.1.1 Adding Coded Attribute

If we refer Table 3, there are nine attributes with attribute type 'code'. All these attributes can be added to cluster plot form by same method. Some illustrations are described in this Section to add Coded attributes.

5.1.1.1 Cluster plot no

Right click on the **Cluster Plot Form** (record type), a drop-down window will open and click on **Add attribute**, another drop-down window will open, then click on **Code** (can also be added as text attribute, (if we are to type CP no. in the field), a field will open on the side of the existing window. Type the name of the coded attribute as ***'cluster_plot_no*** (all lower case without spacing, select **'Key',** as the cluster plot number is the key identity to distinguish one cluster from another, and then select relevant code list from the drop-down button. In this case, select **sampling_design** which we have added earlier while adding code list. The label for the attribute appear automatically. Click **Save** to save attribute. The illustration is described in Figure 27. This may be repeated for all types of coded attributes.

Note: Tick key in the field as all information are related to cluster plot No.

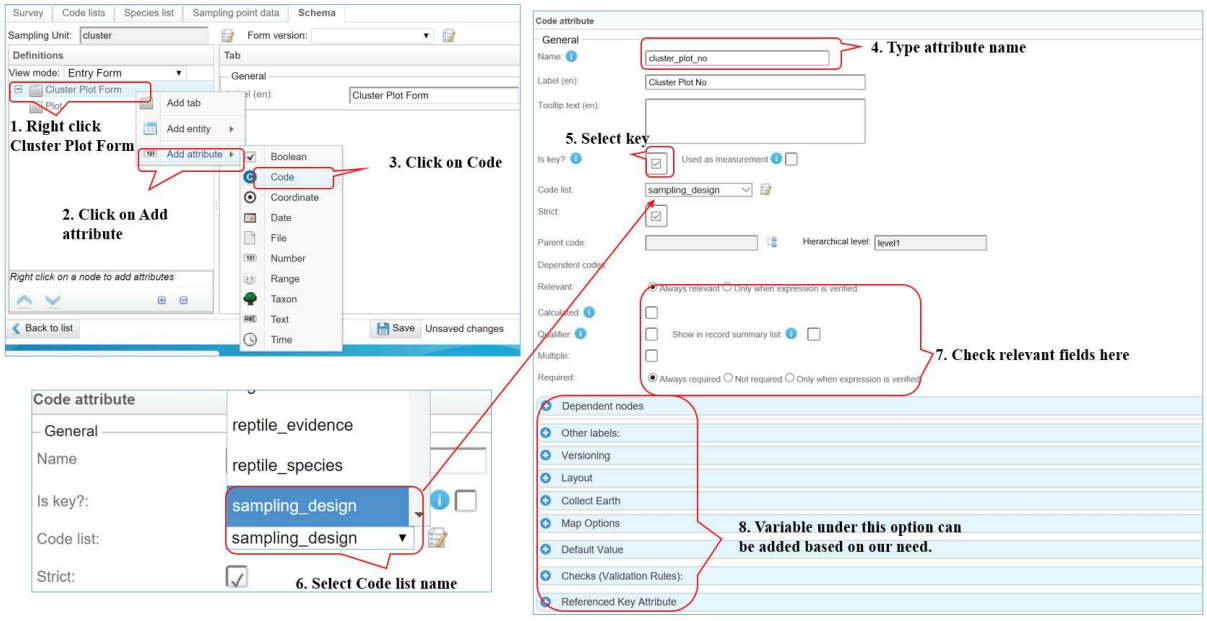


Figure 27: Adding Cluster plot no. as Code Attribute

5.1.2 Adding Date Attribute

Example for adding Date attribute is illustrated here with reference to cluster plot form.

5.1.2.1 Cluster Plot Enumeration date

Right click on the **Cluster Plot Form**, a drop-down window will appear, click on **Add attribute**, select **Date**, type the attribute name as ***cp_enumeration_date*** , check other boxes as may be needed and **Save** the attribute as illustrated in Figure 28.

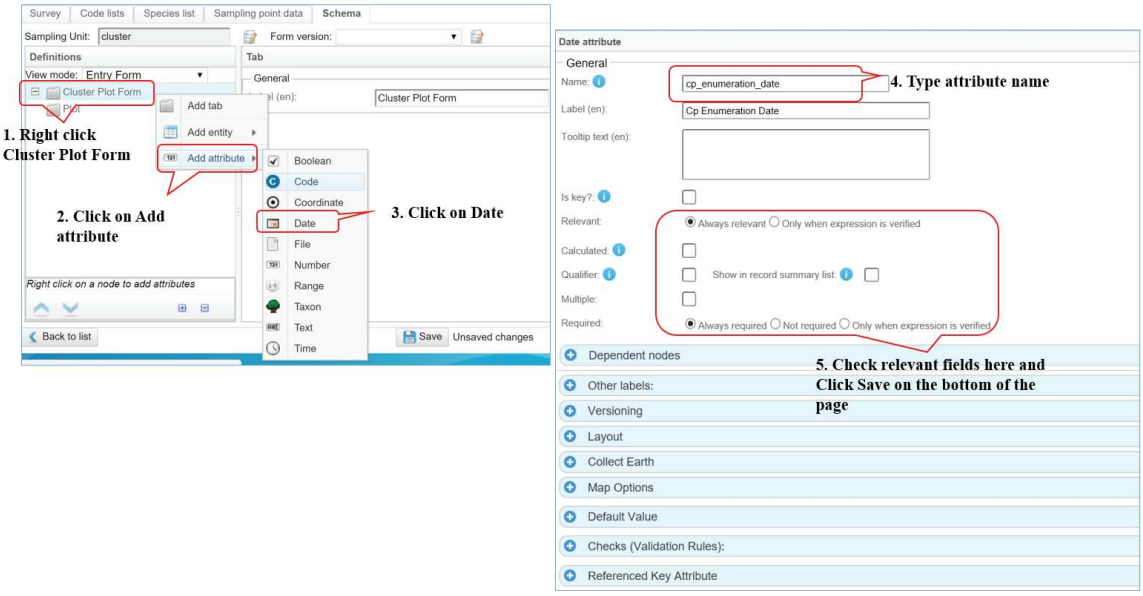


Figure 28: Adding Cluster Plot Enumeration Date as Date attribute

5.1.3 Adding Time Attribute

Example for adding Time attribute is illustrated here with reference to Cluster Plot Form.

5.1.3.1 Cluster plot enumeration time

Right click on the **Cluster Plot Form**, a drop-down window will appear, click on **Add attribute**, select **Time** and type the time attribute name as ***cp_enumeration_time*** and click **Save** to save the attribute as illustrated in Figure 29. This procedure is same for all **time** attributes created in Collect.

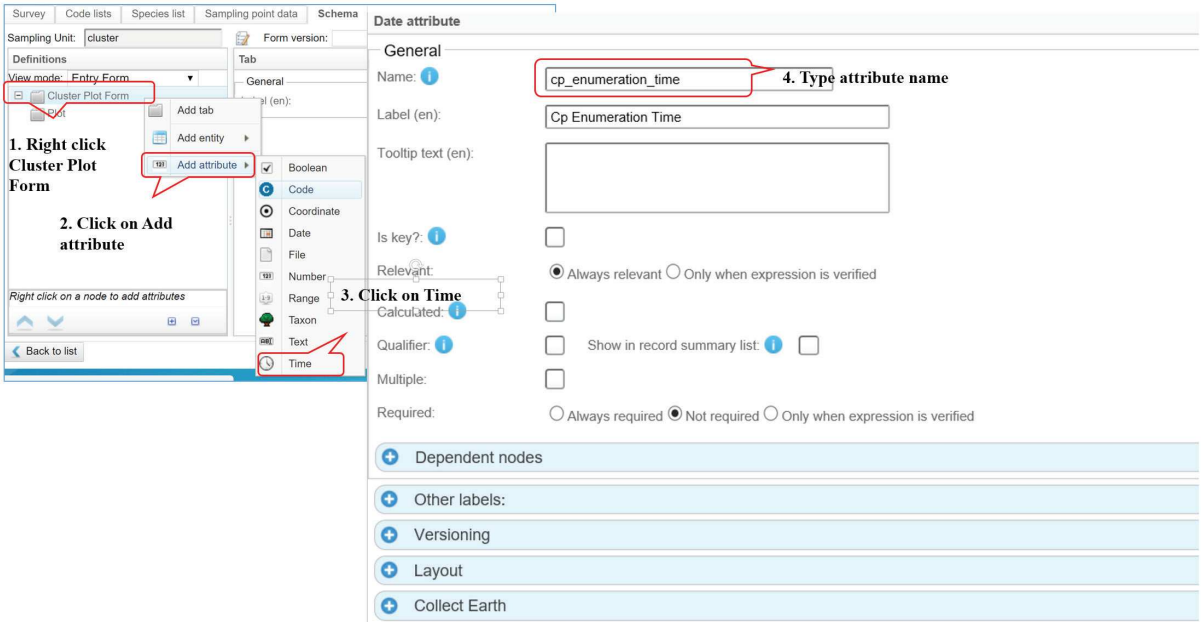


Figure 29: Adding Time Attribute

5.1.4 Adding Coordinate Attribute

Example for adding Coordinate attribute is illustrated here with reference to Cluster Plot Form.

5.1.4.1 Cluster Plot Location

To add coordinate attribute to Cluster Plot Form, **right** click on the **Cluster Plot Form.** A drop-down window will open, click on **Add attribute**, another drop-down window will open, click on **Coordinate** (as Plot location is coordinate attribute), a field will open on the side of the existing window. Type the name of the attribute as ***cp_location*** and click **Save** to save the attribute as illustrated in Figure 30. All Coordinate attributes are added by same method.

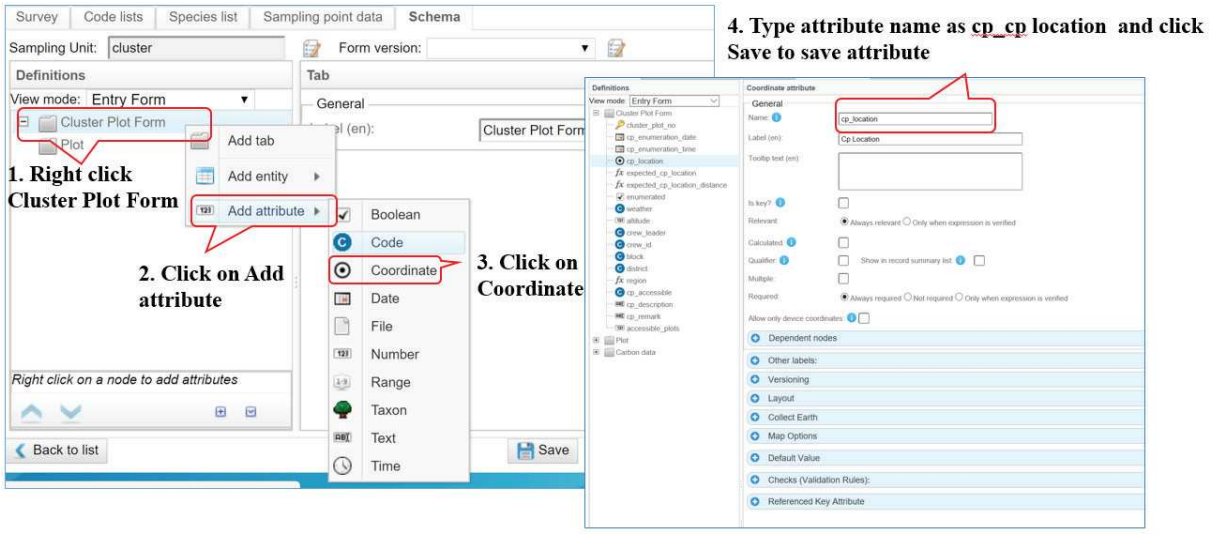


Figure 30: Adding Coordinate attribute CP Location

5.1.4.2 Adding Coordinate attribute with calculated expression

Right click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Coordinate**, a field will open on the side of the existing window. Type the name of the attributes as ***expected_cp_location***. Then check the calculated option box and click on **blue (+)** button in front of the ***Calculated Value Expression*** option (Calculated Value Expressions) highlighted in RED. Click on **green +** [ ] button, a pop-up window will open, insert the expression as *idm:samplingPointCoordinate(-cluster_plot_no*) and click **Apply** to save expression and **Save** to save attribute as illustrated in Figure 31. (idm:samplingPointCoordinate(cluster_plot_no expression is locating the predefined cluster plot coordinate added in Section 4.4 earlier)

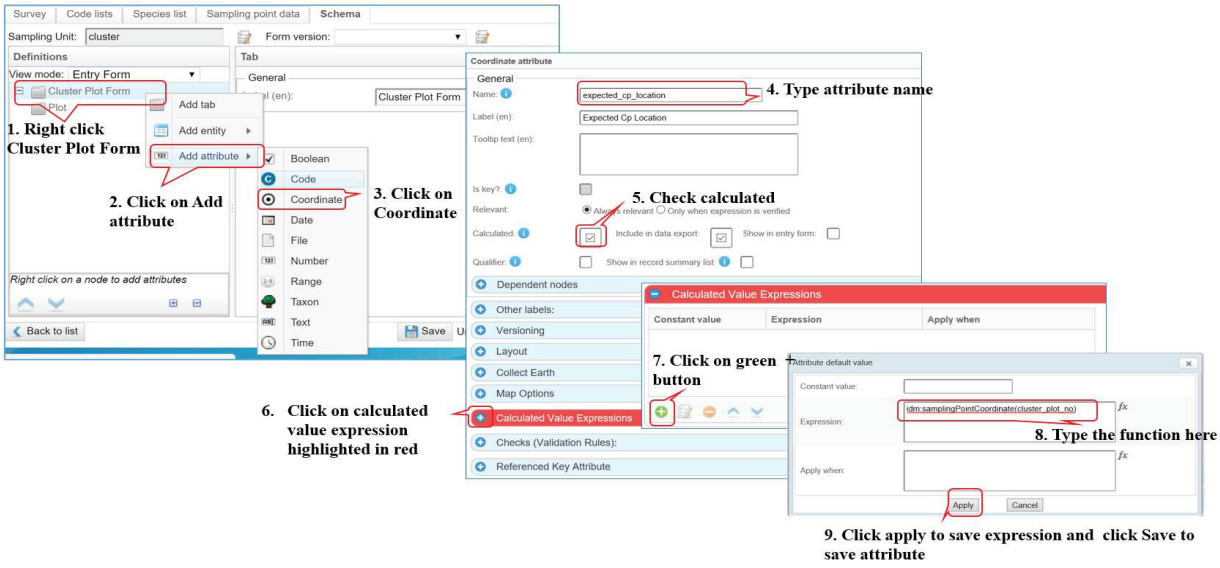


Figure 31: Adding Coordinate Attribute Expected CP location

5.1.5 Adding Number Attribute

Example for adding Number attribute is illustrated here with reference to Cluster Plot Form.

5.1.5.1 Expected CP location distance

Right click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Number**, a field will open on the side of the existing window. Type the attribute name as *expected_cp_location_distance*. Check the **Calculated** option box, click on **blue (+)** in front of Units of measurement option, click **green +** [ ] button, a pop-up window will open, check the **Default box** and select **meters** as Unit, then go to **Calculated Value Expression** highlighted in RED. Click **green +** [ ] button, a pop-up window will open, insert the expression as *idm:distance(cp_location,expected_cp_location)* and click **Apply** to save expression and **Save** to save attribute as illustrated in Figure 32. All attributes having unit may be added as discussed here.

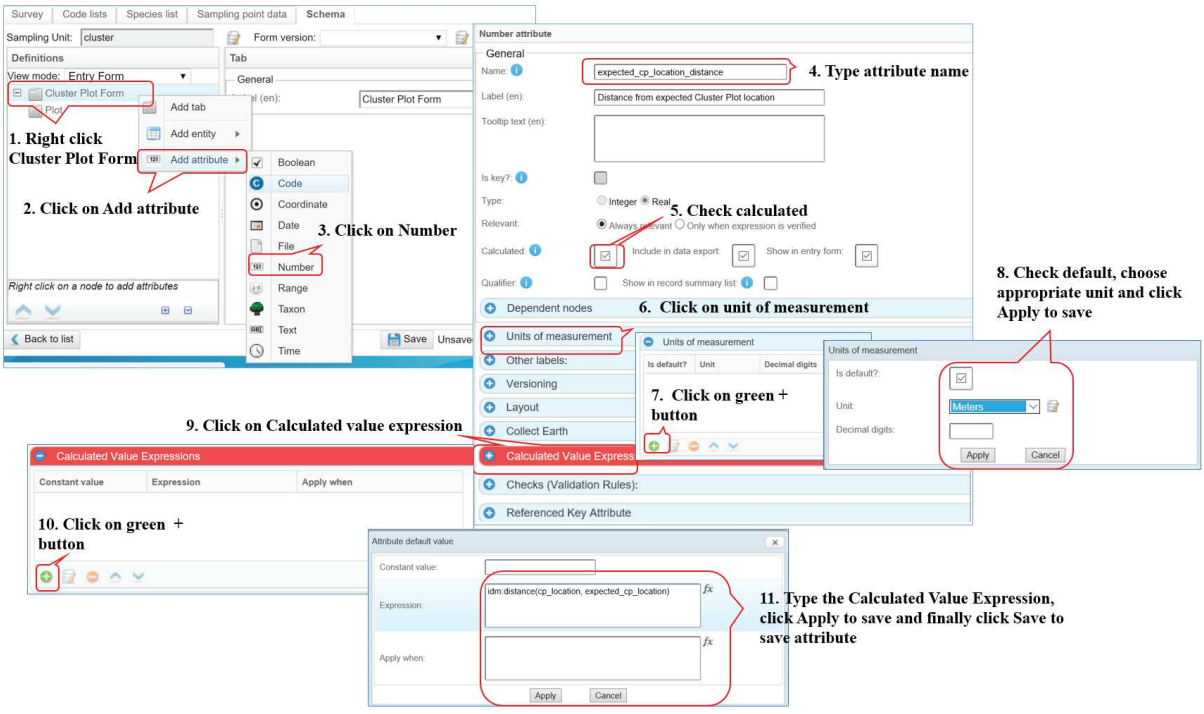


Figure 32: Adding Number attribute expected CP location distance

5.1.6 Adding Boolean Attribute

Example for adding Boolean attribute is illustrated here with reference to cluster plot form.

5.1.6.1 Cluster Plot Enumeration (Yes/No)

Right click on the Cluster Plot Form (record type), drop-down window will open and click on Add attribute, another drop-down window will open, click on Boolean, a field will open on the side of the existing window. Type the name of the attribute as enumerated. Go to Default value, Click on green + [ ] button, a pop-up window will open, insert the type expression as 'true()'and click **Apply** to save expression and **Save** to save attribute as illustrated in Figure 33.

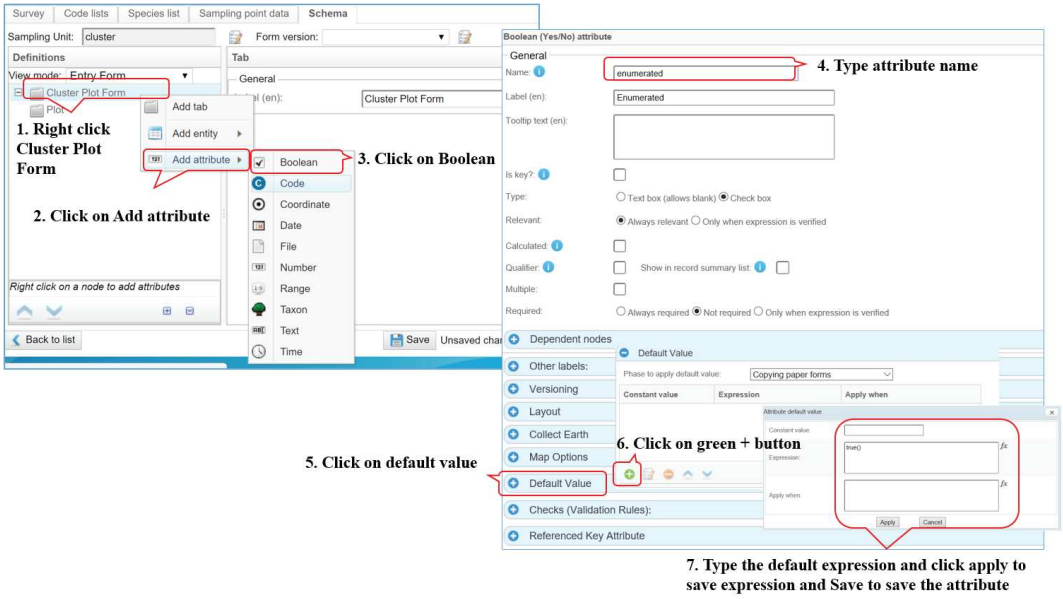


Figure 33: Adding a Boolean attribute Cluster plot enumerated

5.1.7 Some examples of adding Code attributes

Example for adding Code attribute is illustrated here with reference to Cluster Plot Form.

5.1.7.1 Weather on date of data collection

Right click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Code**, a field will open on the side of the existing window. Type the attribute name as ***weather*** and select code for **weather.** Alternatively, click  to add code from the code list added earlier, select the code for weather and click apply. Click **Save** to save attribute as illustrated in Figure 34.

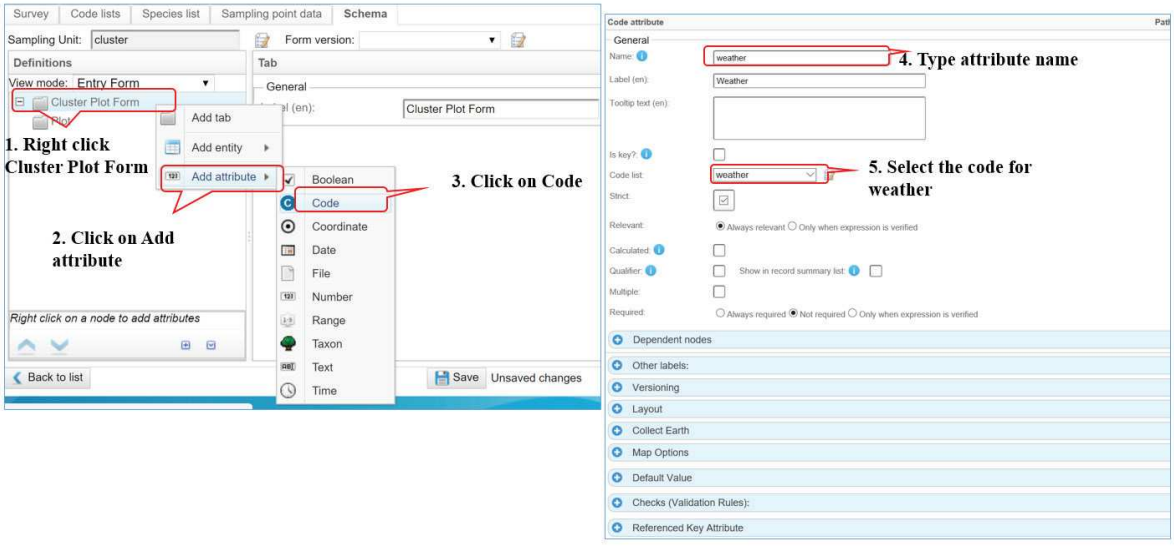


Figure 34: Adding weather as coded attribute

5.1.7.2 Crew leader as a coded attribute

Right click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Code**, a field will open on the side of the existing window. Type the attribute name ***crew_leader***, select the code for crew leader and check rest of the boxes as required. Click **Save** to save attribute as illustrated in Figure 35.

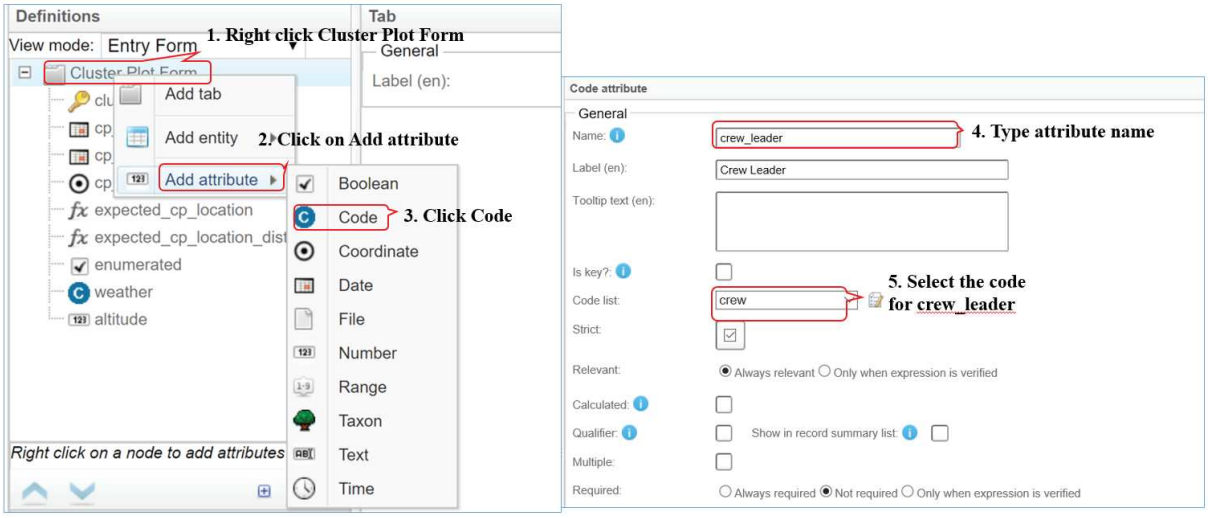


Figure 35: Adding crew leader as coded attribute

5.1.7.3 District as coded attribute

Sometimes, the code list added in Section 4.2 may not address all your requirement. Therefore, you need to add new code to the sample. For this purpose, you can either go back to Section 4.2 to add a code or directly create a new code. For adding new code, we use the example of coding the district. **Right** click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Code**, a field will open on the side of the existing window. Type the attribute name **district**. Go to the code list and click on radio button ( ), a new window will pop up. In the new window click on **green +** [ ] button, another window will pop up, type the name of coded attribute as '***district***' (in this example). Then, click on another **green +** [ ] button, a new window will pop up. Type the **code and label name**, for example bumthang – Bumthang. Click **Apply** to save the code. Repeat this step until you complete adding codes for all twenty dzongkhags or all your code option. Finally. Click **Save** to save attribute as illustrated in Figure 36.

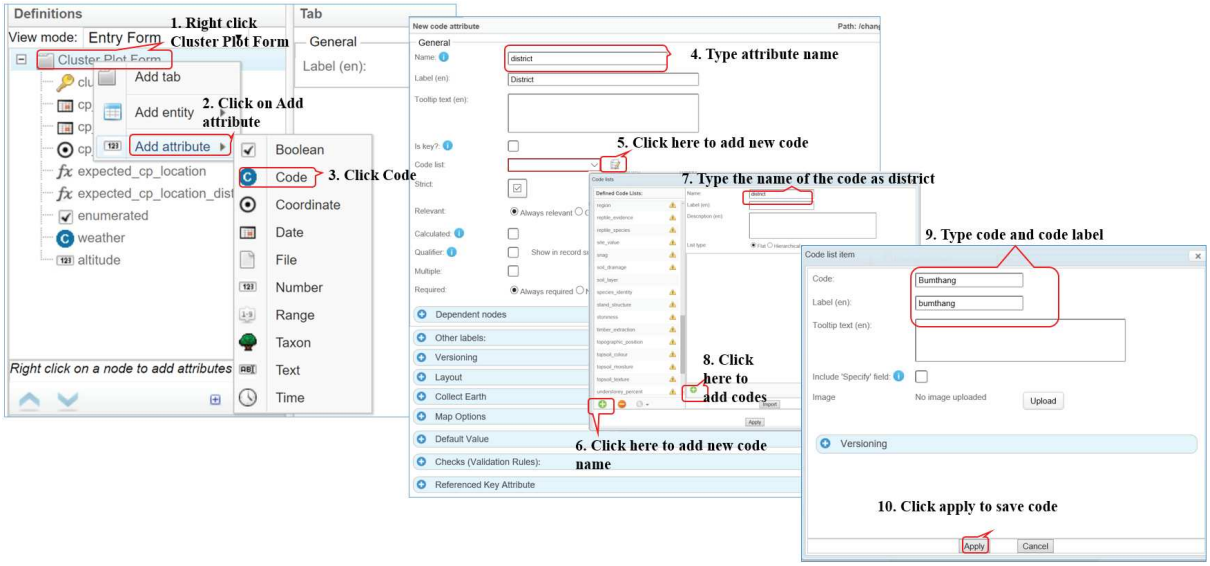


Figure 36: Adding district as coded attribute

5.1.7.4 Region as coded attribute

Sometimes, we need to provide calculated expression for coded attributes. For instance, twenty Dzongkhags are divided into regions or climatic zones. In such cases, we need to provide calculated expression to identify which Dzongkhag falls under particular region or climatic zone. For such purposes, we can insert a validation rule such that when we enter information for district attribute and the region gets automatically updated or if a wrong region name is manually entered, then the information will appears as an error. This can be done by checking ***Calculated*** option box and inserting and expression. The Table 4 shows the expression to be inserted while designing the survey form so that we need not have to enter the information for region attribute while collecting the data in the field. The attribute is added normally by **right clicking** on the **Cluster Plot Form** (record type), clicking **Add attribute**, selecting **Code** and typing the name of attribute (**region**). Now check the **Calculated** option box and click on **blue (+)** button in front of the **Calculated Value Expression** option highlighted in RED. Click on **green +** [ ] button, a pop-up window will open, insert the expression as tabulated in Table 4 and follow the illustration in Figure 37. Click Apply to save expression and **Save** to save attribute.

The *Constant value* here in the table means the value applied to predefined condition and its auto updated when a condition is fulfilled. In the example, NW is applied to districts of Chhukha, Gasa, Haa, Paro, Punakha, Samtse, Thimphu and Wangduephodrang, EC is applied to districts of Bumthang, Lhuntse, Mongar, Pemagatshel, Trashiyangtse, Trashigang, Trongsa and Zhemgang while Dagana, Samdrupjongkhar, Sarpang and Tsirang are grouped into S.

Table 4: Expression for region

Constant value	Expression	Apply when
NW (North western)		district = 'Chhukha' or district = 'Gasa' or district = 'Haa' or district = 'Paro' or district = 'Punakha' or district = 'Samtse' or district = 'Thimphu' or district = 'Wangduephodrang'
EC East Central)		district = 'Bumthang' or district = 'Lhuntse' or district = 'Mongar' or district = 'Pemagatshel' or district = 'Trashigang' or district = 'Trashiyangtse' or district = 'Trongsa' or district = 'Zhemgang'
S (South)		district = 'Dagana' or district = 'Samdrupjongkhar' or district = 'Sarpang' or district = 'Tsirang'

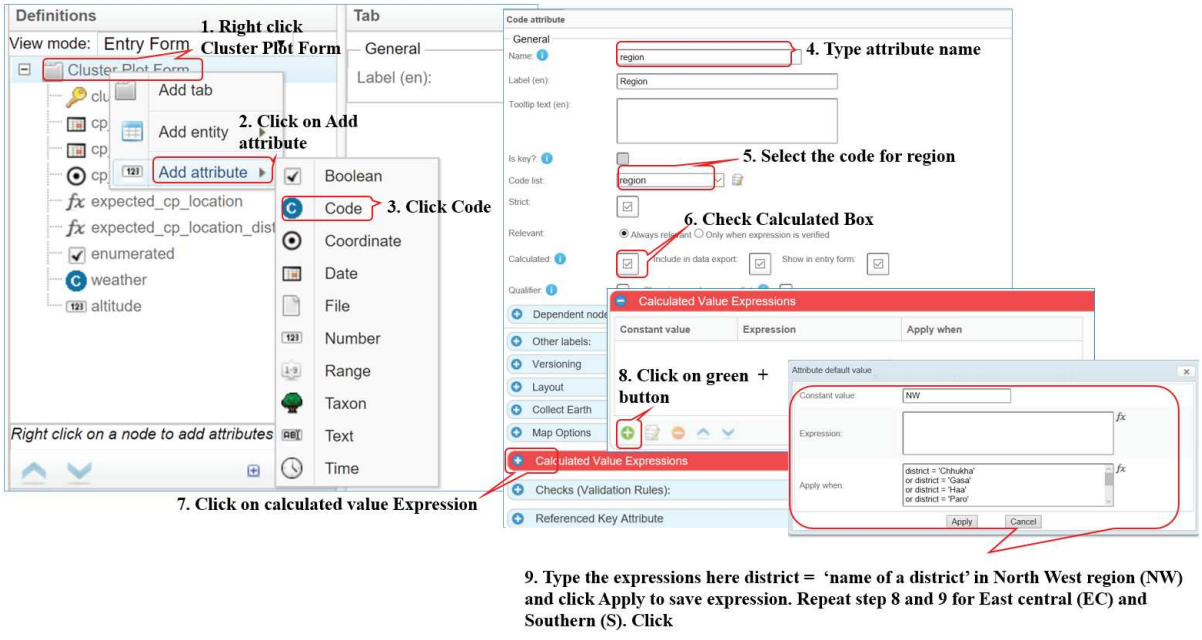


Figure 37: Adding region as coded attribute with calculated expression

Note: For all other coded attributes such as forest type, crew id, block, cluster plot accessibility, the same steps as described above.

5.1.8 Examples of adding Number attribute

Example for adding Number attribute is illustrated with the help of Number attributes in Cluster Plot Form.

5.1.8.1 Altitude as number attribute

Right click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Number**, a field will open on the side of the existing window. Type the attribute name as ***altitude.*** Go to ***Units of measurement***, click **green +** [ ] button, a pop-up window will open, check default box and select meters as ***unit***. Click **Apply** to save unit and **Save** to save attribute as illustrated in Figure 38.

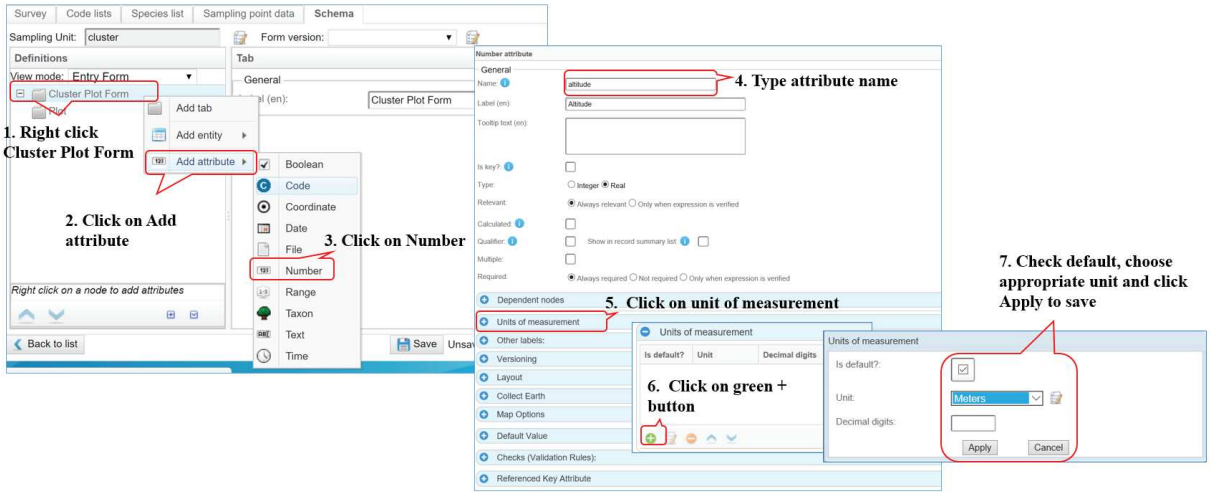


Figure 38: Adding altitude as Number attribute

5.1.8.2 Number of accessible subplots

Right click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Number** a field will open on the side of the existing window. Type the attribute name ***accessible_plots***, check calculated option box and go to **Calculated Value Expression** option highlighted in RED. Click button, a pop-up window will open, insert the expression as tabulated in Table 5 and as illustrated in Figure 39. Click Apply to save expression and **Save** to save attribute.

Table 5: Calculated expression for number of accessible plots

Constant value	Expression	Apply when
0		ldm:blank(plot)
	count(plot[accessible = 'yes'])	

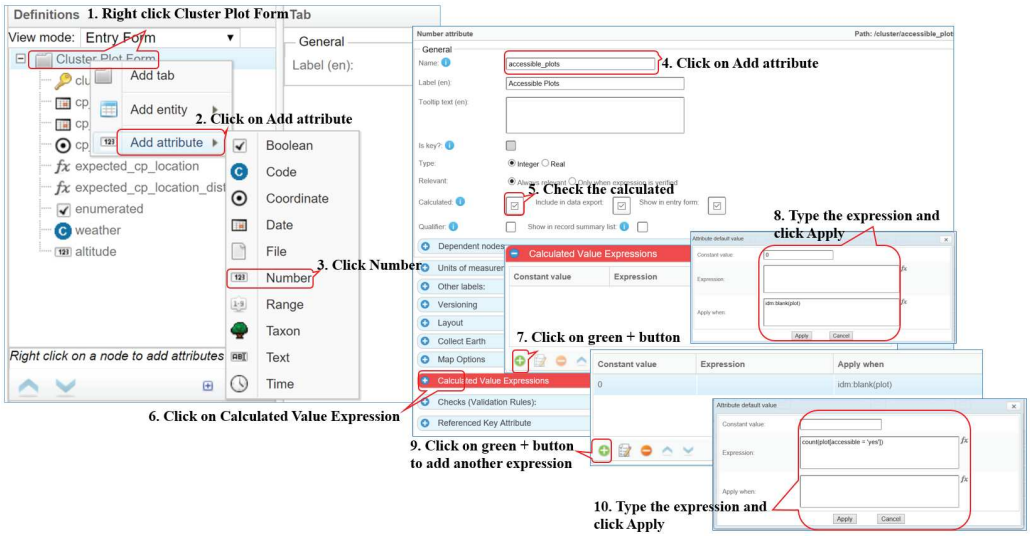


Figure 39: Adding number of accessible plots as Number attribute

5.1.9 Adding Text Attribute

Example of adding text attribute is illustrated with the text attributes added to Cluster Plot Form

5.1.9.1 Cluster Plot Description

Right click on the **Cluster Plot Form** (record type), drop-down window will open and click on **Add attribute**, another drop-down window will open, click on **Text**, a field will open on the side of the existing window. Type the attribute name ***cp_description***, select the text type as **memo**, then check multiple text box, enter minimum and maximum number of memos to be filled and finally click **Save** to save attribute as illustrated in Figure 40.

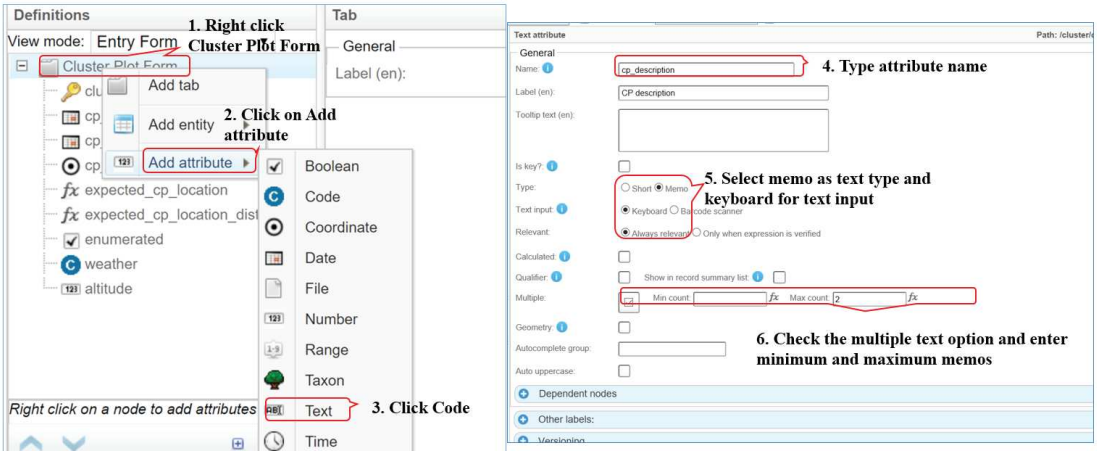


Figure 40: Adding Text Attribute (Cluster Plot Description)

Note: cluster plot remarks, which is a text attribute can be added as following the same steps.

5.2 Preview of the Cluster Plot Form

The attributes table and/form can be previewed at any point of time while designing the form or adding the attributes. This can be done by clicking on the **Preview** (Preview) option located on bottom right of the Survey designer. A new window will pop up with which contains records. Click Preview button to display the table as illustrated in Figure 41.

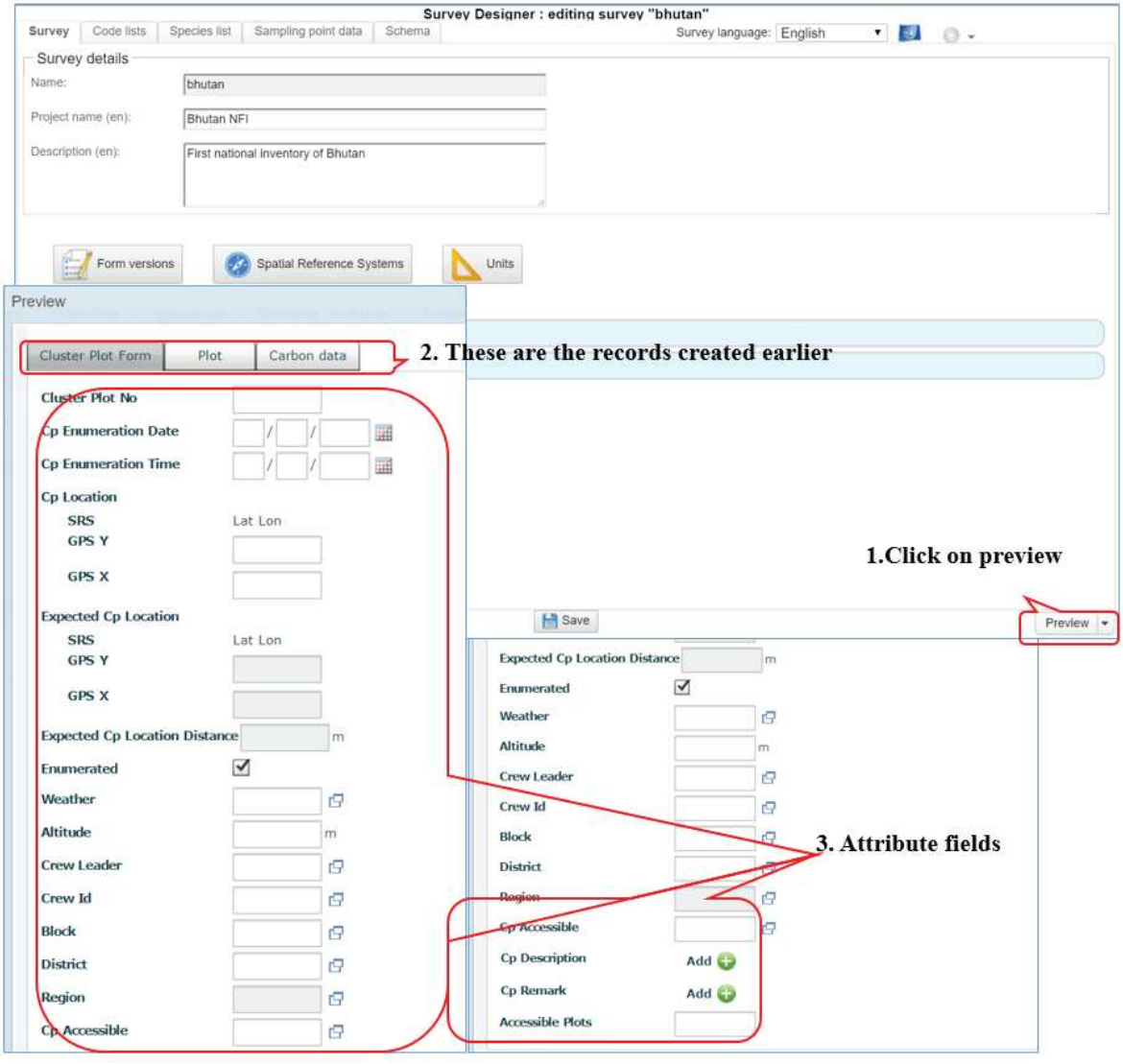


Figure 41: Preview of cluster plot form attributes and forms

06 Designing the forms for data to be collected from PLOT

6.1 Adding a record Type

Second record type we have is the PLOT. All field data are collected in from plots and each plot is therefore, related to two or more features. To add record type, **right click** anywhere below the existing record, Cluster Plot Form. Add tab will appear on the screen. Click on Add tab, another window will open, type the record name as Plot as demonstrated earlier in Section 4.5.3 and illustration in Figure 26.

6.2 Adding the plot as entity

Since, all data for tree, sapling, herbs, shrubs, regeneration, animals, etc. are collected from plot, therefore the plot has 1: N relation and plot has to be added as entity and not attribute. To add **an entity**, **right click** on **Plot tab**, a drop-down window will appear, click on **Add entity** and select **Multiple (1:N)** (Form layout). A table to fill details of entity will appear on right. Type the entity name as '**plot**', and check multiple option, type '0' in minimum count and '3' in maximum. Click **Save** to save entity as illustrated in figure 42.

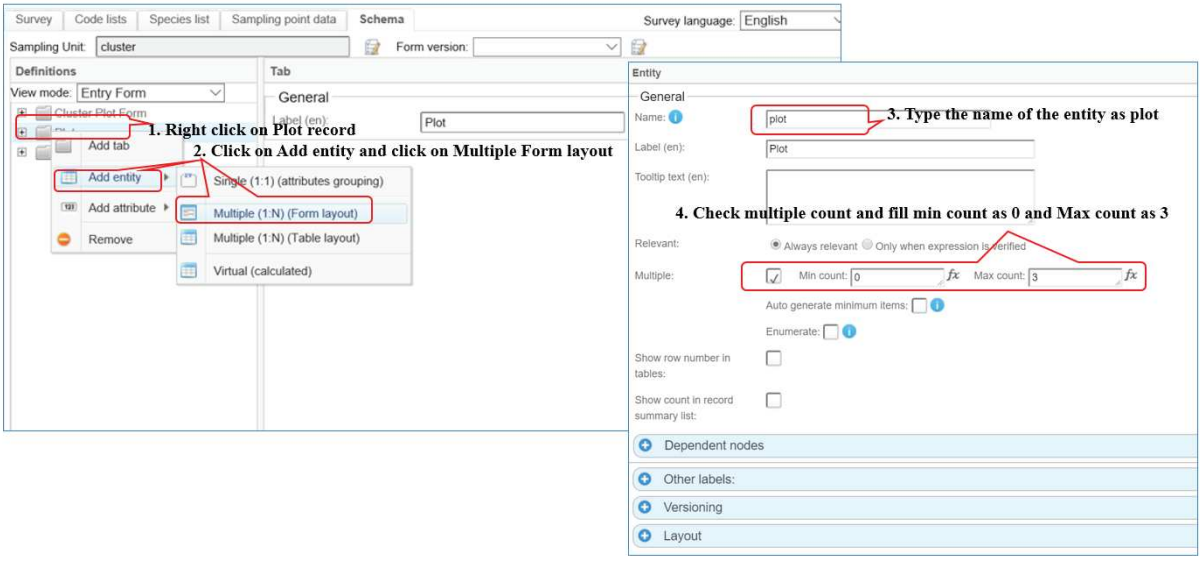


Figure 42: Adding plot entity

Note: in Multiple fields: minimum count is filled as zero and maximum count as 3. This is done so as to enable us to include inaccessible plots and 3 to ensure that LNE plots are recorded as separate plot.

6.3 Adding attribute under entity

Attributes can be added to entity by same procedure as we did for while adding attributes for Cluster Plot Form record earlier in the Section 5.1. Some illustrations are repeated here for reference.

6.3.1 Adding Plot type as code attribute

Right click on the **plot entity**, click on **Add attribute** and select **Code**. A table to fill details of attribute will appear on right. Type the attribute name as **'plot_type',** check **Key** box , select Code list as **plot_type**, click **Save** to save attribute as illustrated in Figure 43.

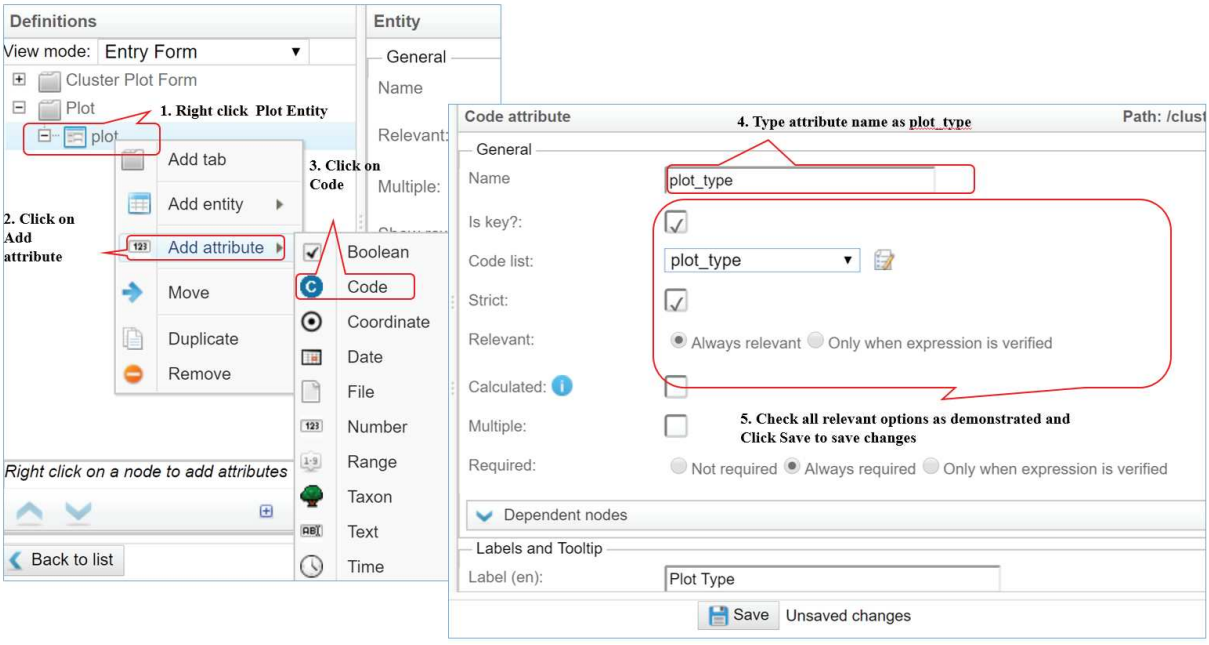


Figure 43: Illustration of adding code attribute plot type

Note: All coded attributes are added in same procedure

6.3.2 Adding Plot Enumeration Date as Date attribute

Right click on the **Plot entity**, a drop-down window will appear, click on **Add attribute**, select **Date**, type the attribute name ***cp_enumeration_date***, check rest of the boxes as required. Click **Save** to save attribute as illustrated in Figure 44.

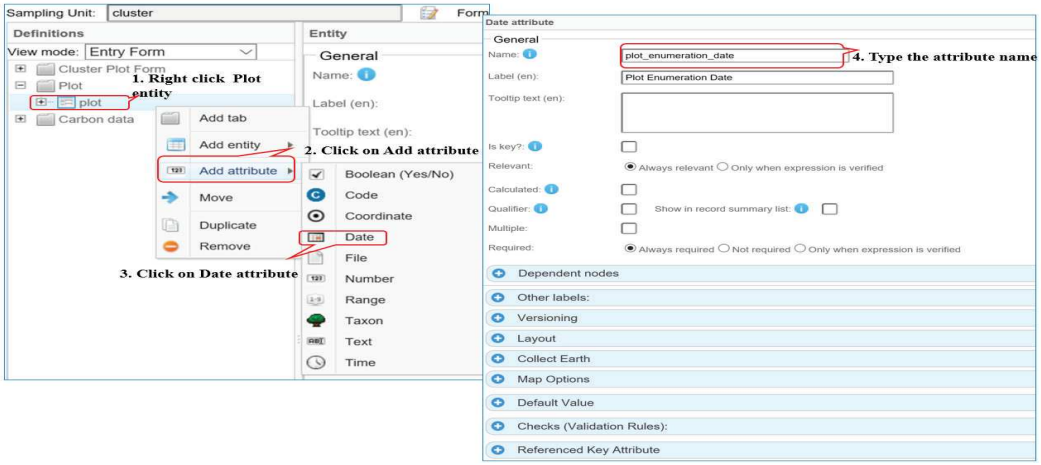


Figure 44: Adding plot enumeration date as date attribute

6.3.3 Adding Plot Enumeration Time as Time attribute

Right click on the **Plot entity**, a drop-down window will appear, click on **Add attribute**, select **Time**, a field will open on the side of the existing window. Type the attribute name ***cp_enumeration_time*** and check rest of the boxes as required. Click **Save** to save attribute as illustrated in Figure 45.

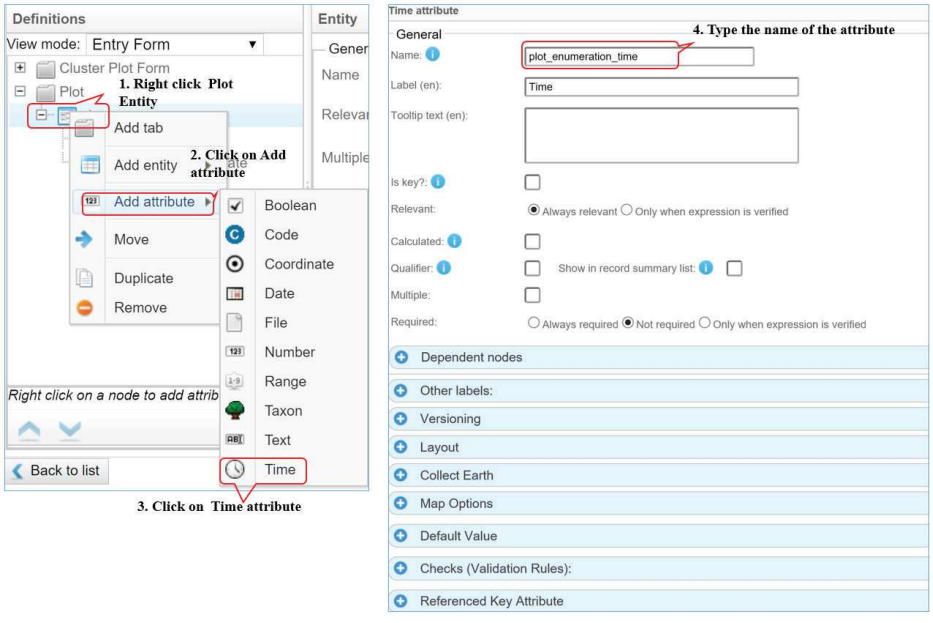


Figure 45: Adding plot enumeration time as time attribute

6.3.4 Adding Plot Accessibility Code attribute

Right click on the **Plot entity**, a drop-down window will appear, click on **Add attribute**, select **Code**, a field will open on the side of the existing window. Type the attribute name ***plot_accessible***, select the code for accessibility **(yes/no)** and check rest of the boxes as required. Click **Save** to save changes as illustrated in Figure 46. This can also be added as ***Boolean attribute*** as illustrated in Section 5.1.6.

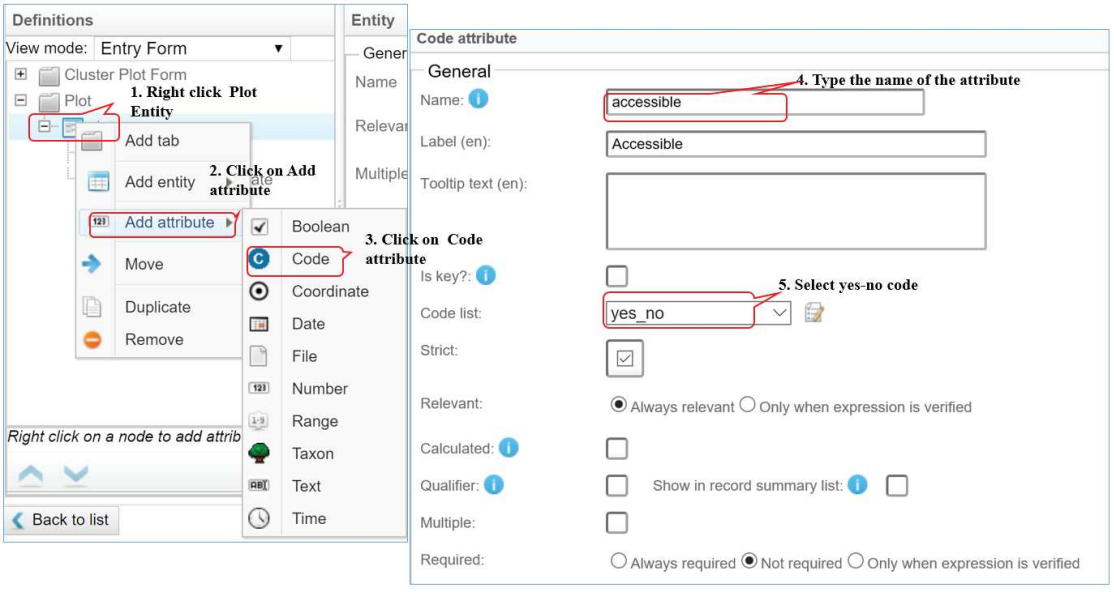


Figure 46: Adding plot accessibility as code attribute

6.4 Adding sub-record to Plot Entity

All the data such as information on trees, herbs, regeneration, shrubs, mammals, reptiles, bird, etc. are collected from individual plots. These data sets constitute sub-records under plot entity. Therefore, they are added as sub-record and the information related to these record are either as an entity or attribute depending on nature of information to be collected. The following constitute sub-record under plot

i. Reference Point Form
ii. Regeneration
iii. Plot Description Form
iv. Trees
v. Sapling
vi. Shrub
vii. Herb
viii. Mammal
ix. Bird
x. Reptile
xi. Coarse Woody Debris

6.4.1 Illustration of creating sub-record

To add the sub-record, right click on **Plot Entity**, click on **Add tab** and type the name of the **sub-record**, viz. Reference Point Form. Click Save to save changes as illustrated in Figure 47. This procedure is repeated for rest of the sub-records mentioned in Section 6.4 and preview of the sub-records is shown in Figure 48.

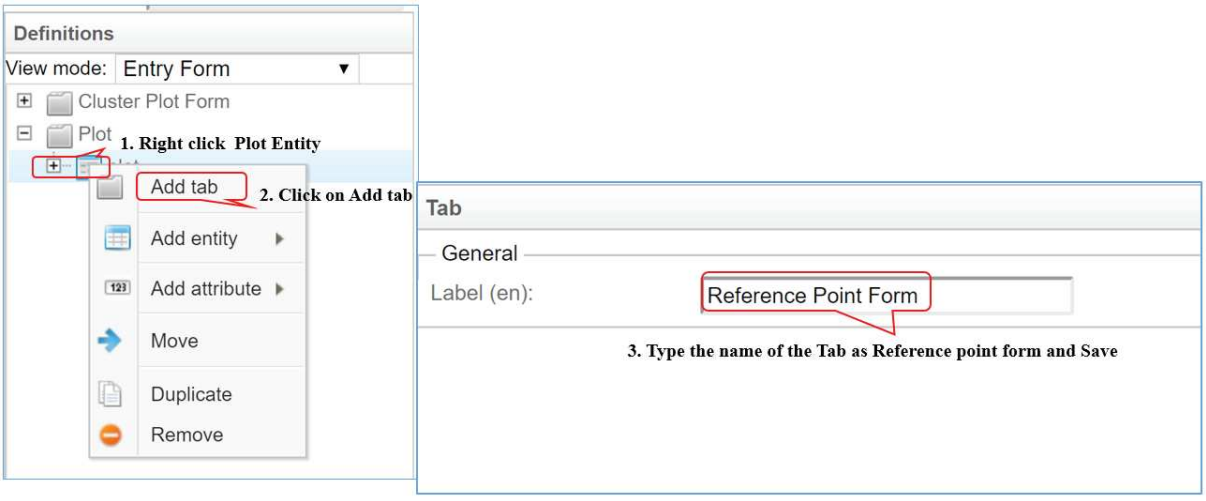


Figure 47: Illustration of adding sub-record to entity

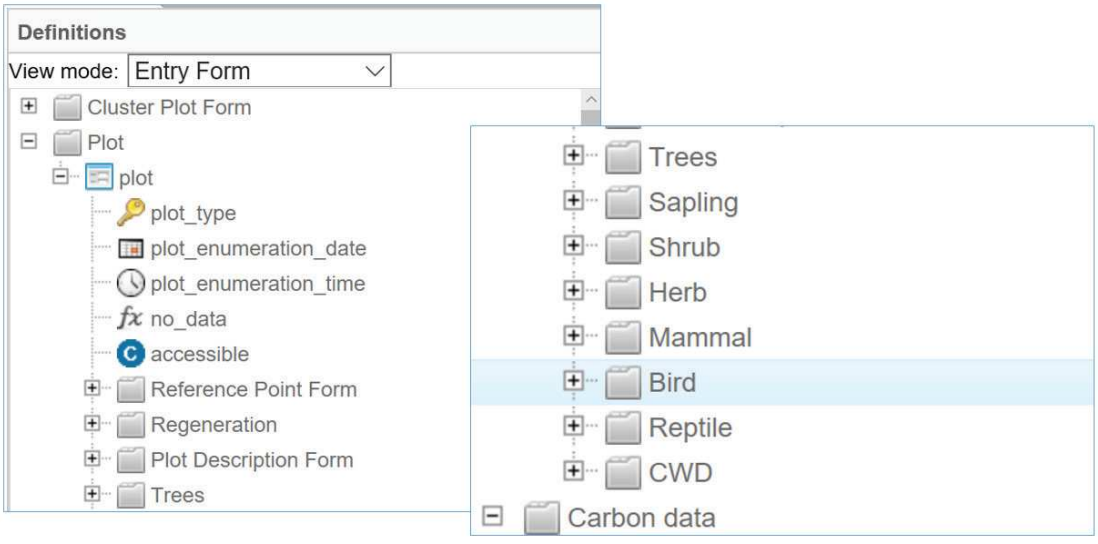


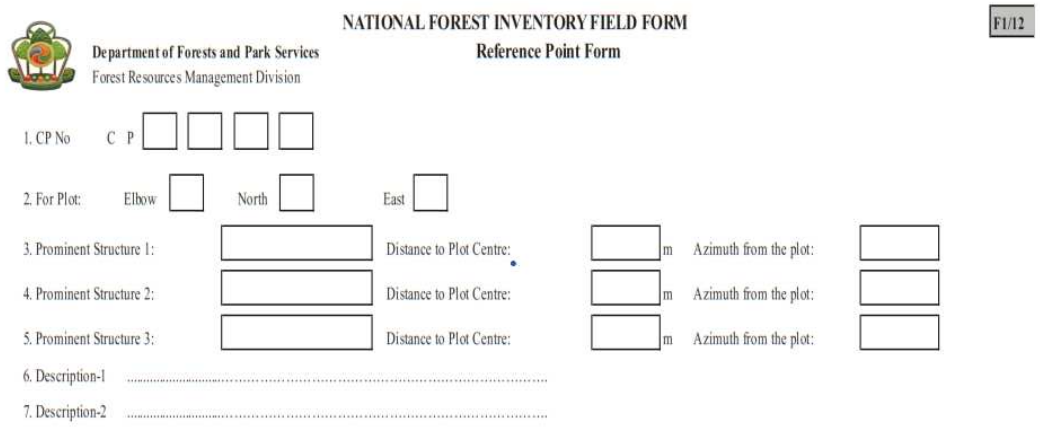
Figure 48: Preview for sub-records

6.5 Adding entity or attributes to sub–records

It is always important to have pre-designed paper form to aid in designing the forms. This helps designer in creating an appropriate attribute name and attribute type as discussed earlier in Section 5.1.

6.5.1 Reference Point Form

The predesigned paper form for reference point is illustrated in Figure 49. This helps in deciding whether we need to create an entity or attribute as well as the type of entity or attribute to be added.



NATIONAL FOREST INVENTORY FIELD FORM

F1/12

Department of Forests and Park Services
Forest Resources Management Division

Reference Point Form

1. CP No C P

2. For Plot: Elbow North East

3. Prominent Structure 1: Distance to Plot Centre: m Azimuth from the plot:

4. Prominent Structure 2: Distance to Plot Centre: m Azimuth from the plot:

5. Prominent Structure 3: Distance to Plot Centre: m Azimuth from the plot:

6. Description-1 .....

7. Description-2 .....

Figure 49: Paper form for reference point

6.5.1.1 Adding entity to sub-record

Adding entity to sub-record is another very important step in designing the survey form. The attributes are then added to an entity. The example for adding entity is done here with Reference Point Form as illustrated in Figure 50. To add an entity, **right click on Reference Point Form record,** click on **Add entity**, select **multiple table layout** , type the name of entity as ***prominent structure,*** select multiple option, fill minimum and maximum count. The entities created for all sub-records following same method and preview of entities created under each sub record is shown in Figure 51.

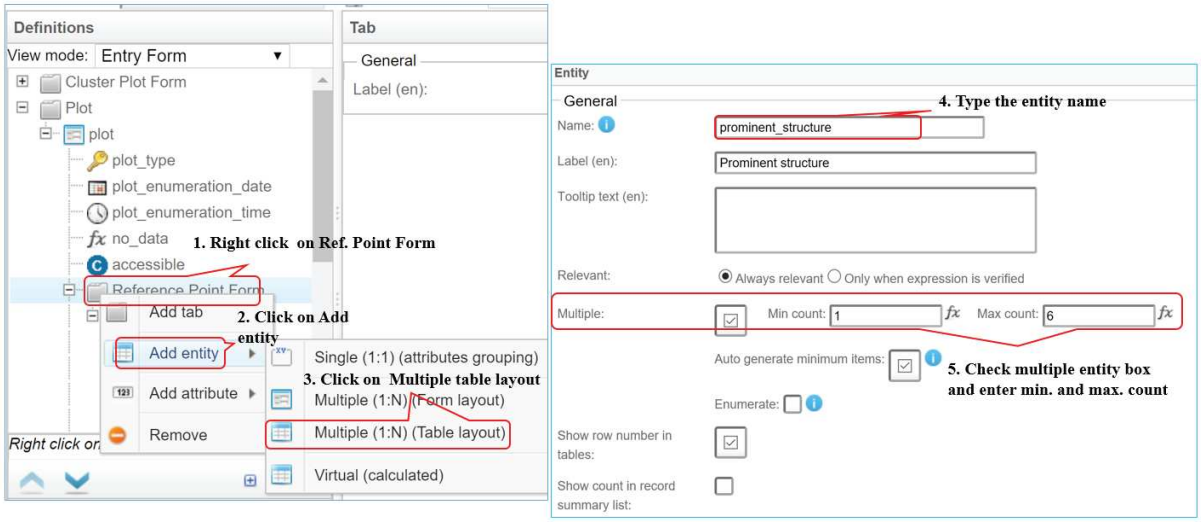


Figure 50: Adding entity to sub-record

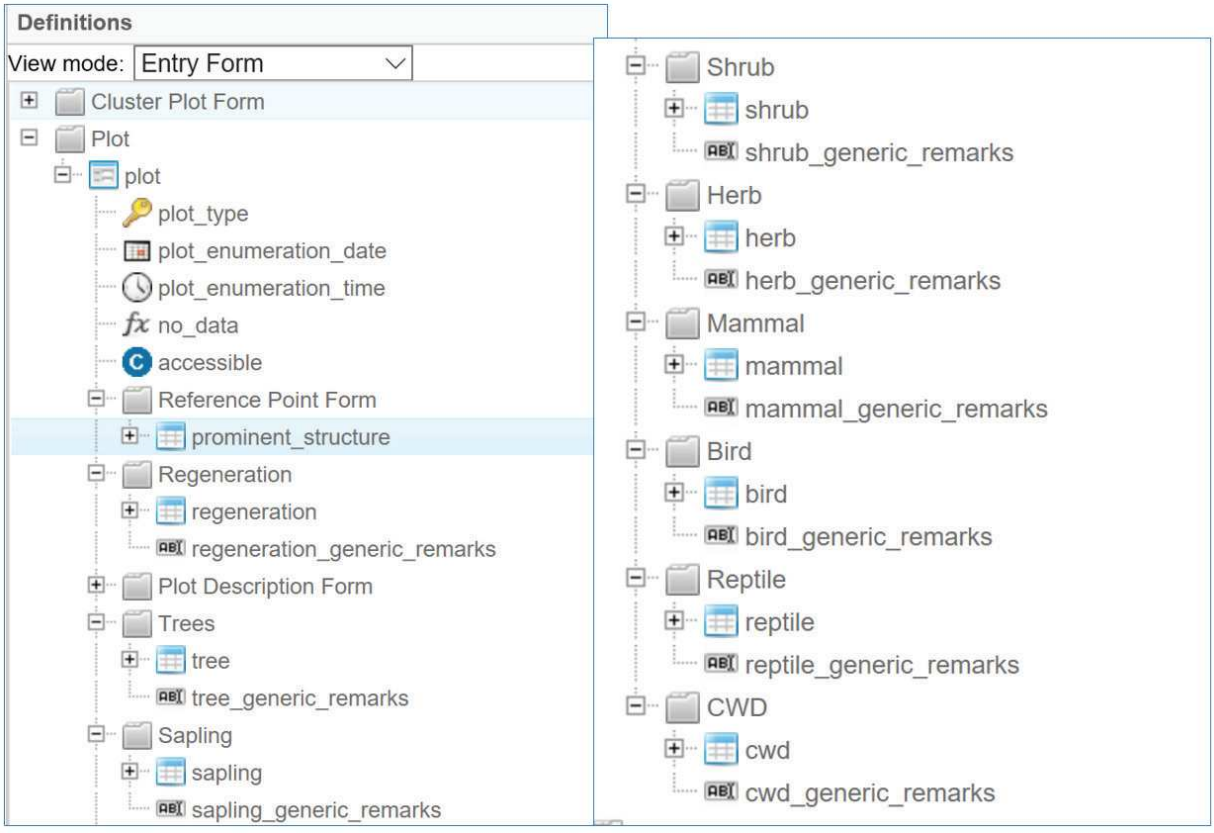


Figure 51: Preview of entities added to all sub-records

6.5.1.2 Adding attribute for sub-record Reference Point Form

Adding attributes can be done as we did for Cluster Plot Form attributes. It is desirable to have overview of the information to be collected. Table 6 provides the list of name and type of attributes to be added to Reference Point Form under entity called Prominent Structure. We don't need to create attribute called cluster plot no. and plot type as they are linked in hierarchical structure of the survey.

Table 6: Name of the attributes created under reference point form

Sl. No.	Attribute Name	Attribute Type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	prominent_structure_position	Number
4	prominent_structure_name	Text
5	prominent_structure_distance	Number
6	prominent_structure_distance_unit_name	Text
7	prominent_structure_azimuth	Number
8	prominent_structure_azimuth_unit_name	Text
9	prominent_structure_description	Text
10	prominent_structure_description_2	Text

6.5.1.2.1 Preview of the attribute of reference point

The attributes of the Reference Point Form (Table 6) is added to prominent structure entity following the procedure described earlier of adding **Text** and **Number** attributes. The preview off this attributes is displayed in Figure 52.

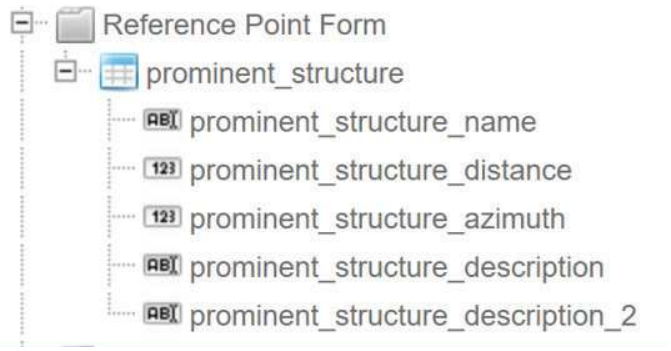


Figure 52: Preview of attributes added to entity prominent structure

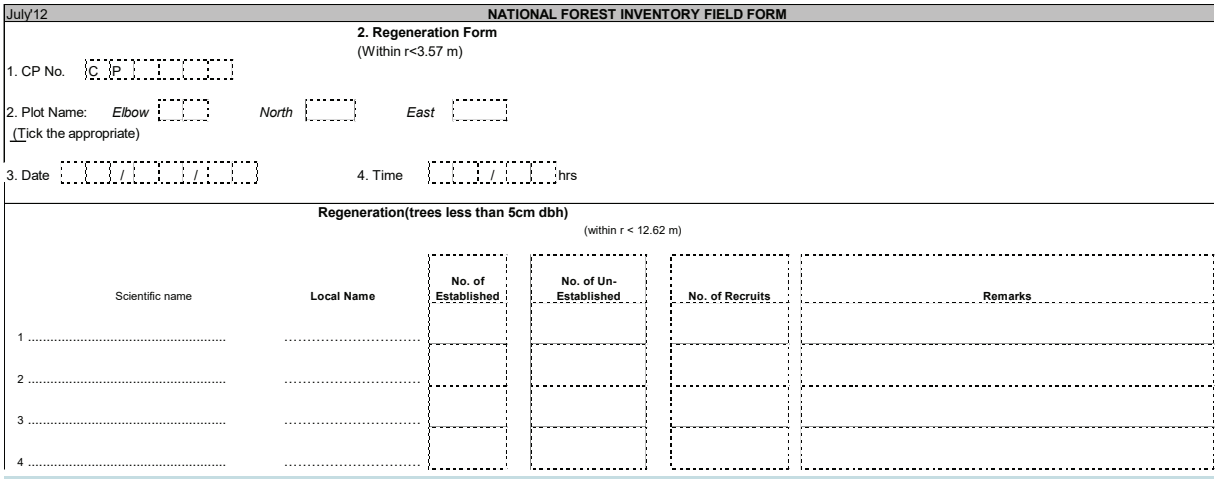
6.5.1.2.2 Preview reference point form

The reference point attribute fields can be previewed by following the steps described in Section 5.2. Click the preview option, a preview with records is generated. Select plot from the heading of preview and click on **green +** [ ] below plot, all sub-records created under plot entity will be displayed. Now click on reference point form to view the table for reference point data collection. The preview of the form is displayed in Figure 53.

Figure 53: Preview of Reference point form

6.5.2 Regeneration form

Add regeneration form as sub-record following the steps illustrated in figure 47 (Section 6.4.1) under the plot entity, if not created earlier. Then add an entity called **regeneration** following the steps illustrated in Figure 50 (Section 6.5.1.1). Change maximum count to 1000 after checking the multiple entry box. The Figure 54 shows the paper form for regeneration and Table 7 shows the name and type of attributes to added to regeneration entity.



July'12 NATIONAL FOREST INVENTORY FIELD FORM

2. Regeneration Form
(Within r<3.57 m)

1. CP No. C P

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

3. Date / / 4. Time / hrs

Regeneration(trees less than 5cm dbh)
(within r < 12.62 m)

Scientific name	Local Name	No. of Established	No. of Un-Established	No. of Recruits	Remarks
1					
2					
3					
4					

Figure 54: Regeneration Form

Table 7: List of attributes of Regeneration Form

Sl. No.	Attribute Name	Attribute Type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_regeneration_position	Number
4	regeneration_enumeration_date_year regeneration_enumeration_date_month regeneration_enumeration_date_day	Date
5	regeneration_enumeration_time_hour regeneration_enumeration_time_minute	Time
6	regeneration_location_srs regeneration_location_x regeneration_location_y	Coordinate
7	regeneration_species_code	Number
8	regeneration_species_scientific_name	Taxon
9	regeneration_species_vernacular_name	Text
10	regeneration_species_language_code	Text
11	regeneration_species_language_variety	Text
12	established_regeneration	Number
13	unestablished_regeneration	Number
14	recruits	Number
15	regeneration_remarks	Text

6.5.2.1 Preview of the attributes added to entity regeneration

The attributes of the regeneration entity (Table 7) is added following the procedure described earlier for adding Text, Code, Date, Time, Coordinate and Number Attribute, while addition of Taxon attribute type is described later. The preview of attributes created under regeneration entity is shown in Figure 55.

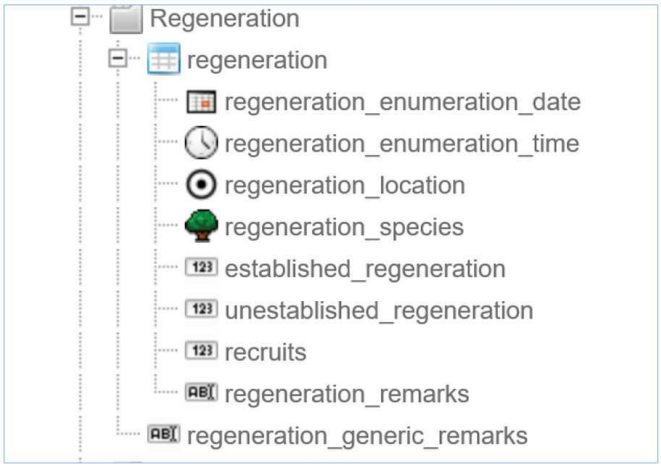


Figure 55: Attributes added to regemeration entity

6.5.2.2 Adding attribute Taxon to entity regeneration

Since attribute called Taxon is not added in any of the earlier form, it is illustrated here as demonstration for regeneration and other forms like tree, sapling, herb, shrub, etc. To **add the Taxon attribute, right click** on the regeneration attribute, click on **Add attribute**, then click on **Taxon**, type the Taxon attribute name as ***regeneration_species***, select the relevant species list (trees in this case) and click **Save** to save attribute as illustrated in Figure 56.

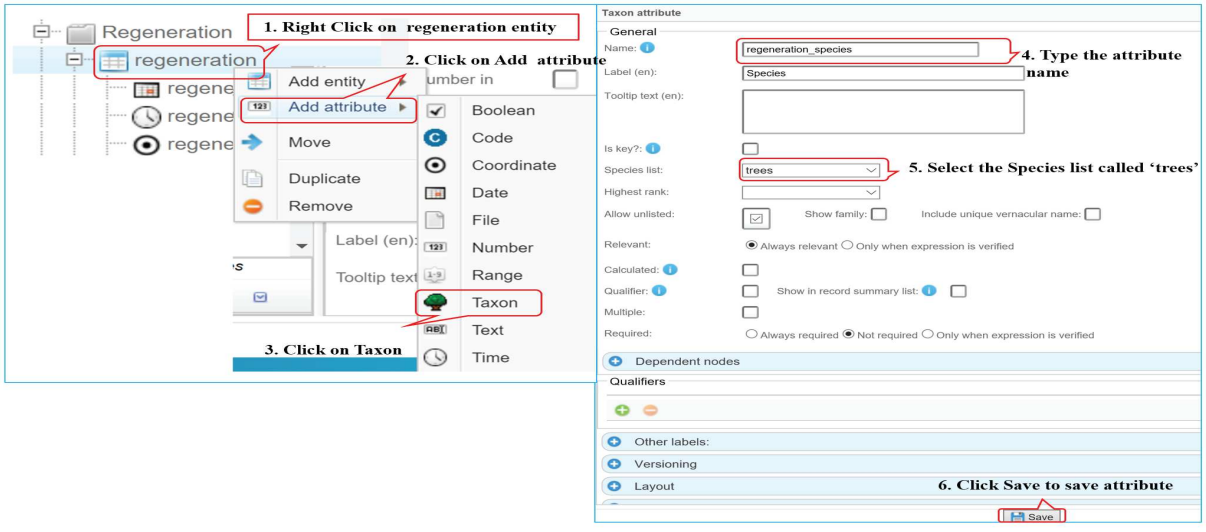


Figure 56: Illustration of creating Taxon attribute

6.5.2.3 Preview of regeneration form

The reference point attribute fields can be previewed by following the steps described in Section 5.2 and 6.5.1.2.2. The preview of the form is displayed in Figure 57.

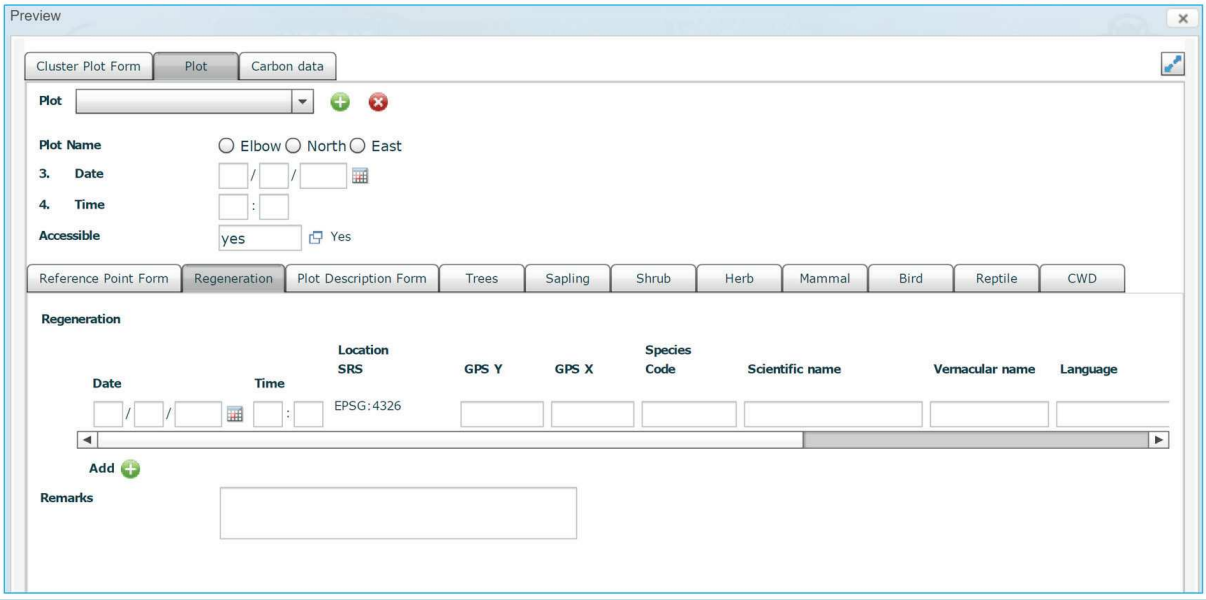


Figure 57: Preview of Regeneration Form

6.5.3 Plot Description form

The plot description form is little different compare to rest of the forms and amount of the information collected as part of plot description is very huge (See Annexure I for plot description paper form). The information to be collected as part of plot description are

i. Topographic positions
ii. Aspect
iii. Slope
iv. Stand Description
v. Forest Resources
vi. Forest Disturbance
vii. Forest health
viii. Duff, Litter and fuel bed
ix. Soil
x. Water bodies; and,
xi. Site value

All of these features **except topographic position and aspect,** while others are grouped as single (grouping) entity, which allows grouping attributes together. The topographic position and aspect are added as coded attribute, while Slope, Stand Description, Forest Resources, Forest Health, Duff, Litter and Fuel bed, Soil, Water bodies and Site value are first added as entity and attributes are added to these entities as detailed out in Table 8.

Table 8: Name and type of attribute directly added to plot description record

Sl. No.	Entity/Attribute Name	Entity/Attribute Type
1	cluster_cluster_plot_no	Text
2	plot_enumeartion date	
3	Plot enumeration time	
4	plot_location_srs plot_location_x plot_location_y	Coordinate
5	expected_plot_location_srs expected_plot_location_x expected_plot_location_y	Coordinate
6	expected_plot_location_distance	Number
7	expected_plot_location_distance_unit_name	Text
8	topographic_position	Code
9	aspect	Code
	Slope	**1:1 entity**
10	slope_slope_up	Number
11	slope_slope_up_unit_name	Text
12	slope_slope_down	Number
13	slope_slope_down_unit_name	Text
	Stand description	**1:1 entity**
14	stand_description_stand_height	Number
15	stand_description_stand_height_unit_name	Text
16	stand_description_canopy_closure	Number
17	stand_description_canopy_closure_unit_name	Text
18	stand_description_land_ownership	Code
19	stand_description_land_ownership_note	Code
20	stand_description_land_cover	Code
21	stand_description_vegetation_composition	Code
22	stand_description_forest_type	Code
23	stand_description_forest_stand_structure	Code
24	stand_description_main_understorey_type	Code
25	stand_description_understorey_percent	Number
	Forest resources	**1:1 entity**
26	forest_resources_bamboo_presence	Code
27	forest_resources_bamboo_scientific_name	Text
28	forest_resources_bamboo_cover_percent	Number
29	forest_resources_bamboo_regeneration	Code
30	forest_resources_cane_cover	Code
31	forest_resources_cane_dbh	Number
32	forest_resources_daphne_cover	Code

Sl. No.	Entity/Attribute Name	Entity/Attribute Type
33	forest_resources_snag	Code
34	forest_resources_fallen_tree	Code
	Forest Diturbance	**1:1 entity**
35	forest_disturbance_forest_fire_extent	Code
36	forest_disturbance_fire_type	Code
37	forest_disturbance_grazing_evidence	Code
38	forest_disturbance_grazing_incidence	Code
39	forest_disturbance_timber_extraction	Code
40	forest_disturbance_mining	Code
41	forest_disturbance_transmission_lines	Code
42	forest_disturbance_garbage	Code
	Forest Health	**1:1 entity**
43	forest_health_pest_and_disease_evidence	Code
44	forest_health_mistle_toe	Code
45	forest_health_dieback_fir	Code
46	forest_health_bark_beetle	Code
47	forest_health_forest_health_others	Code
	Duff Litter Fuelbed	**1:1 entity**
48	duff_litter_fuelbed_litter_depth_value	Number
49	duff_litter_fuelbed_litter_depth_value_unit_name	Text
50	duff_litter_fuelbed_humus_depth_value	Number
51	duff_litter_fuelbed_humus_depth_value_unit_name	Text
52	duff_litter_fuelbed_fuelbed_depth_value	Number
53	duff_litter_fuelbed_fuelbed_depth_value_unit_name	Text
54	duff_litter_fuelbed_litter_cover_percent	Number
55	duff_litter_fuelbed_litter_cover_percent_unit_name	Text
	Soil	**1:1 entity**
56	duff_litter_fuelbed_bare_soil_cover_percent	Number
57	duff_litter_fuelbed_bare_soil_cover_percent_unit_name	Text
58	soil_stoniness	Code
59	soil_soil_drainage	Code
60	soil_top_soil_moisture	Code
61	soil_top_soil_colour	Code
62	soil_top_soil_colour_chart	Code
63	soil_top_soil_texture	Code
64	soil_soil_sample_collected	Code
65	soil_evidence_gully	Code
66	soil_evidence_erosion	Code

Sl. No.	Entity/Attribute Name	Entity/Attribute Type
	Water Bodies	**1:1 entity**
67	water_bodies_stream_river	Code
68	water_bodies_wetland_marshy_area	Code
69	water_bodies_lake	Code
70	water_bodies_glacier	Code
71	water_bodies_pond	Code
	Site Value	**1:1 entity**
72	site_natural_trail_facility	Code
73	site_scenic	Code
74	site_visitor_evidence	Code
75	site_site_value	Code
76	site_site_name	Code
77	site_site_remarks	Text

6.5.3.1 Adding single (grouping) entity under plot description

To add single (grouping) entity to plot description, right click on the plot description record, a drop-down window will open, click on **Add entity,** and select **Single (1:1) (attributes single grouping)**. Type the name of entity and click **Save** on the bottom of the page to save the entity. The steps for creating **Single (1:1) (attributes single grouping)** entity with slope is illustrated in Figure 58. The same procedure is followed for rest of the attributes groups (entity) and preview of same is shown in Figure 59.

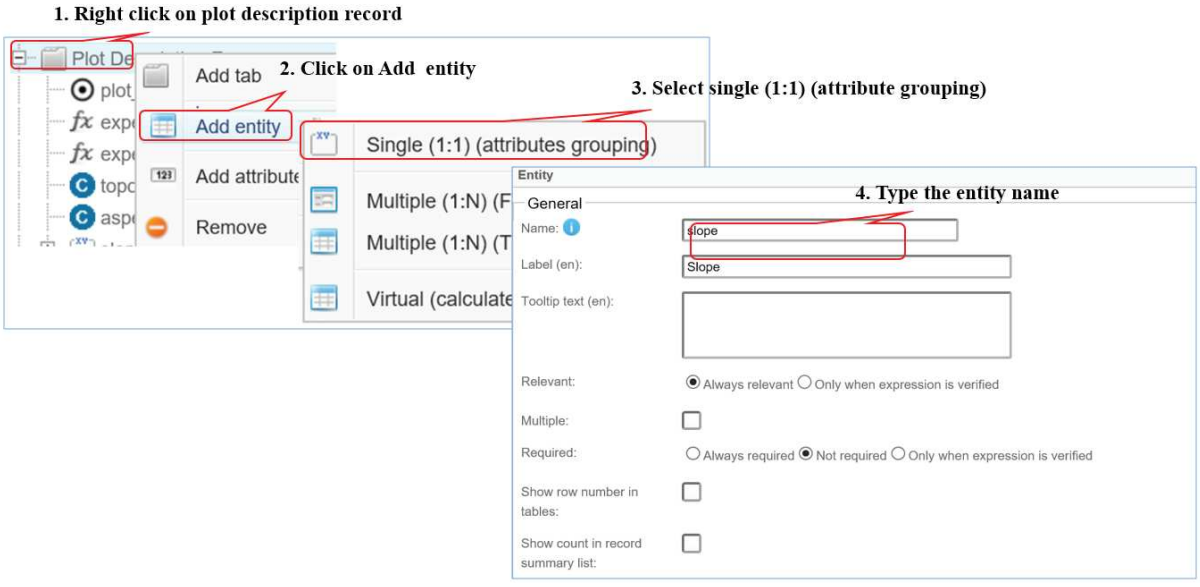


Figure 58: Adding single (1:1) attribute grouping entity with slope

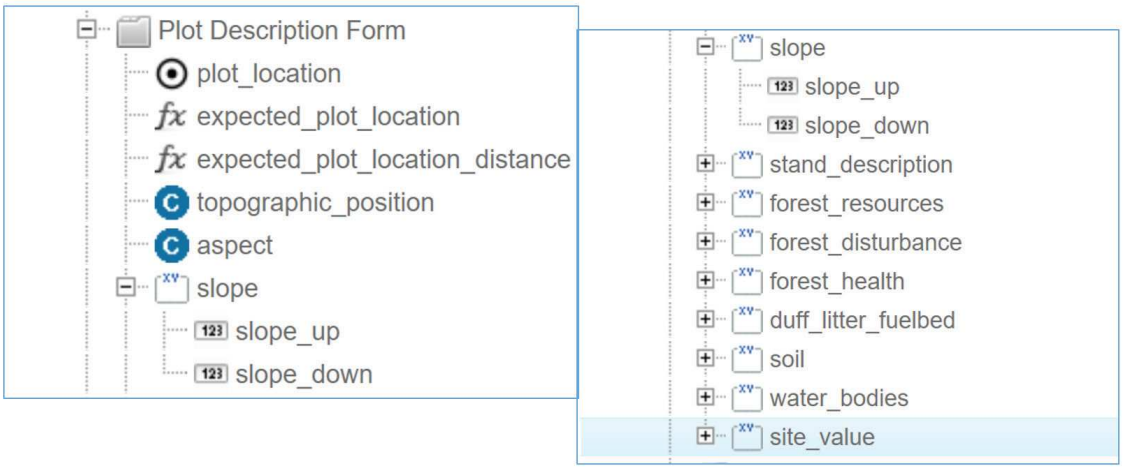


Figure 59: Preview of single (1:1) attributes created for grouped attributes

6.5.3.2 Preview of Plot Description Form

The plot description attribute fields can be previewed by following the steps described in Section 5.2 and 6.5.1.2.2. For detail step wise illustration refer Figure 60.

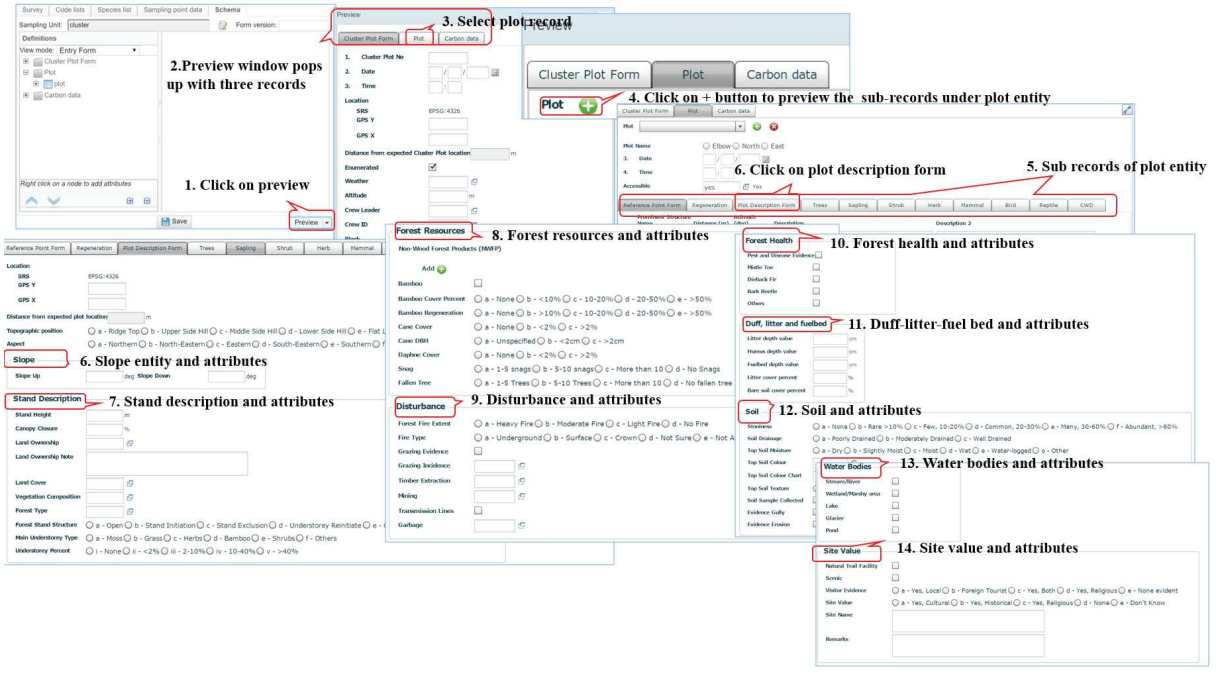


Figure 60: Preview of Plot Description Form

6.5.4 Tree form

Add **Tree** form as sub-record following the steps illustrated in Figure 47 under plot entity under Section 6.4.1. Add an entity called ***tree*** following the steps illustrated in Figure 50 (Section 6.5.1.1). The Figure 61 shows the paper form for Tree and Table 9 shows the name and type of attribute created under tree entity.

July '12 NATIONAL FOREST INVENTORY FIELD FORMS

5. TREE FORM

Plot Identification

1. Cluster Plot No. C P

2.Plot Name Elbow North East

(Tick the appropriate)

3. Date / / 4. Time / hrs

Tree Form(>10cm DBH)

(within r < 12.62 m)

Sl.No	Scientific name	Local Name	Distance from Plot centre(m)	Azimuth(degrees)	DBH(cm)	Height (m)	Bole ht(m)	Crown ht(m)	Canopy Position	Condition of tree		Bark thickness(cm)	Core		Core 1N	Core 1nn	Core 1L	10yrs increment(cm)	5yrs increment(cm)	Core 2N	Core 2nn	Core 2L	10yrs increment(cm)	5yrs increment(cm)
										Live	Dead		Y	N										
1																								
2																								
3																								
4																								
5																								

Figure 61: Tree Paper Form

Table 9: Name and type of tree attributes

Sl. No.	Attribute Name	Attribute Type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_tree_position	Number
4	tree_enumeration_date_year tree_enumeration_date_month tree_enumeration_date_day	Date
5	tree_enumeration_time_hour tree_enumeration_time_minute	Time
6	tree_location_srs tree_location_x tree_location_y	Coordinate
7	tree_plot_location_distance	Number
8	tree_species_code	Number
9	tree_species_scientific_name	Taxon
10	tree_species_vernacular_name	Text

Sl. No.	Attribute Name	Attribute Type
11	tree_species_language_code	Text
12	tree_species_language_variety	Text
13	tree_species_extra	Text
14	tree_distance	Number
15	tree_azimuth	Number
16	tree_dbh	Number
17	tree_total_height	Number
18	tree_bole_height	Number
19	tree_crown_height	Number
20	tree_canopy_position	Code
21	tree_condition	Code
22	tree_bark_thickness	Number
23	core_taken	Code
24	total_rings_core1	Number
25	total_innerrings_core1	Number
26	length_core1	Number
27	core1_10years	Number
28	core1_10years_unit_name	Text
29	core1_5years	Number
30	core1_5years_unit_name	Text
31	total_rings_core2	Number
32	total_innerrings_core2	Number
33	length_core2	Number
34	core2_10years	Number
35	core2_10years_unit_name	Text
36	core2_5years	Number
37	core2_5years_unit_name	Text
38	tree_remarks	Text

6.5.4.1 Preview of the attributes added to entity regeneration

The attributes of the tree entity (Table 9) are created following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under tree entity is shown in Figure 62.

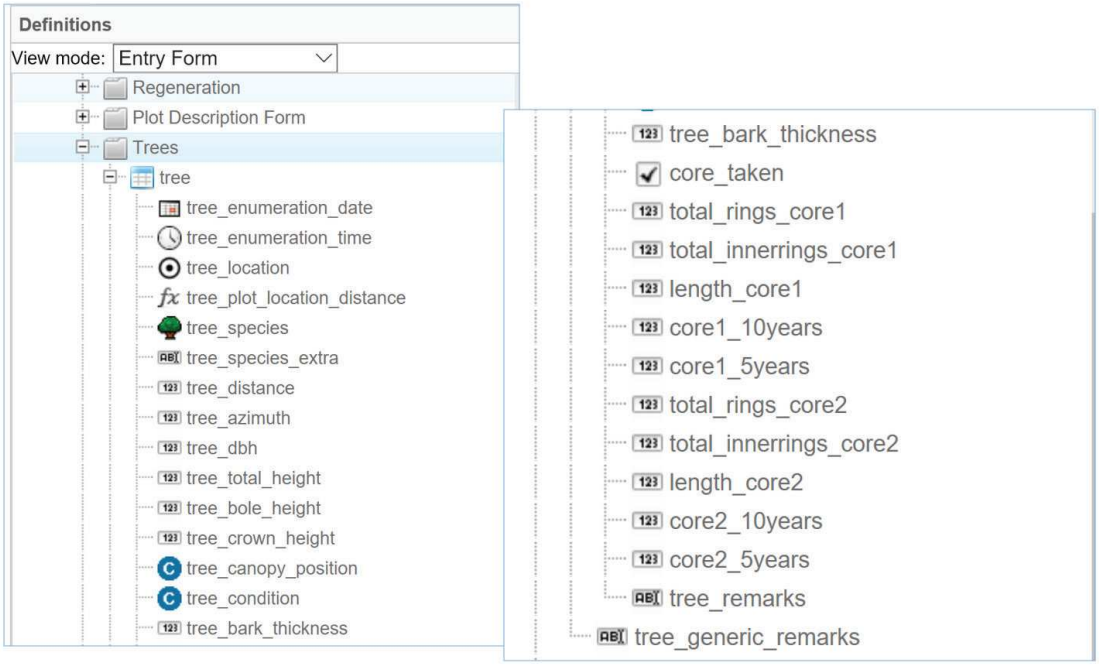


Figure 62: Preview of attributes added to tree entity

6.5.4.2 Preview of the tree form attribute fields

The tree form attribute fields can be previewed by following the steps described in Section 5.2. 6.5.1.2.2 and illustration in 6.5.3.2. The preview of the form is displayed in Figure 63.

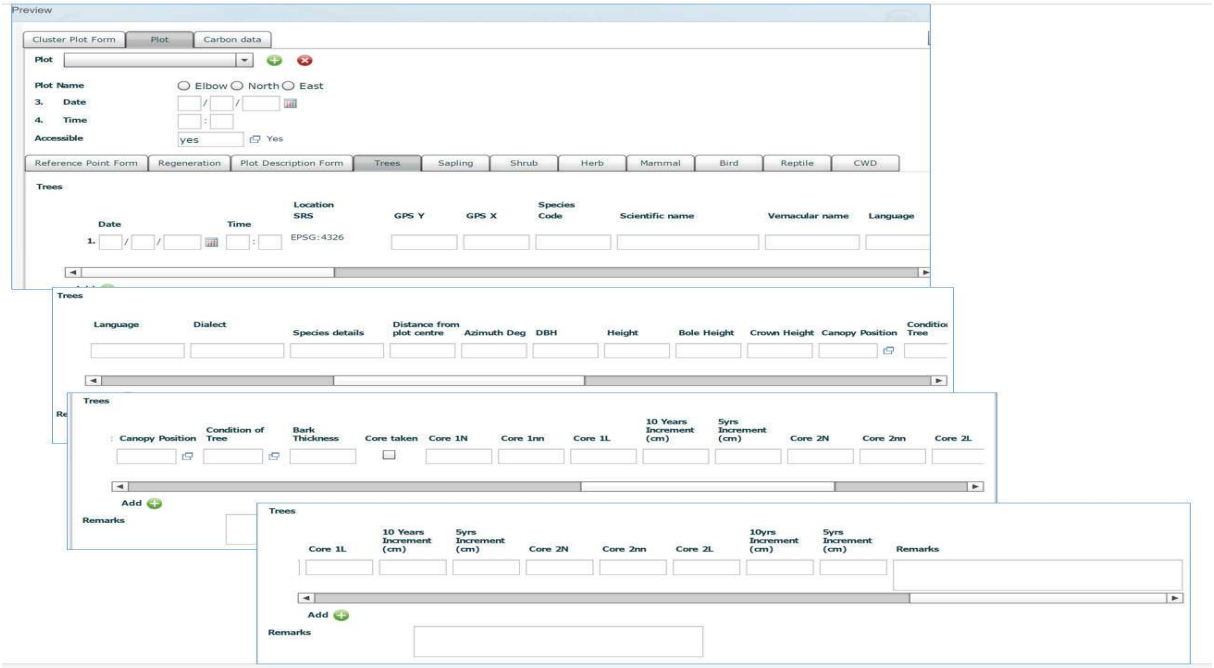
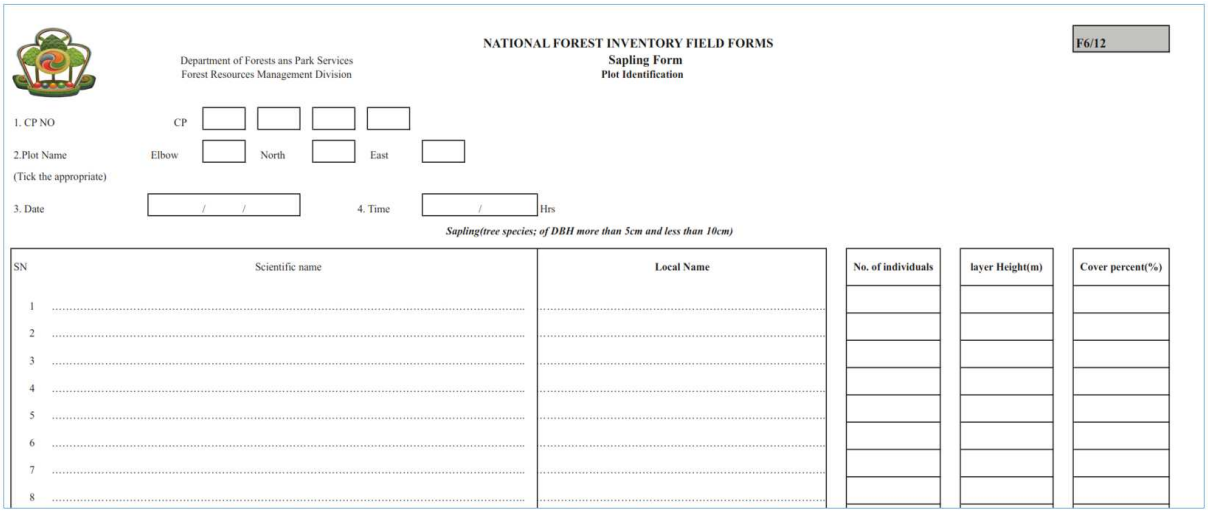


Figure 63: Preview of the tree form and name of the columns

6.5.5 Sapling form

Add **sapling** as sub-record following the steps illustrated in Figure 47 (Section 6.4.1) under plot entity. Then **add an entity** called **Sapling** following the steps illustrated in figure 50 (Section 6.5.1.1. Figure 64 shows the paper form for Sapling and Table 10 shows the name and type of attributes created under entity Sapling.



NATIONAL FOREST INVENTORY FIELD FORMS
Sapling Form
Plot Identification

F6/12

Department of Forests ans Park Services
Forest Resources Management Division

1. CP NO CP
2.Plot Name Elbow North East
(Tick the appropriate)
3. Date / /
4. Time / Hrs

Sapling(tree species; of DBH more than 5cm and less than 10cm)

SN	Scientific name	Local Name	No. of individuals	layer Height(m)	Cover percent(%)
1					
2					
3					
4					
5					
6					
7					
8					

Figure 64: Sapling paper form

Table 10: Name and type of attributes for Sapling

Sl. No	Sapling Attribute Name	Attribute Type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_sapling_position	Number
4	sapling_enumeration_date_year sapling_enumeration_date_month sapling_enumeration_date_day	Date
5	sapling_enumeration_time_hour sapling_enumeration_time_minute	Time
6	sapling_species_code	Number
7	sapling_species_scientific_name	Taxon
8	sapling_species_vernacular_name	Text
9	sapling_species_language_code	Text
10	sapling_species_language_variety	
11	sapling_individuals	
12	sapling_layer_height	Number
13	sapling_layer_height_unit_name	Text
14	sapling_cover_percent	Number
15	sapling_cover_percent_unit_name	Text
16	sapling_remarks	Text

6.5.5.1 Attributes added to entity Sapling

The attributes of the sapling entity (Table 13) are created following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under sapling entity is shown in Figure 65.

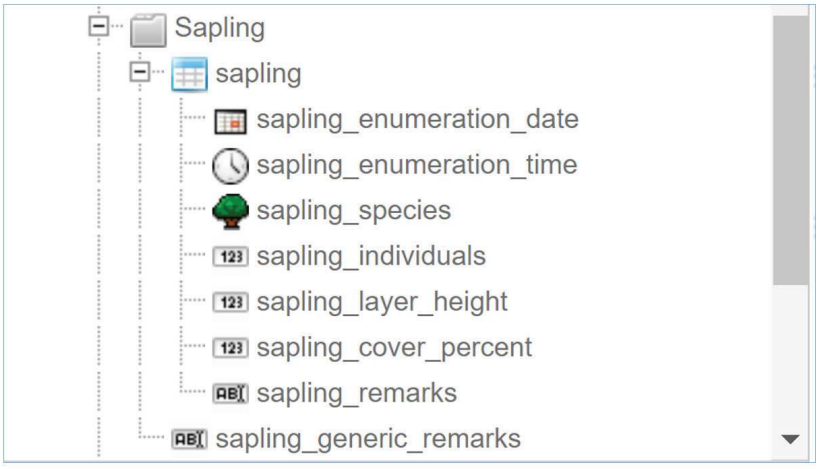


Figure 65: Attributes added to Sapling entity

6.5.5.2 Preview of the tree form

The attribute fields of sapling entity can be previewed by following the steps described in Section 5.2, 6.5.1.2.2 and 6.5.3.2. The preview of the form is displayed in Figure 66.

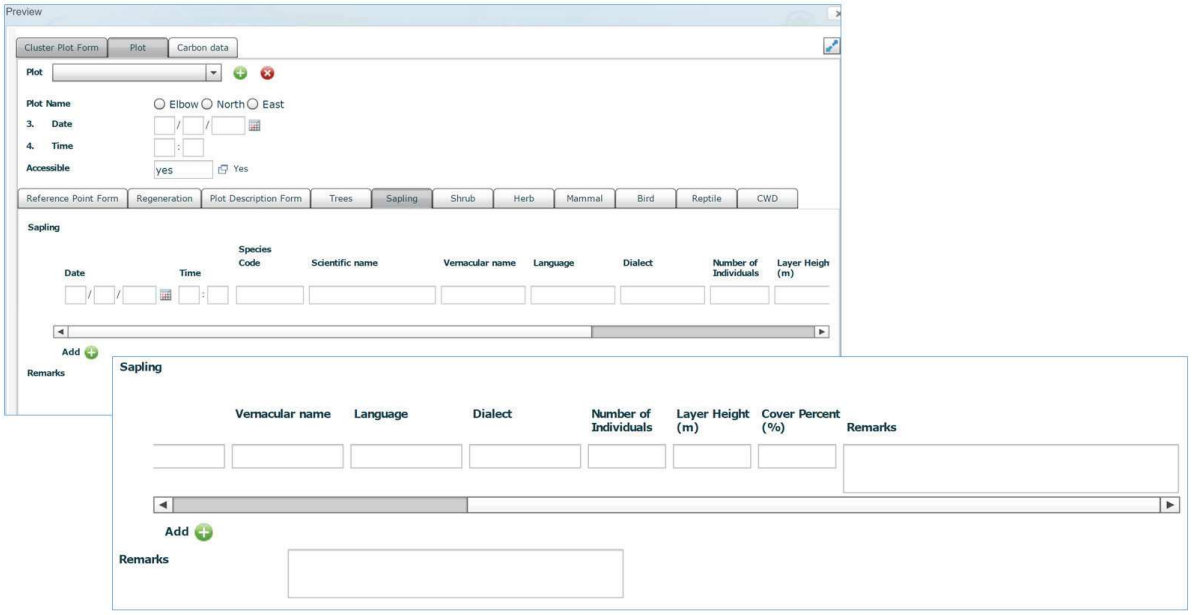


Figure 66: Preview sapling form

6.5.6 Shrub form

Add **shrub as sub-record** following the steps illustrated in Figure 47 (Section 6.4.1) under plot entity. Then add an entity the called Shrub following the steps illustrated in Figure 50 under Section 6.5.1.1. The Figure 67 shows the paper form for Shrub and Table 11 shows the name and type of attributes created under entity Shrub.

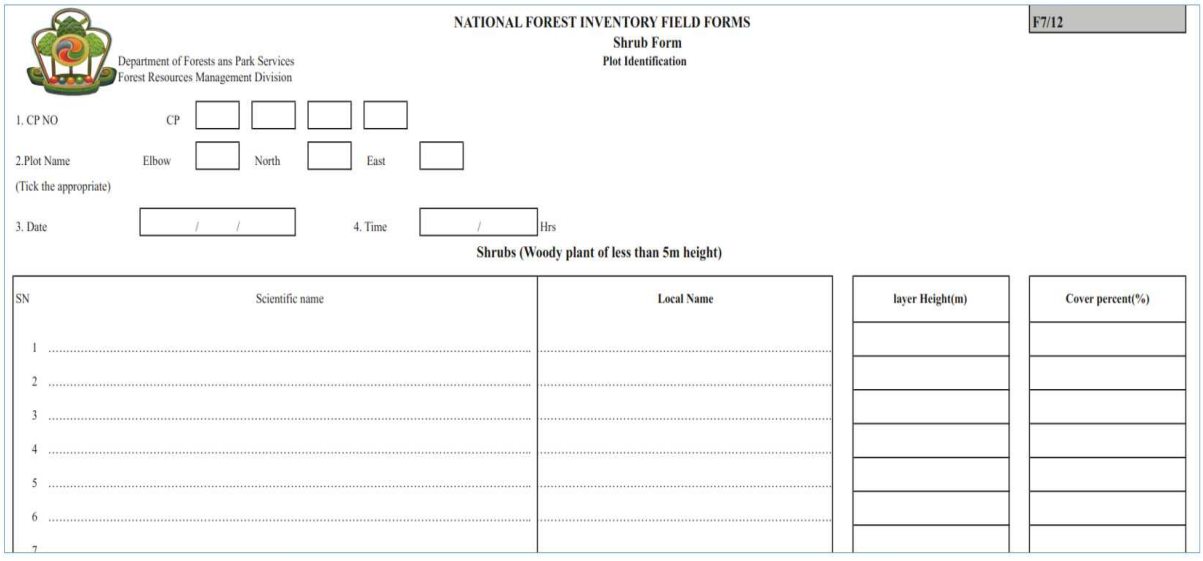

NATIONAL FOREST INVENTORY FIELD FORMS
Shrub Form
Plot Identification
F7/12
Department of Forests ans Park Services
Forest Resources Management Division
1. CP NO CP
2.Plot Name Elbow North East
(Tick the appropriate)
3. Date / /
4. Time / Hrs
Shrubs (Woody plant of less than 5m height)
SN | Scientific name | Local Name | layer Height(m) | Cover percent(%)
1
2
3
4
5
6
7

Figure 67: Shrub Paper Form

Table 11: Name and type of shrub attribute

Sl. No	Shrub Attribute Name	Attribute Type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	shrub_no	Number
4	shrub_enumeration_date_year shrub_enumeration_date_month shrub_enumeration_date_day	Date
5	shrub_enumeration_time_hour shrub_enumeration_time_minute	Time
6	shrub_species_code	Number
7	shrub_species_scientific_name	Taxon
8	shrub_species_vernacular_name	Text
9	shrub_species_language_code	Text
10	shrub_species_language_variety	Text
11	shrub_layer_height	Number
12	shrub_cover_percent	Number
13	shrub_remarks	Text

6.5.6.1 Attributes added to entity shrub

The attributes of the shrub entity (Table 14) are created following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under shrub entity is shown in Figure 68.

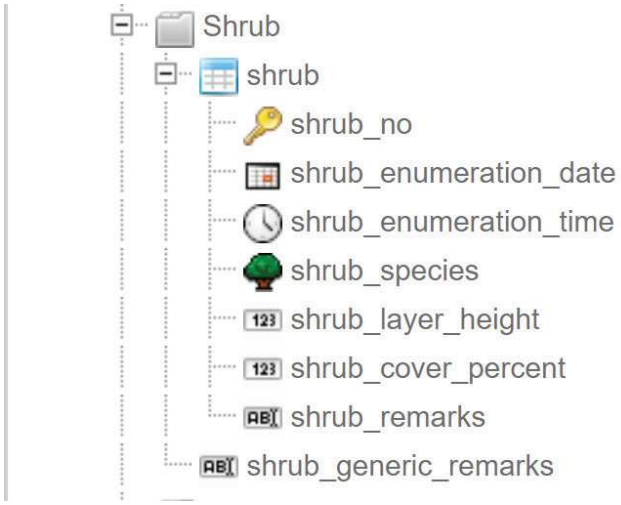


Figure 68: Attributes of shrub form

6.5.6.2 Preview of the shrub form

The attribute fields of shrub entity can be previewed by following the steps described in Section 5.2, 6.5.1.2.2 and 6.5.3.2. The preview of the form is displayed in Figure 69.

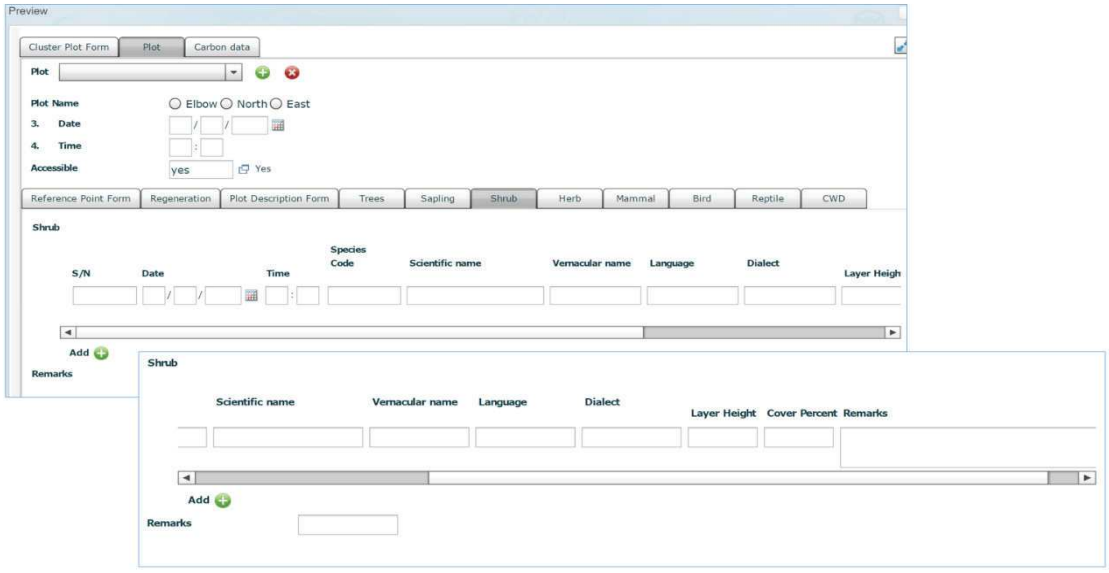
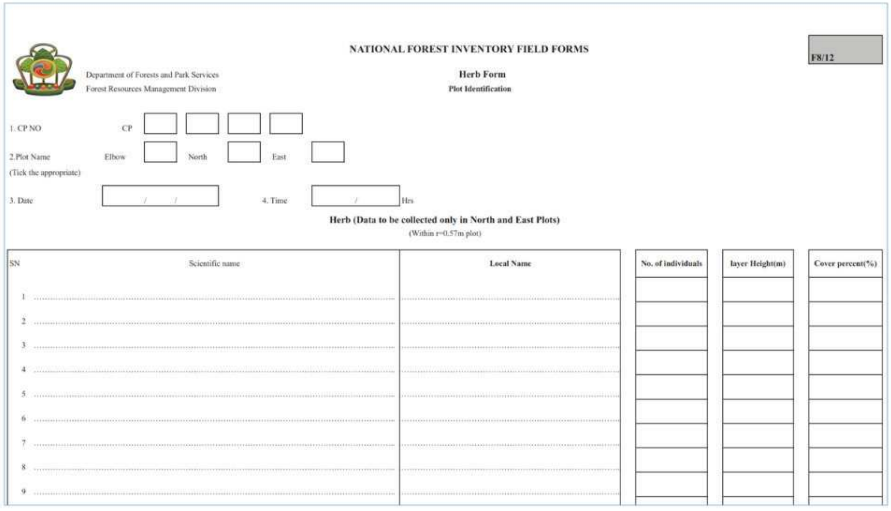


Figure 69: Preview of shrub form

6.5.7 Herb form

Add **Herb sub-record** following the steps illustrated in Figure 47 (Section 6.4.1) under plot entity. Then add an entity called **herb** following the steps illustrated in Figure 50 under Section 6.5.1.1. The Figure 70 shows the paper form for Herb data collection and Table 12 shows the name and type of attributes created under entity herb.


NATIONAL FOREST INVENTORY FIELD FORMS

F8/12

Department of Forests and Park Services
Forest Resources Management Division

Herb Form
Plot Identification

1. CP NO CP
2.Plot Name Elbow North East
(Tick the appropriate)
3. Date 4. Time Hrs

Herb (Data to be collected only in North and East Plots)
(Within r=0.57m plot)

SN	Scientific name	Local Name	No. of Individuals	layer Height(m)	Cover percent(%)
1					
2					
3					
4					
5					
6					
7					
8					
9					

Figure 70: Herb Paper Form

Table 12: Name and type of Herb attributes

Sl. No.	Herb Attribute Name	Attribute Type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_herb_position	Number
4	herb_enumeration_date_year herb_enumeration_date_month herb_enumeration_date_day	Date
5	herb_enumeration_time_hour herb_enumeration_time_minute	Time
6	herb_species_code	Number
7	herb_species_scientific_name	Taxon
8	herb_species_vernacular_name	Text
9	herb_species_language_code	Text
10	herb_species_language_variety	Text
11	herb_individuals	Number
12	herb_cover	Number
13	herb_layer_height	Number
14	herb_layer_height_unit_name	Text
15	herb_remarks	Text

6.5.7.1 Attributes added to entity herb

The attributes of the tree entity (Table 15) are created following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under tree entity is shown in Figure 71.

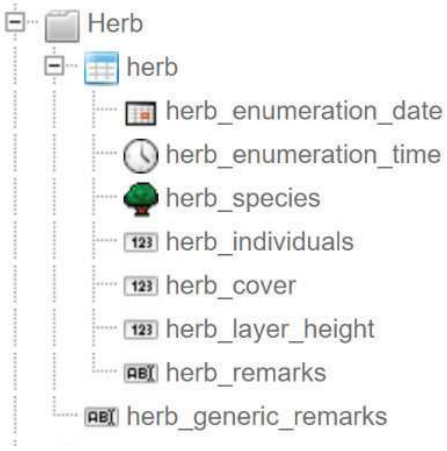


Figure 71: Attributes added to herb entity

6.5.7.2 Preview of herb form

The attribute fields of herb entity/form can be previewed by following the steps described in Section 5.2, 6.5.1.2.2 and 6.5.3.2. The preview of the form is displayed in Figure 72.

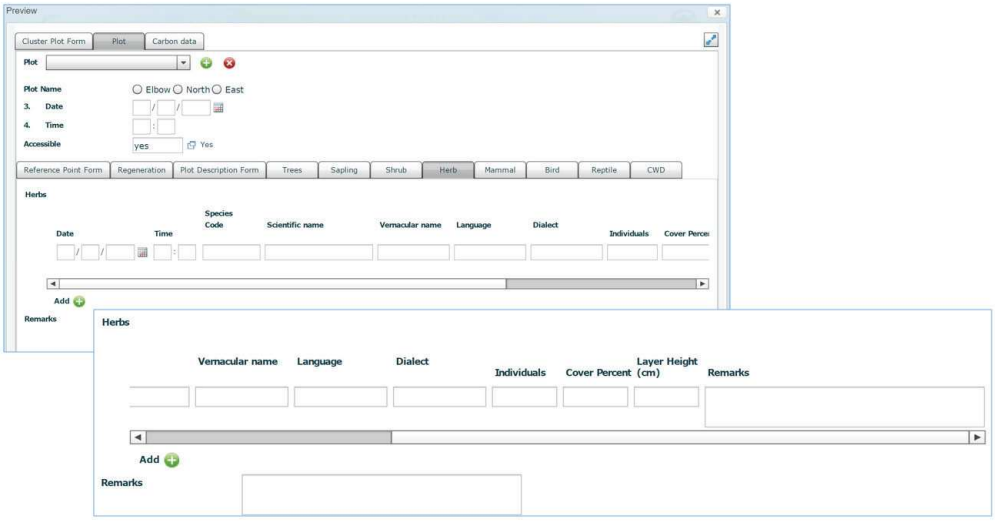
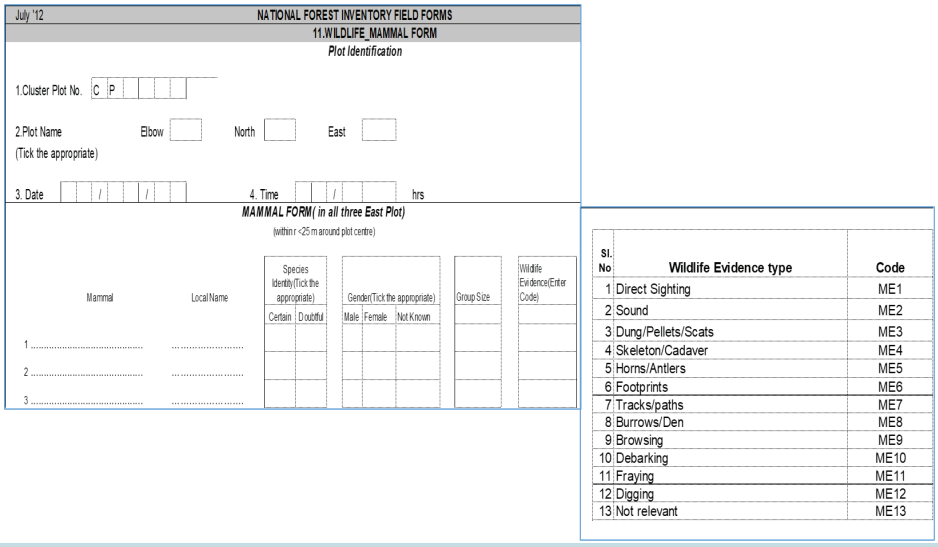


Figure 72: Preview of Herb form

6.5.8 Mammal form

Add **Mammal sub-record** following the steps illustrated in Figure 47 (Section 6.4.1) under plot entity. Then add an entity the called **mammal** following the steps illustrated in Figure 50 under Section 6.5.1.1. The Figure 73 shows the paper form for Mammal and Table 13 shows the names of the attributes created under entity mammal.



July '12 NATIONAL FOREST INVENTORY FIELD FORMS

11.WILDLIFE_MAMMAL FORM

Plot Identification

1.Cluster Plot No. C P

2.Plot Name Elbow North East

(Tick the appropriate)

3. Date / / 4. Time / hrs

MAMMAL FORM (in all three East Plot)

(within r <25 m around plot centre)

Mammal	Local Name	Species Identity(Tick the appropriate)		Gender(Tick the appropriate)			Group Size	Wildlife Evidence(Enter Code)
		Certain	Doubtful	Male	Female	Not Known		
1	.....							
2	.....							
3	.....							

Sl. No	Wildlife Evidence type	Code
1	Direct Sighting	ME1
2	Sound	ME2
3	Dung/Pellets/Scats	ME3
4	Skeleton/Cadaver	ME4
5	Horns/Antlers	ME5
6	Footprints	ME6
7	Tracks/paths	ME7
8	Burrows/Den	ME8
9	Browsing	ME9
10	Debarking	ME10
11	Fraying	ME11
12	Digging	ME12
13	Not relevant	ME13

Figure 73: Paper form for mammal

Table 13: Name and type of attributes of mammal form

Sl. No.	Mammal Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_mammal_position	Number
4	mammal_enumeration_date_year mammal_enumeration_date_month mammal_enumeration_date_day	Date
5	mammal_enumeration_time_hour mammal_enumeration_time_minute	Time
6	mammal_species_code	Number
7	mammal_species_scientific_name	Taxon
8	mammal_species_vernacular_name	Text
9	mammal_species_language_code	Text
10	mammal_species_language_variety	Text
11	mammal_identity	Code
12	mammal_gender	Code
13	mammal_group_size	Number
14	mammal_evidence	Code
15	mammal_remarks	Text

6.5.8.1 Attributes created under mammal entity

The attributes of the mammal entity (Table 16) are added following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under mammal entity is shown in Figure 74.

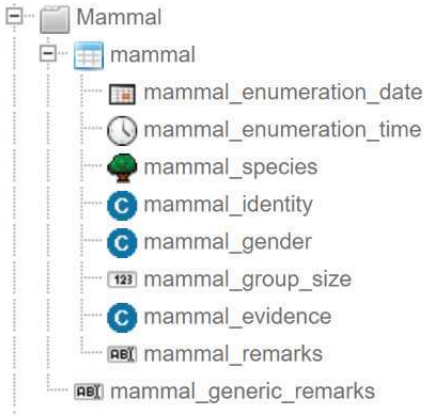


Figure 74: Preview of attributes added to mammal entity

6.5.8.2 Preview of Mammal form

The attribute fields of Mammal entity /form can be previewed by following the steps described in Section 5.2, 6.5.1.2.2 and 6.5.3.2. The preview of the form is displayed in Figure 75.

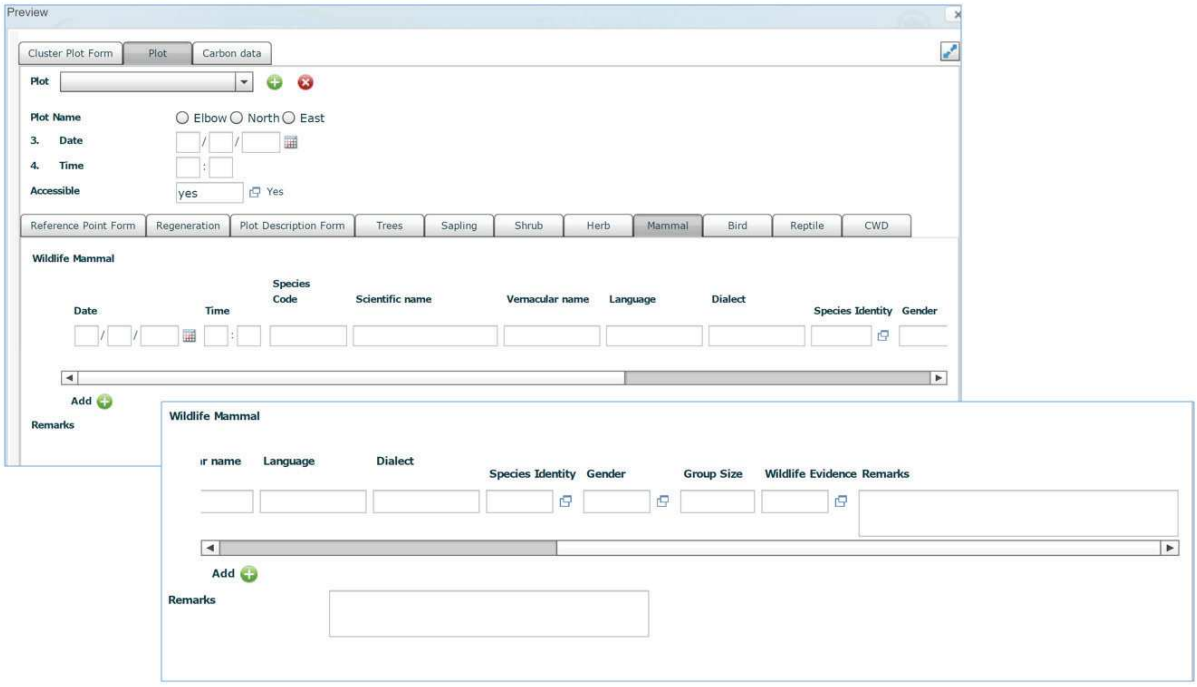
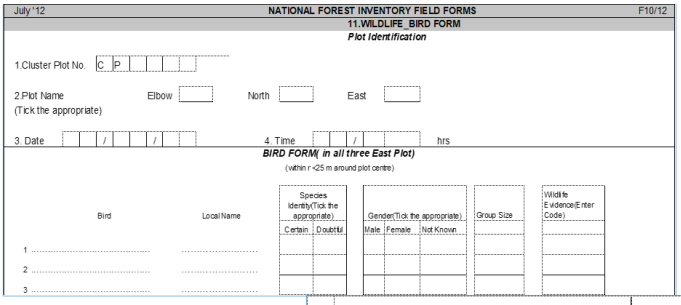


Figure 75: Preview of mammal form

6.5.9 Bird form

Add **Bird sub-record** following the steps illustrated in figure 47 (Section 6.4.1) under plot entity. Then add an entity the called **bird** following the steps illustrated in figure 50 under Section 6.5.1.1. The figure 76 shows the paper form for Bird and table 14 shows the name and type of attributes created under entity Bird.



Sl. No	Wildlife Evidence type	Code
1	Direct Sighting	BE1
2	Sound	BE2
3	Droppings	BE3
4	Eggs	BE4
5	Skeleton/Cadaver	BE5
6	Feathers	BE6
7	Footprints	BE7
8	Tracks/paths	BE8
9	Nests/Burrows	BE9
10	Not relevant	BE10

Figure 76: Bird paper form

Table 14: Name and type of attributes for bird form

Sl. No.	Bird Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_bird_position	Number
4	bird_enumeration_date_year bird_enumeration_date_month bird_enumeration_date_day	Date
5	bird_enumeration_time_hour bird_enumeration_time_minute	Time
6	bird_species_code	Number
7	bird_species_scientific_name	Taxon
8	bird_species_vernacular_name	Text
9	bird_species_language_code	Text
10	bird_species_language_variety	Text
11	bird_identity	Code
12	bird_gender	Code
13	bird_group_size	Number
14	bird_evidence	Code
15	bird_remarks	Text

6.5.9.1 Attributes created under bird entity

The attributes of the bird entity (Table 17) are added following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under bird entity is shown in Figure 77.

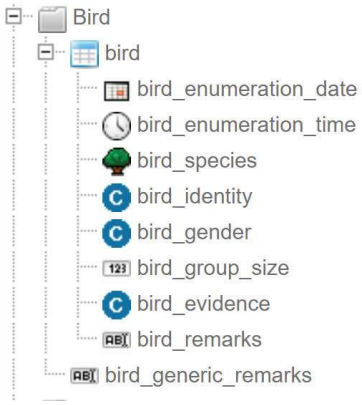


Figure 77: Attributes added to bird entity

6.5.9.2 Preview of the bird form

The attribute fields of bird entity/form can be previewed by following the steps described in Section 5.2, 6.5.1.2.2 and 6.5.3.2. The preview of the form is displayed in Figure 78.

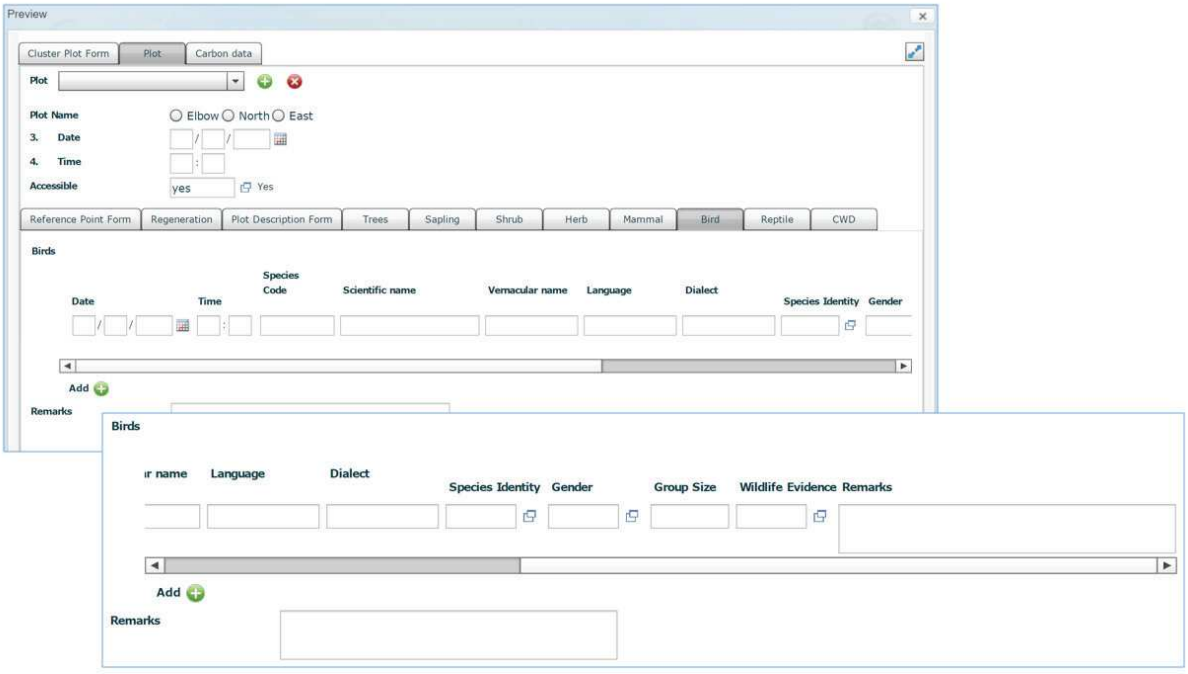
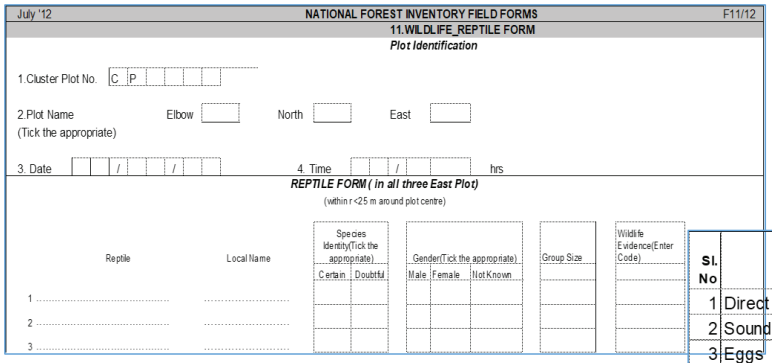


Figure 78: Preview of bird form

6.5.10 Reptile form

Add **Reptile** as sub-record following the steps illustrated in figure 47 (Section 6.4.1) under plot entity. Then add an entity called **Reptile** following the steps illustrated in figure 50 under Section 6.5.1.1. The Figure 79 shows the paper form for Reptile and Table 15 shows the name and type of attributes created under entity Reptile.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11.WILDLIFE_REPTILE FORM

Plot Identification

1.Cluster Plot No. C P

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

3. Date / / 4. Time / hrs

REPTILE FORM (in all three East Plot)

(within r <25 m around plot centre)

Reptile	Local Name	Species Identity(Tick the appropriate)		Gender(Tick the appropriate)			Group Size	Wildlife Evidence(Enter Code)
		Certain	Doubtful	Male	Female	Not Known		
1								
2								
3								

Sl. No	Wildlife Evidence type	Code
1	Direct Sighting	RE1
2	Sound	RE2
3	Eggs	RE3
4	Skeleton	RE4
5	Skin	RE5
6	Tracks/paths	RE6
7	Nests/Burrows	RE7
8	Not relevant	RE8

Figure 79: Reptile paper form

Table 15: Name and type of reptile attributes

Sl. No.	Reptile Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_reptile_position	Number
4	reptile_enumeration_date_year reptile_enumeration_date_month reptile_enumeration_date_day	Date
5	reptile_enumeration_time_hour reptile_enumeration_time_minute	Time
6	reptile_species_code	Number
7	reptile_species_code_qualifier	Taxon
8	reptile_common_name	Text
9	reptile_identity	Code
10	reptile_gender	Code
11	reptile_group_size	Number
12	reptile_evidence	Code
13	reptile_remarks	Text

6.5.10.1 Attributes created under reptile entity

The attributes of the reptile entity (Table 18) are added following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under reptile entity is shown in Figure 80.

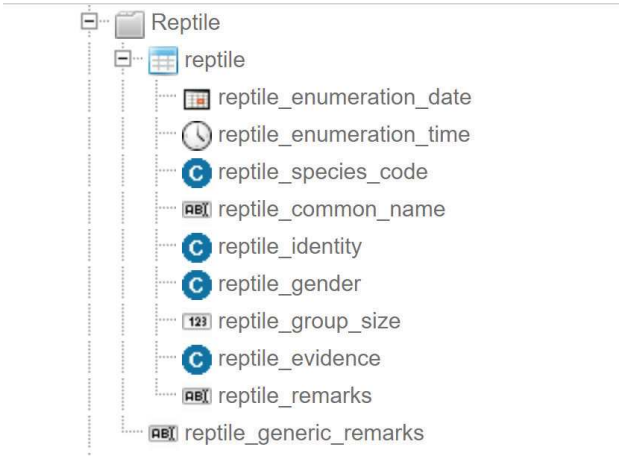


Figure 80: Attribtes added to entity reptile

6.5.10.2 Preview of the reptile form

The attribute fields of reptile entity/form can be previewed by following the steps described in Section 5.2, Section 6.5.1.2.2 and illustration in Section 6.5.3.2. The preview of the form is displayed in Figure 81.

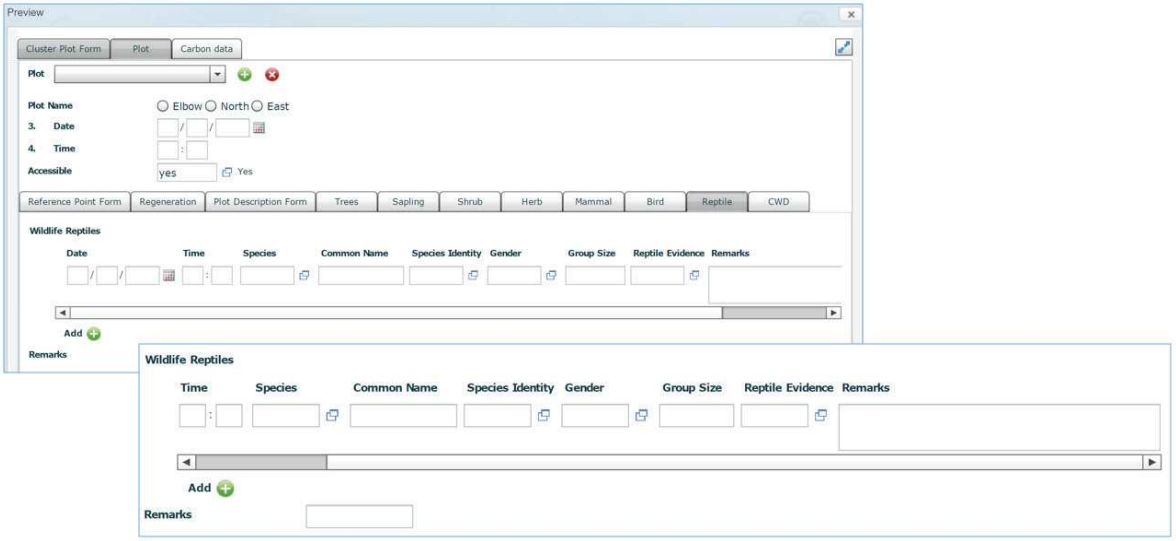
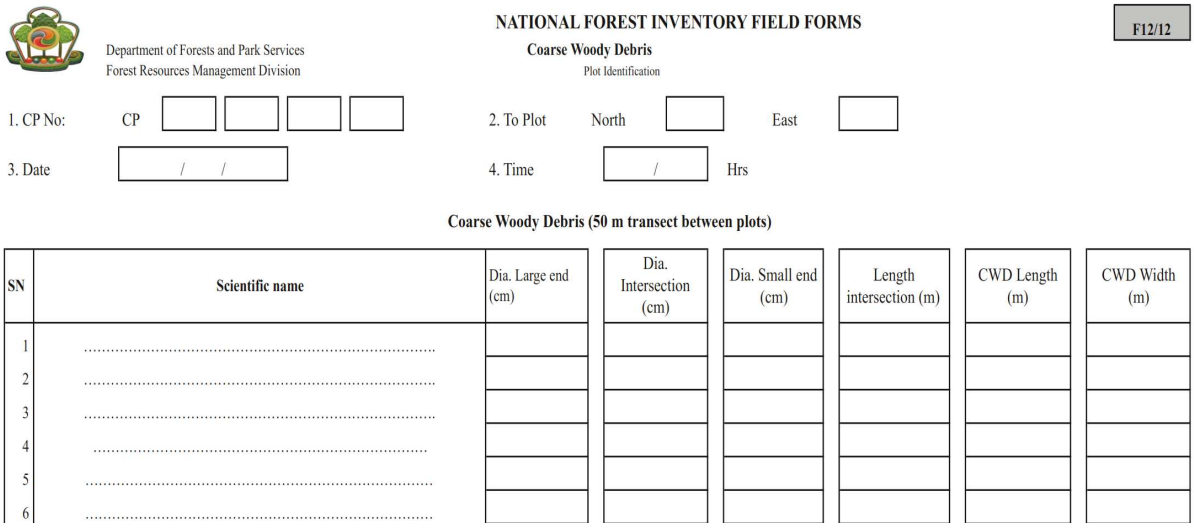


Figure 81: Preview of reptile form

6.5.11 Coarse Woody Debris form

Add CWD **sub-record** following the steps illustrated in Figure 47 (Section 6.4.1) under plot entity. Then add an entity called **CWD** following the steps illustrated in Figure 50 under Section 6.5.1.1. Figure 82 show the paper form for CWD and Table 16 shows the name and type of attributes added to entity CWD.



Department of Forests and Park Services
Forest Resources Management Division

NATIONAL FOREST INVENTORY FIELD FORMS

Coarse Woody Debris

Plot Identification

F12/12

1. CP No: CP ____ 2. To Plot North ____ East ____

3. Date ____/____/____ 4. Time ____/____ Hrs

Coarse Woody Debris (50 m transect between plots)

SN	Scientific name	Dia. Large end (cm)	Dia. Intersection (cm)	Dia. Small end (cm)	Length intersection (m)	CWD Length (m)	CWD Width (m)
1	.....						
2	.....						
3	.....						
4	.....						
5	.....						
6	.....						

Figure 82: CWD paper form

Table 16: Name and type of CWD attributes

Sl. No.	CWD Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	plot_plot_type	Code
3	_cwd_position	Number
4	cwd_enumeration_date_year cwd_enumeration_date_month cwd_enumeration_date_day	Date
5	cwd_enumeration_time_hour cwd_enumeration_time_minute	Time
6	cwd_species_code	Number
7	cwd_species_scientific_name	Taxon
8	cwd_species_vernacular_name	Text
9	cwd_species_language_code	Text
10	cwd_species_language_variety	Text
11	cwd_diameter_large_end	Number
12	cwd_diameter_large_end_unit_name	Text
13	cwd_diameter_intersection	Number
14	cwd_diameter_intersection_unit_name	Text

Sl. No.	CWD Attribute Name	Attribute type
15	cwd_diameter_small_end	Number
16	cwd_diameter_small_end_unit_name	Text
17	cwd_length_intersection	Number
18	cwd_length_intersection_unit_name	Text
19	cwd_length	Number
20	cwd_length_unit_name	Text
21	cwd_width	Number
22	cwd_width_unit_name	Text
23	cwd_remarks	Text

6.5.11.1 Attributes created under CWD entity

The attributes of the cwd entity (Table 19) are created following the procedure described earlier for adding Text, Code, Date, Time, Coordinate, Taxon and Number Attribute. The preview of attributes created under cwd entity is shown in Figure 83.

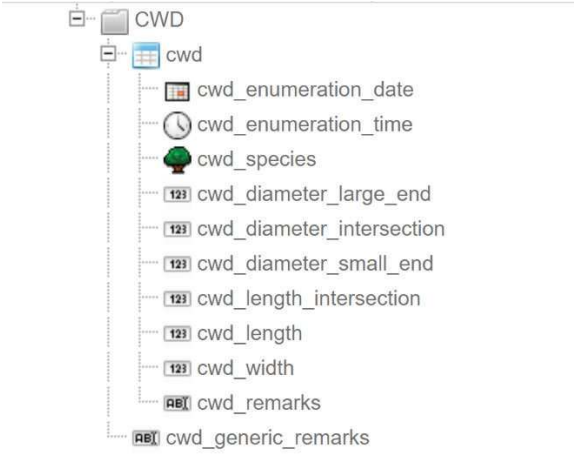


Figure 83: Attributes added to entity CWD

6.5.11.2 Preview of cwd form

The attribute fields of cwd entity/form can be previewed by following the steps described in Section 5.2, 6.5.1.2.2 and 6.5.3.2. The preview of the form is displayed in Figure 84.

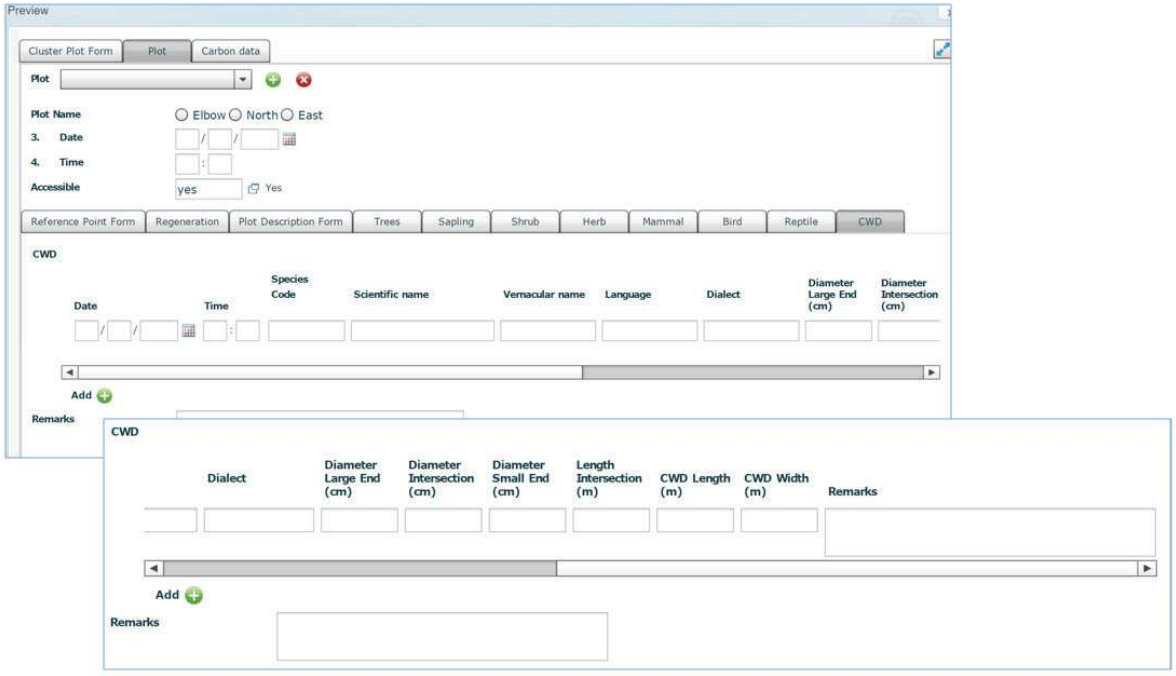


Figure 84: Preview of CWD form

07 Carbon form

The data collection for understory carbon, litter, fine woody debris and soil is a little different from the data collection forms for other forest information collected using forms designed in previous steps.

7.1 Creating Carbon Forms

Third record type in the NFI survey is collection of carbon data and record is called Carbon Data. If Carbon data record is not created under Section 4.5.3, create one following the illustration (Figure 85) below .Right click anywhere below the existing record, Cluster Plot Form and Plot Record, a Add tab will appear on the screen. Click on Add tab, another window will open, type the record name as **Carbon Data** as we did in case of Plot.

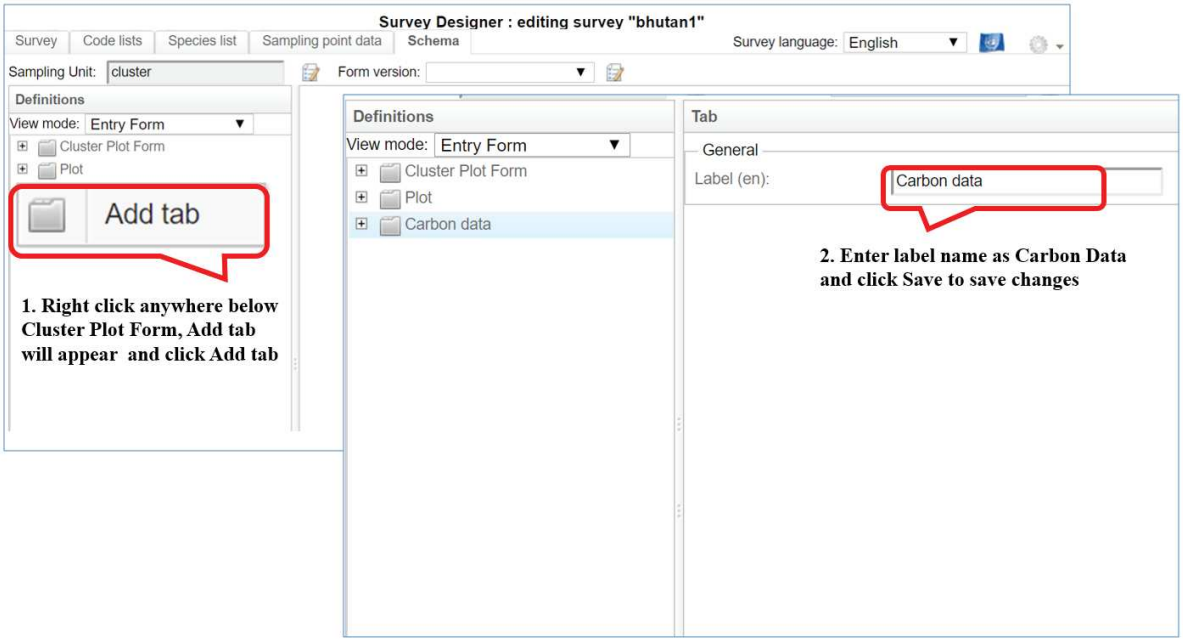


Figure 85: Adding carbon data as another record

7.2 Entities under carbon data

We have five entities for collection of carbon data

i. Shrub Sampling
ii. Herb Sampling
iii. Soil Sampling
iv. Litter Sampling
v. Fine Woody Debris

And these entities are added to Carbon data record following the same procedure described in previous Sections (e.g adding entity for reference point form).

7.2.1 Adding entity and attributes to shrub sampling

As described in the previous Sections, to add entity, **right click on the Carbon Data**, then click on **Add entity** (Add entity), then select **Multiple Table Layout** (Multiple (1:N) (Table layout)) and type the name of the entity as **shrub_sampling**, click **Save** to save entity. Repeat the procedure for herb sampling, soil sampling, litter sampling and fine woody debris sampling. The steps are demonstrated with shrub_sampling in Figure 86. Upon creating the entity, then add attribute to each entity following the steps described earlier for different attribute type.

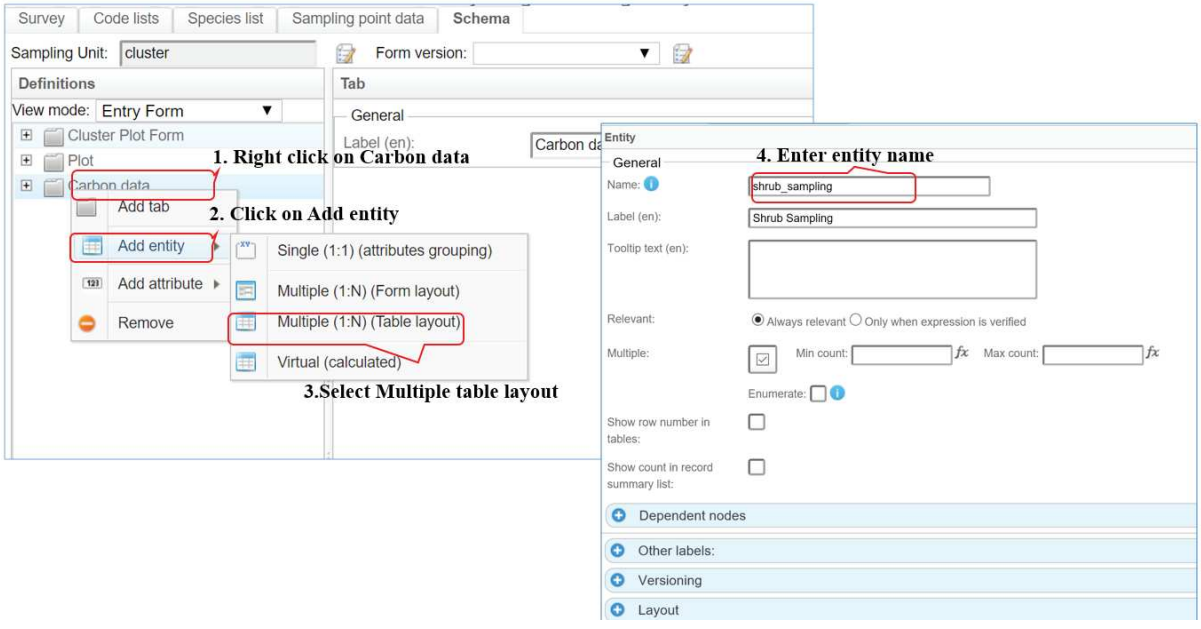
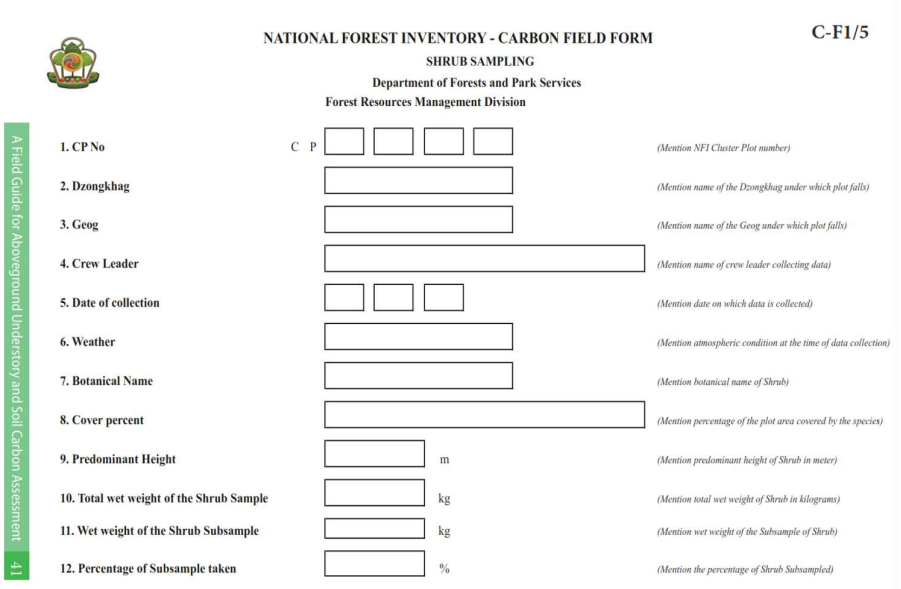


Figure 86: Adding shrub sampling as entity

7.2.1.1 Adding attribute to shrub sampling

Figure 87 shows paper form for shrub sampling and Table 17 shows the name and type of attributes to be added to entity shrub_sampling.



NATIONAL FOREST INVENTORY - CARBON FIELD FORM C-F1/5

SHRUB SAMPLING

Department of Forests and Park Services

Forest Resources Management Division

1. CP No	C P ☐☐☐☐	(Mention NFI Cluster Plot number)
2. Dzongkhag	☐	(Mention name of the Dzongkhag under which plot falls)
3. Geog	☐	(Mention name of the Geog under which plot falls)
4. Crew Leader	☐	(Mention name of crew leader collecting data)
5. Date of collection	☐☐☐	(Mention date on which data is collected)
6. Weather	☐	(Mention atmospheric condition at the time of data collection)
7. Botanical Name	☐	(Mention botanical name of Shrub)
8. Cover percent	☐	(Mention percentage of the plot area covered by the species)
9. Predominant Height	☐ m	(Mention predominant height of Shrub in meter)
10. Total wet weight of the Shrub Sample	☐ kg	(Mention total wet weight of Shrub in kilograms)
11. Wet weight of the Shrub Subsample	☐ kg	(Mention wet weight of the Subsample of Shrub)
12. Percentage of Subsample taken	☐ %	(Mention the percentage of Shrub Subsampled)

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Figure 87: Shrub sampling paper form

Table 17: Name and type of attribute for shrub carbon sampling

Sl. No.	Shrub Carbon Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	Shrub_carbon_sampling_date_year	Date
3	Shrub_total_wet_weight	Number
4	Shrub_subsample_wet_weight	Number
5	Shrub_subsample_percent	Number

7.2.1.2 Preview of the attributes and attribute fields of shrub carbon sampling

The attributes of shrub sampling (table 17) are added as Text, Date and Number following the procedures described earlier. Figure 88 shows the attributes added to shrub_sampling entity and illustration of preview attribute field of shrub sampling. To preview, follow the illustration in Section 5.2, 6.5.1.2.2 and 6.5.3.2. The procedure is also described here once again. To preview the form, click on Preview button on right bottom corner in the scheme window. Then select the relevant record, Carbon data in this case and click on plus button, table for data collection will be displayed (Figure 88).

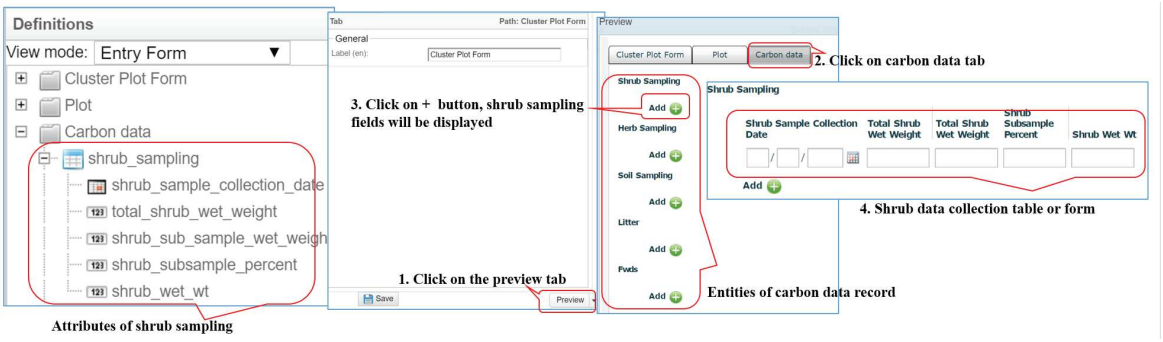
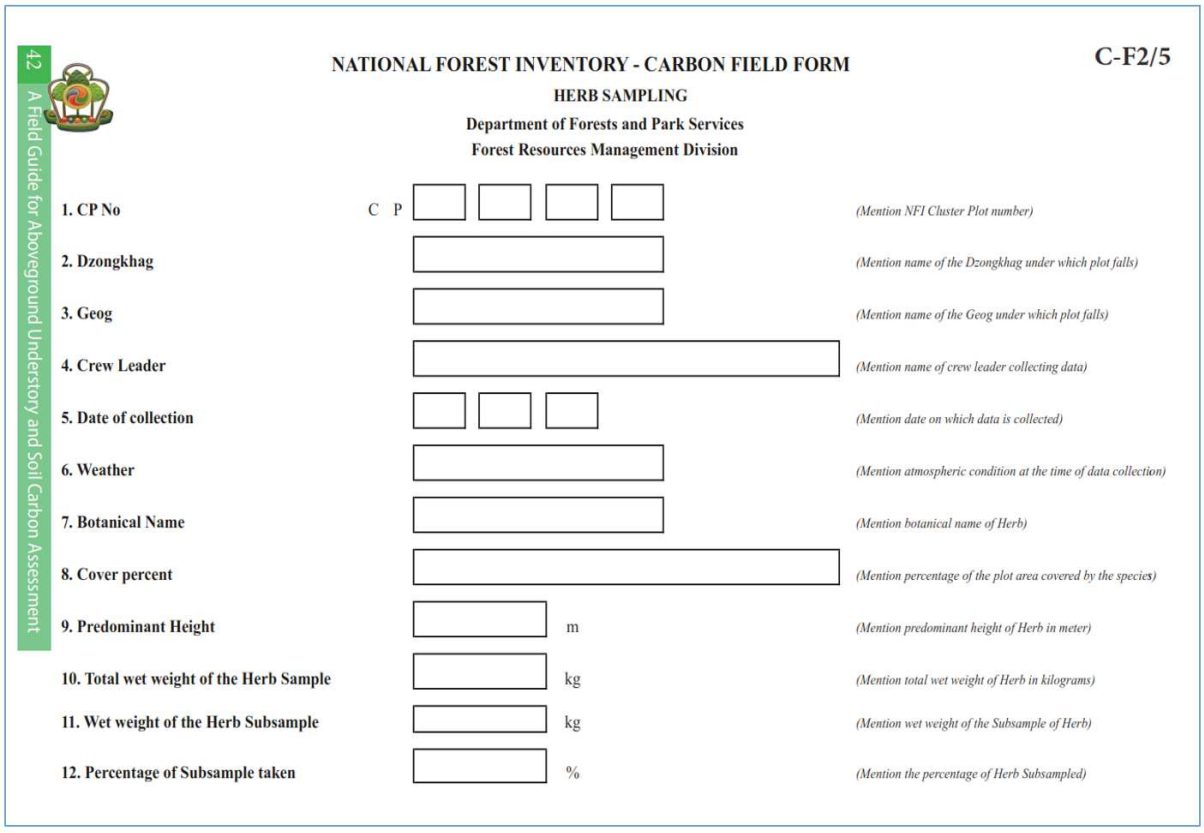


Figure 88: Preview of attributes and attribute field of shrub sampling

7.2.2 Adding attribute to herb sampling

Figure 89 shows the paper form for herb sampling and Table 18 shows the name and type of attributes to be added to herb_sampling entity, which can be created following the procedure and illustration in Section 7.2.1.



NATIONAL FOREST INVENTORY - CARBON FIELD FORM

C-F2/5

HERB SAMPLING

Department of Forests and Park Services

Forest Resources Management Division

1. CP No	C P	(Mention NFI Cluster Plot number)
2. Dzongkhag		(Mention name of the Dzongkhag under which plot falls)
3. Geog		(Mention name of the Geog under which plot falls)
4. Crew Leader		(Mention name of crew leader collecting data)
5. Date of collection		(Mention date on which data is collected)
6. Weather		(Mention atmospheric condition at the time of data collection)
7. Botanical Name		(Mention botanical name of Herb)
8. Cover percent		(Mention percentage of the plot area covered by the species)
9. Predominant Height	m	(Mention predominant height of Herb in meter)
10. Total wet weight of the Herb Sample	kg	(Mention total wet weight of Herb in kilograms)
11. Wet weight of the Herb Subsample	kg	(Mention wet weight of the Subsample of Herb)
12. Percentage of Subsample taken	%	(Mention the percentage of Herb Subsampled)

Figure 89: Herb sampling paper form

Table 18: Name and type of attributes for herb carbon sampling

Sl. No.	herb Carbon Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	herb_carbon_sampling_date_year	Date
3	herb_total_wet_weight	Number
4	herb_subsample_wet_weight	Number
5	herb_subsample_percent	Number

7.2.2.1 Preview of the attributes of herb carbon sampling

The attributes of herb sampling (Table 18) are added as Text, Date and Number following the procedures described earlier. Figure 90 shows the attributes added to herb sampling entity and illustration of preview of attribute fields of herb sampling. To preview, follow the illustration in any of the Sections 5.2, 6.5.1.2.2, 6.5.3.2 and 7.2.2.1.

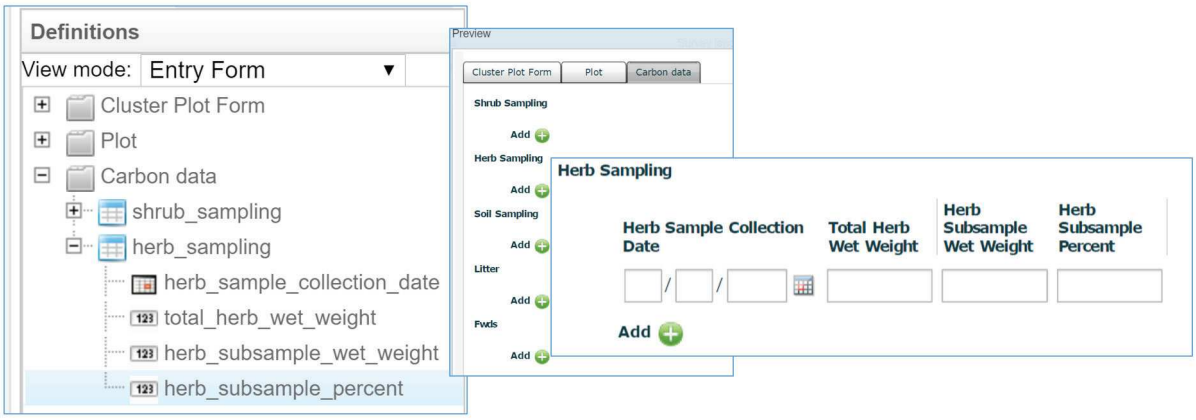
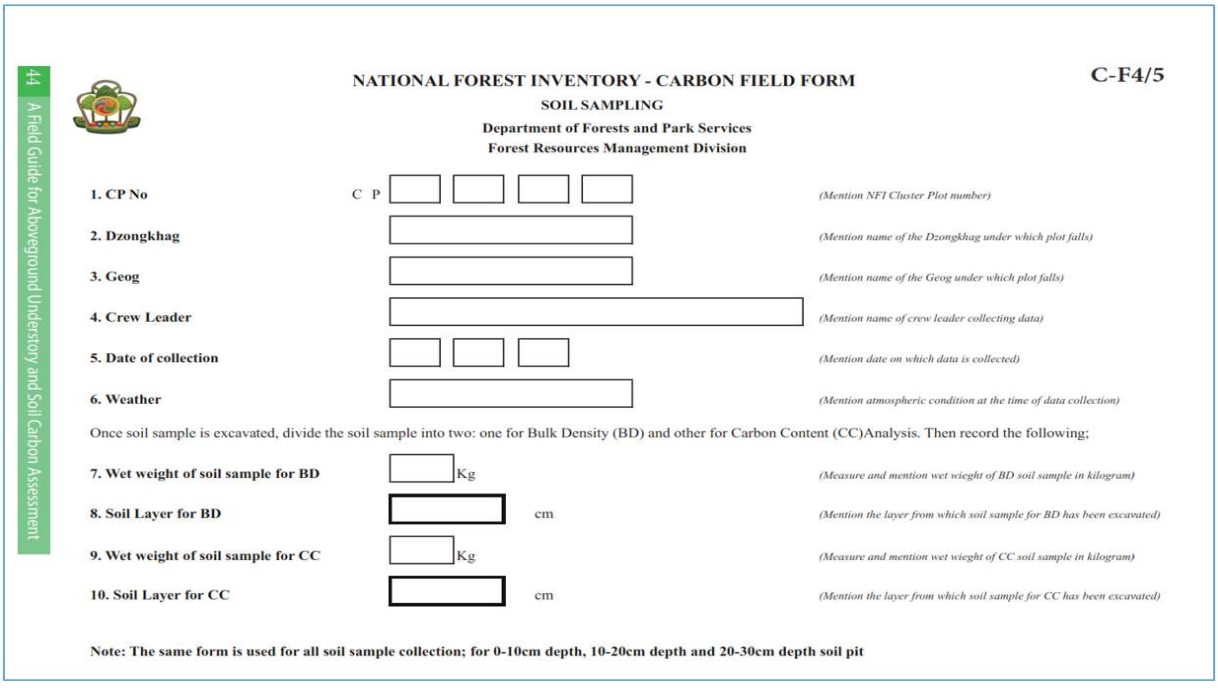


Figure 90: Preview of attributes and attribute fields of herb sampling

7.2.3 Adding attribute to soil sampling

The Figure 91 shows the paper form for soil sampling and Table 19 shows the name and type of attributes to be added to soil sampling entity, which can be created following the procedure and illustration in Section 7.2.1.



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NATIONAL FOREST INVENTORY - CARBON FIELD FORM C-F4/5

SOIL SAMPLING

Department of Forests and Park Services

Forest Resources Management Division

1. CP No	C P	*(Mention NFI Cluster Plot number)*
2. Dzongkhag		*(Mention name of the Dzongkhag under which plot falls)*
3. Geog		*(Mention name of the Geog under which plot falls)*
4. Crew Leader		*(Mention name of crew leader collecting data)*
5. Date of collection		*(Mention date on which data is collected)*
6. Weather		*(Mention atmospheric condition at the time of data collection)*

Once soil sample is excavated, divide the soil sample into two: one for Bulk Density (BD) and other for Carbon Content (CC)Analysis. Then record the following;

7. Wet weight of soil sample for BD	Kg	*(Measure and mention wet wieght of BD soil sample in kilogram)*
8. Soil Layer for BD	cm	*(Mention the layer from which soil sample for BD has been excavated)*
9. Wet weight of soil sample for CC	Kg	*(Measure and mention wet wieght of CC soil sample in kilogram)*
10. Soil Layer for CC	cm	*(Mention the layer from which soil sample for CC has been excavated)*

Note: The same form is used for all soil sample collection; for 0-10cm depth, 10-20cm depth and 20-30cm depth soil pit

Figure 91: Paper form for soil sampling

Table 19: Name and type of attribute for soil sampling

Sl. No.	Soil Carbon Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	soil_carbon_sampling_date_year	Date
3	soil_layer	Code
3	soil_total_wet_weight_bulk_density	Number
4	soil_total_wet_weight_soc	Number

7.2.3.1 Preview of attributes added to soil sampling entity and attribute fields

The attributes of soil sampling (Table 19) are added as Text, Code, Date and Number following the procedures described earlier. Please note that soil layer has three codes of 0-10 cm, 10-20cm and 20-30cm depth, which is referred as layer. Figure 92 shows the attributes added to soil sampling entity and attribute fields. To preview, follow the illustration in any of the Sections 5.2, 6.5.3.2 and 7.2.2.1. Note that clicking green + (Add) allows us to add data row or fields.

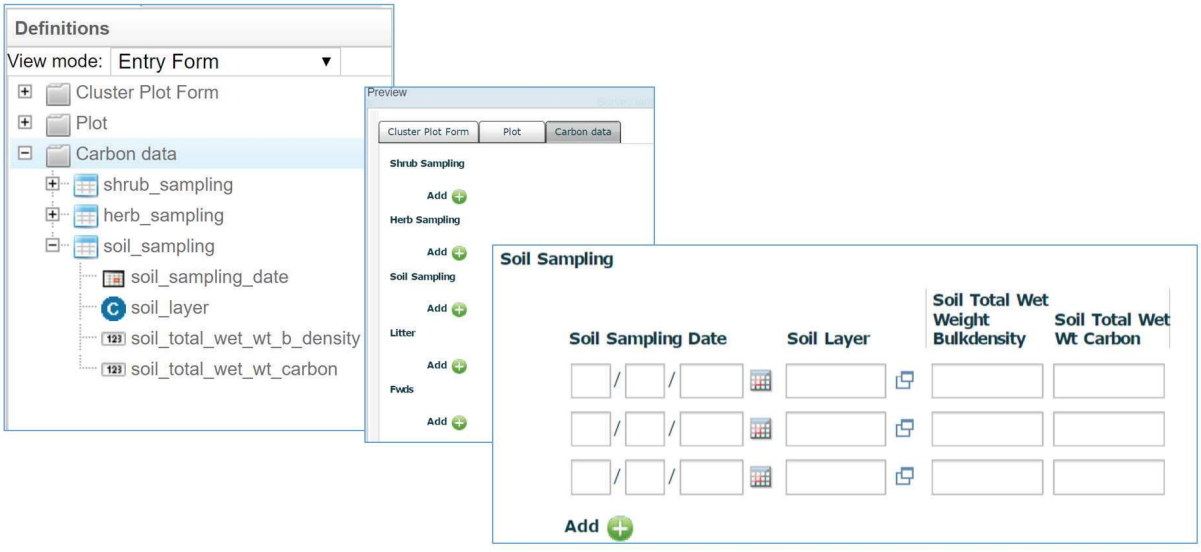
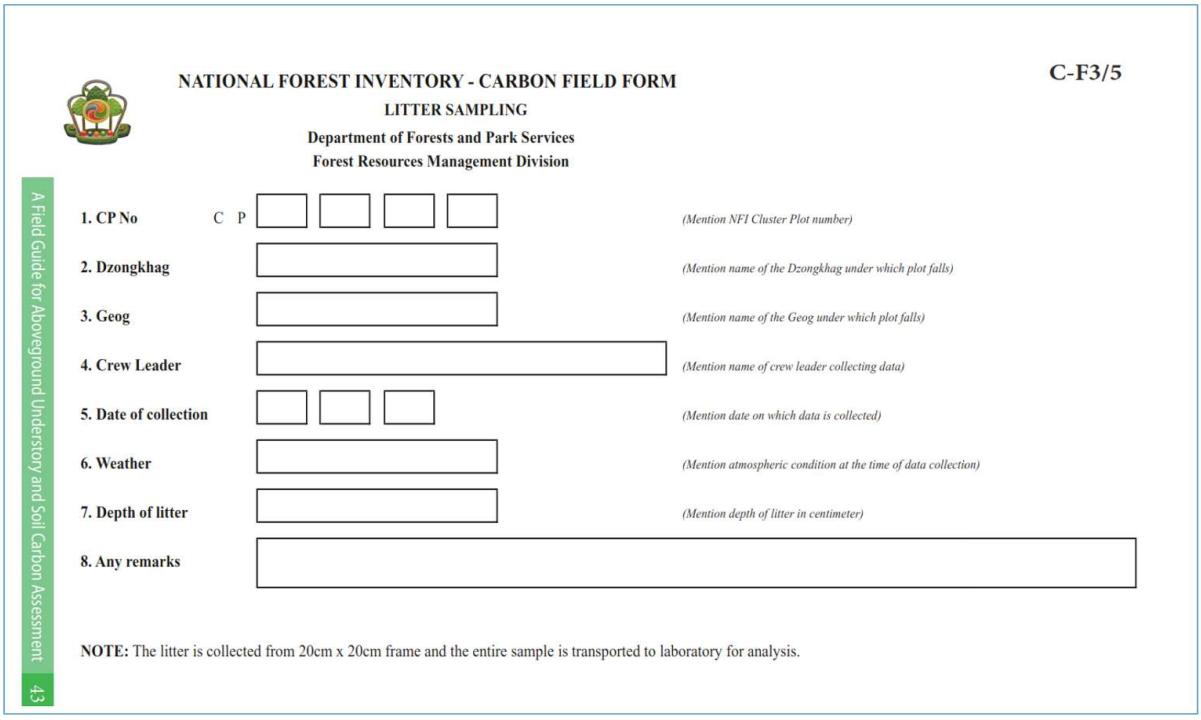


Figure 92: Attributes and attributes fields of soil sampling

7.2.4 Adding attribute to litter sampling

The Figure 93 shows the paper form for litter sampling and Table 20 shows the name and type of attributes created under litter entity, which can be created following the procedure and illustration in Section 7.2.1.



NATIONAL FOREST INVENTORY - CARBON FIELD FORM

C-F3/5

LITTER SAMPLING

Department of Forests and Park Services

Forest Resources Management Division

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1. CP No C P (Mention NFI Cluster Plot number)

2. Dzongkhag (Mention name of the Dzongkhag under which plot falls)

3. Geog (Mention name of the Geog under which plot falls)

4. Crew Leader (Mention name of crew leader collecting data)

5. Date of collection (Mention date on which data is collected)

6. Weather (Mention atmospheric condition at the time of data collection)

7. Depth of litter (Mention depth of litter in centimeter)

8. Any remarks

NOTE: The litter is collected from 20cm x 20cm frame and the entire sample is transported to laboratory for analysis.

Figure 93: Litter sampling paper form

From this form we do not need to collect information on weather, so we don't have to added attribute for them. However, we have created additional attributes as mentioned in Table 20 for litter sampling

Table 20: Name and type of attributes for litter sampling

Sl. No.	litter Carbon Attribute Name	Attribute type
1	cluster_cluster_plot_no	Text
2	litter_carbon_sampling_date_year	Date
3	litter_total_wet_weight	Number
4	litter_depth	Number

7.2.4.1 Preview of attributes and attribute fields of litter entity

The attributes of litter sampling (Table 20) are added as Text, Date and Number attribute following the procedures described earlier. Figure 94 shows the attributes added to litter entity and attribute fields. To preview, follow the illustration in any of the Sections 5.2, 6.5.3.2 and 7.2.2.1.

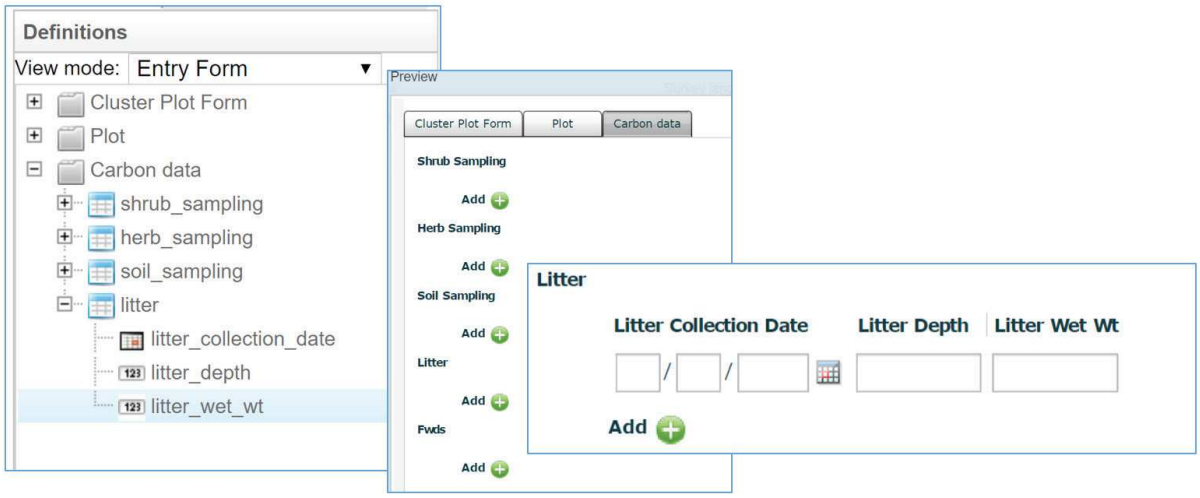
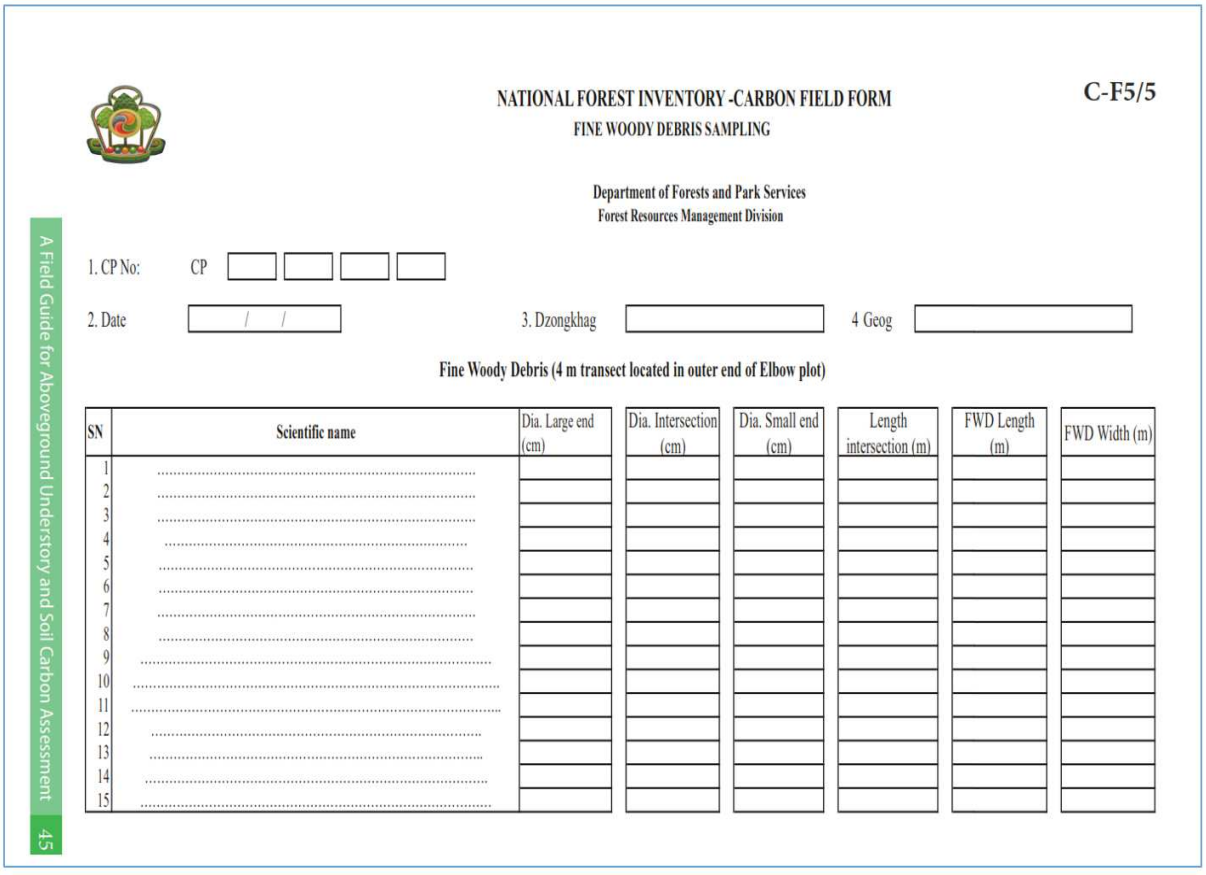


Figure 94: Attribtes and attribute fields of litter sampling

7.2.5 Adding attribute to fine woody debris (FWD)

The Figure 95 shows the paper form for fine woody debris sampling and Table 21 shows the name and type of attributes created under fwd entity, which can be created following the procedure and illustration in Section 7.2.1.



NATIONAL FOREST INVENTORY -CARBON FIELD FORM

C-F5/5

FINE WOODY DEBRIS SAMPLING

Department of Forests and Park Services
Forest Resources Management Division

1. CP No: CP

2. Date / /

3. Dzongkhag

4 Geog

Fine Woody Debris (4 m transect located in outer end of Elbow plot)

SN	Scientific name	Dia. Large end (cm)	Dia. Intersection (cm)	Dia. Small end (cm)	Length intersection (m)	FWD Length (m)	FWD Width (m)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Figure 95: Paper form for fine woody debris (FWD) sampling

Table 21: Name and type of attribute for fine woody debris sampling

Sl. No.	FWD Attribute Name	Attribute type
1	cluster_cluster_plot_no	Code/Text
2	fwds_species	Taxon
3	fwds_diameter_large_end	Number
4	fwds_diameter_intersection	Number
5	fwds_diameter_small_end	Number
6	fwds_intersection_length	Number
7	fwds_length	Number
8	fwds_width	Number

7.2.5.1 Preview of attributes and attribute fields of fine woody debris

The attributes of fine woody debris (fwd) (Table 21) are added as Text, Code, Taxon and Number following the procedures described earlier. Figure 96 shows the attributes added to fwds entity and attribute fields. To preview, follow the illustration in any of the Sections 5.2, 6.5.3.2 and 7.2.2.1.

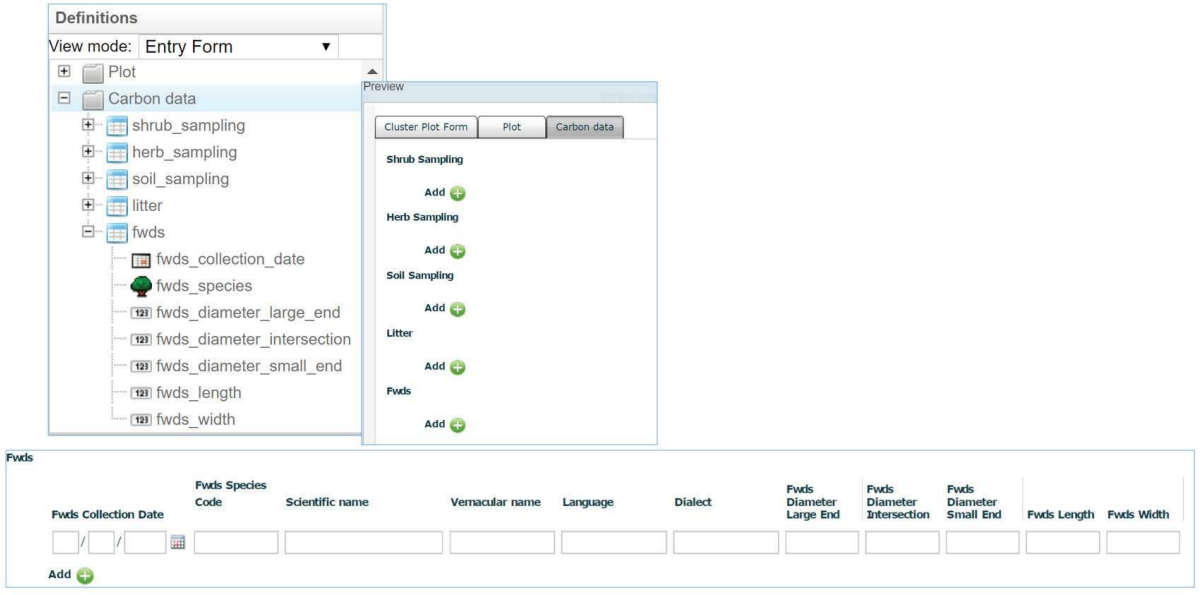


Figure 96: Attribute and attribute fields of fwds

08 Editing, publishing, cloning and deleting the survey

8.1 Editing of survey

At any point in time you can edit your survey and publish. This provides freedom to survey designer to continue from the Section last completed. To edit survey, click on **survey designer,** click on **list of surveys.** Existing surveys will open and select your survey to be edited. As soon as the survey is highlighted, **Edit, Export and Advanced functions** will appear above your list of survey, then click on edit button (this option visible only when a survey is highlighted). Then you can start editing your survey (Figure 97). If you are editing a published survey, republished the survey.

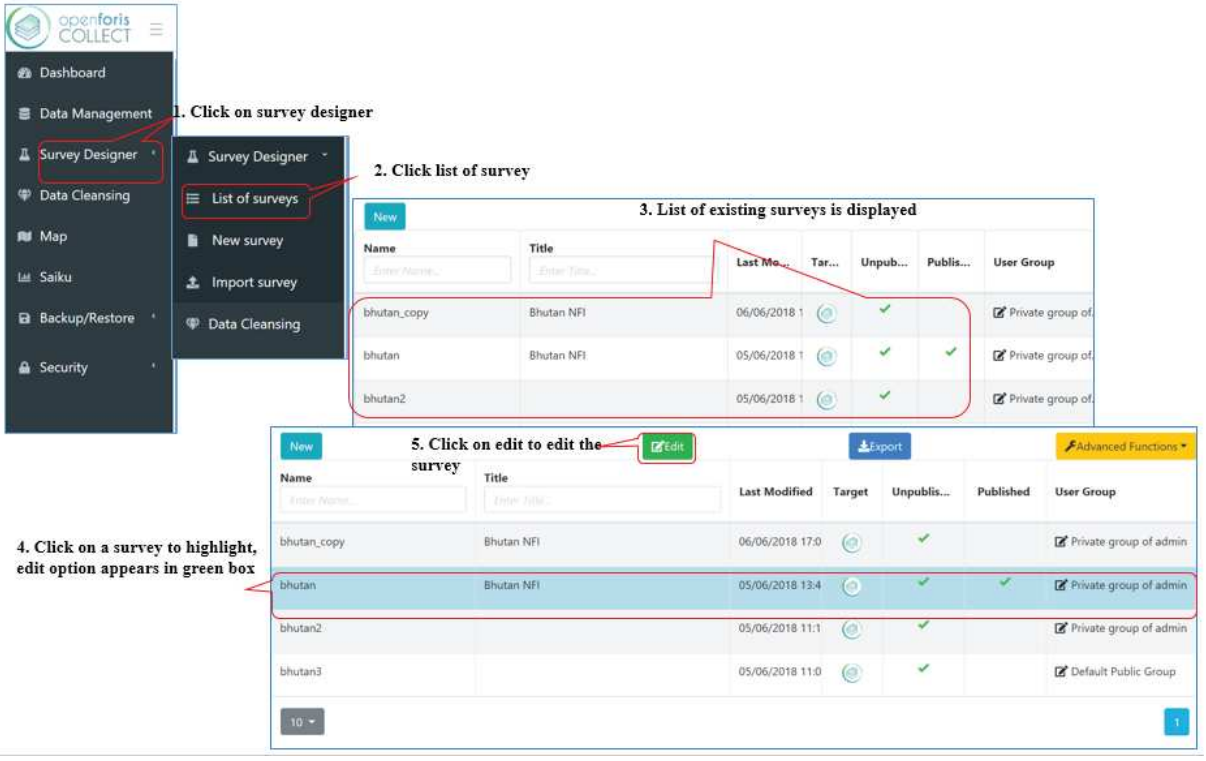


Figure 97: Editing an existing survey

8.2 Publishing a survey

Once the survey designing process is complete, you can publish the survey to enable to user use the survey for data entry, cleansing and analysis. To publish or edit the survey, click on **survey designer** on collect home page and click on **list of surveys**. Existing surveys will open and select your survey to be published. As soon as the survey is highlighted, **Edit, Export and Advanced functions** will appear above your list of survey. Go to the advanced functions and click on drop-down button, you will see four options of ***Publish, Unpublish, Clone and Delete***, click on publish to publish your survey (Figure 98).

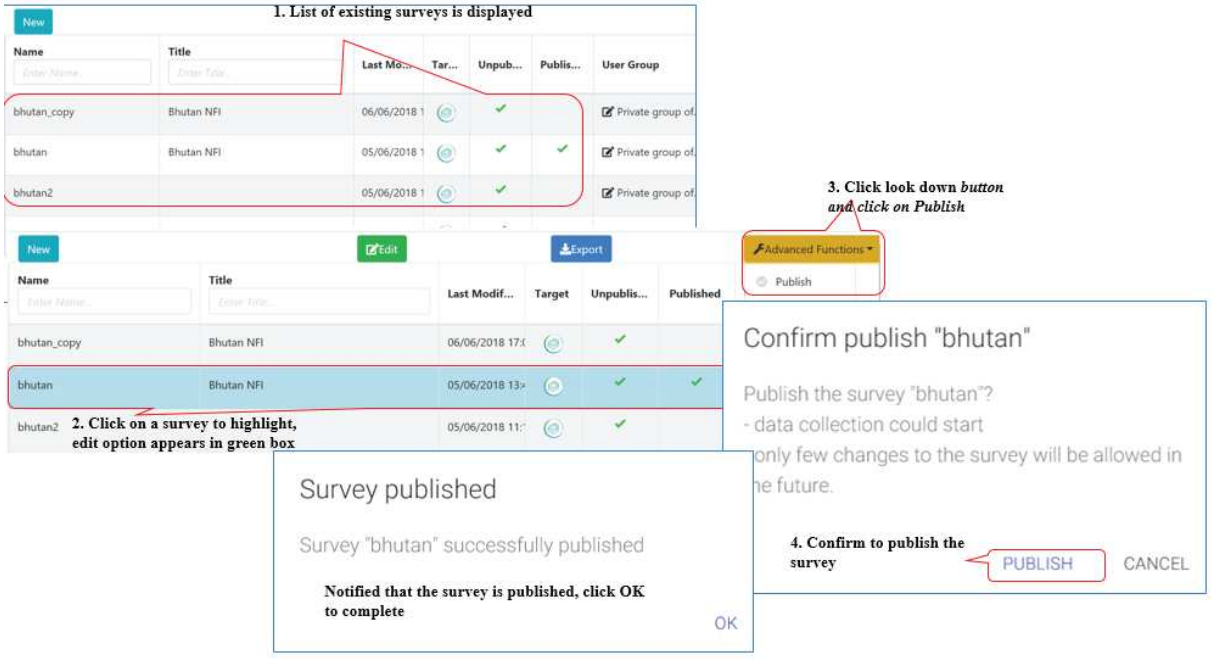


Figure 98: Publishing NFI survey name 'bhutan'

8.3 Cloning the survey

If you wish to create a copy of existing survey, it can be done by cloning the survey, click on **Survey designer** on Collect home page and click on **list of surveys**. Existing surveys will open and select your survey to be cloned. As soon as the survey is highlighted, **Edit, Export and Advanced functions** will appear above your list of survey. Go to the advanced functions and click on drop-down button, you will see four options of ***Publish, Unpublish, Clone and Delete***, click on clone to create copy of survey and rename it as '***bhutan__copy_1'*** as illustrated in Figure 99.

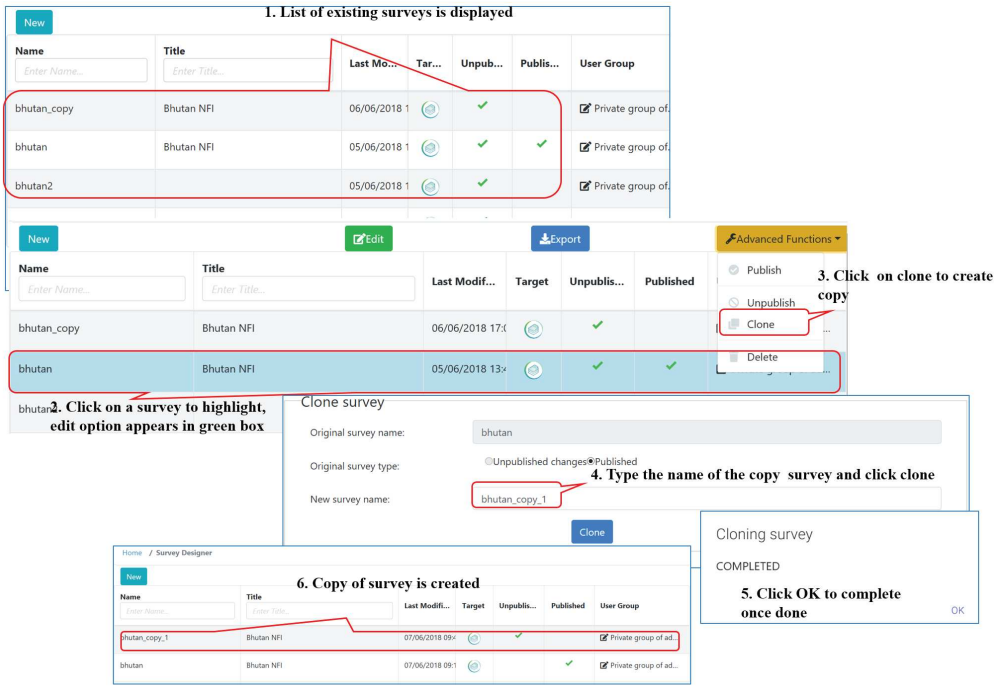


Figure 99: Cloning an existing survey

8.4 Deleting a survey

If you wish to delete an existing survey, click on **survey designer** on Collect home page and click on **list of surveys**. Existing surveys will open and select your survey to be deleted. As soon as the survey is highlighted, **Edit, Export and Advanced functions** will appear above your list of survey. Go to the advanced functions and click on drop-down button, you will see four options of ***Publish, Unpublish, Clone and Delete***, click on **Delete** to delete the existing survey as illustrated in Figure 100.

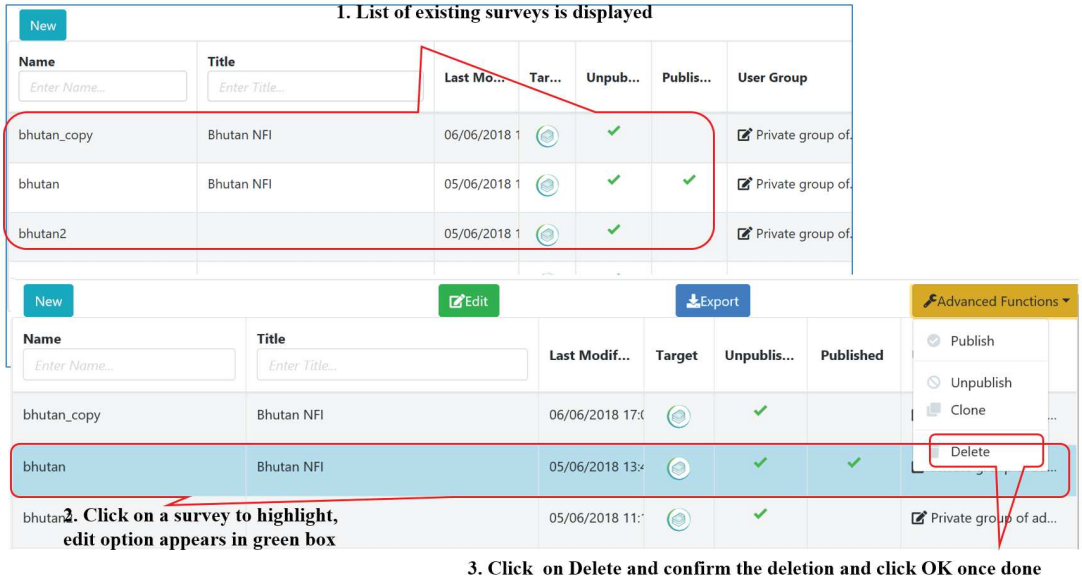


Figure 100: Deleting an existing survey

09 Adding validation rules

For all the attributes added to records or entities in the survey, we can insert or add validations rules to notify person collecting the data or entering the data that the information collected or entered is an error. This can be done either at the time of adding the attributes (as we did in case of region) or after completing the survey designing process (should be editing mode). For the purpose of demonstration, we have used completed survey to add validations rules. Three examples are described using attributes added to tree entity.

i. tree bole height is always less than tree total height
ii. The maximum distance between a tree and plot center is 12.62 m.
iii. Tree should have minimum dbh of 10 cm and maximum of 250 cm

To add the validation rules, select the survey from survey designer, select the survey and click on edit. In the schema Section we can view records, entities and attribute. Select an attribute to which we wanted to add validation rules. In this example, we select tree bole height, tree distance and tree dbh for adding validation rules.

9.1 Adding validation rule for tree bole height

We know that the tree bole height is always less than tree total height. Therefore, we need to insert a condition to notify the person who is collecting data or entering the data into collect that the information s/he entered is wrong or it is an error. To do that click on **bole height** attribute in the tree entity, click on **blue (+)** in front **check validation rules**, a table to insert validation rule will pop up. In this table, click on **green (+)** button, a new pop-up window will open. In this pop-up window, in **severity** option select **error,** type the **error message** viz. ***tree bole height larger than total tree height*** (this message will appear as notification to person who is entering data or who is collecting the data using Collect mobile). Finally click **Apply** to save validation rule and **Save** to save all changes that we made (Figure 101).

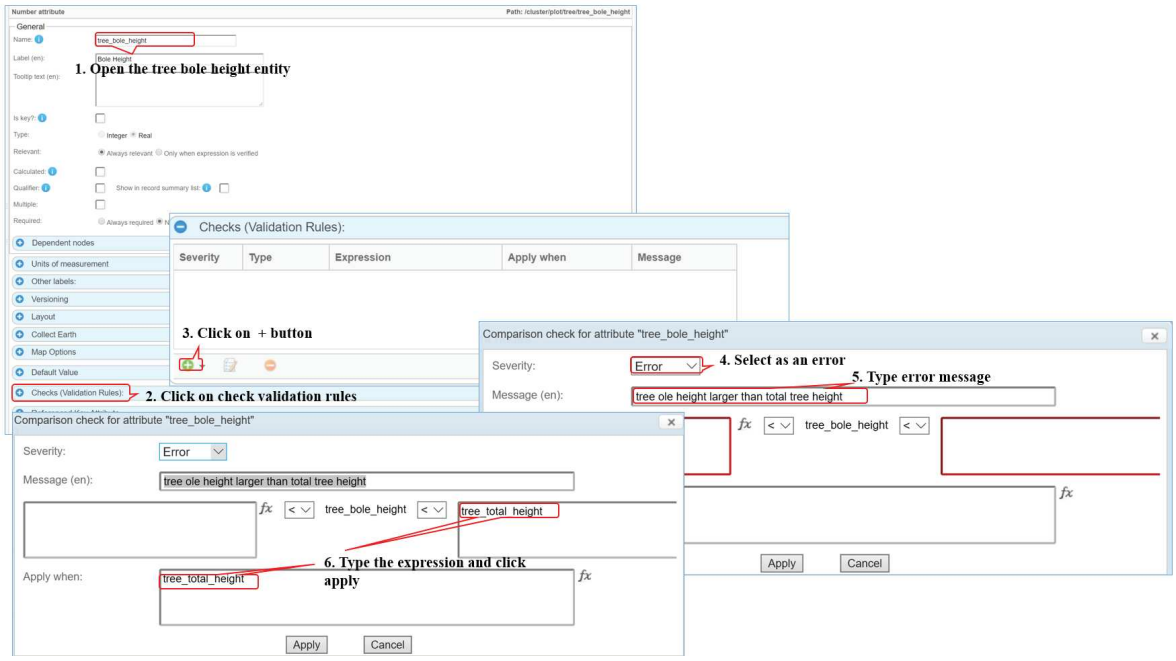


Figure 101: Adding validation rule for tree bole height

9.2 Adding validation rule for tree distance

The distance between plot center and tree location is 12.62 m in NFI. Therefore, trees outside 12.62 m distance are not enumerated as maximum distance between plot center and tree location should be 12.62 m. So, add a validation rule to exclude trees to notify the data collector or person entering data that trees outside 12.62 m distance from plot center should not be enumerated. To perform this task, select **tree distance** from **tree entity**, click on **blue (+)** in front of **check validation rules**, a table to insert validation rule will pop up. In this table, click on **green (+)** button, a new pop-up window will open. In this pop-up window, in severity option select **error,** type the **error message** viz. ***tree distance should be <= 12.62 m*** (this message will appear as notification to person who is entering data or collecting the data using collect mobile). Finally click **Apply** to save validation rule and **Save** to save all changes that we made (Figure 102).

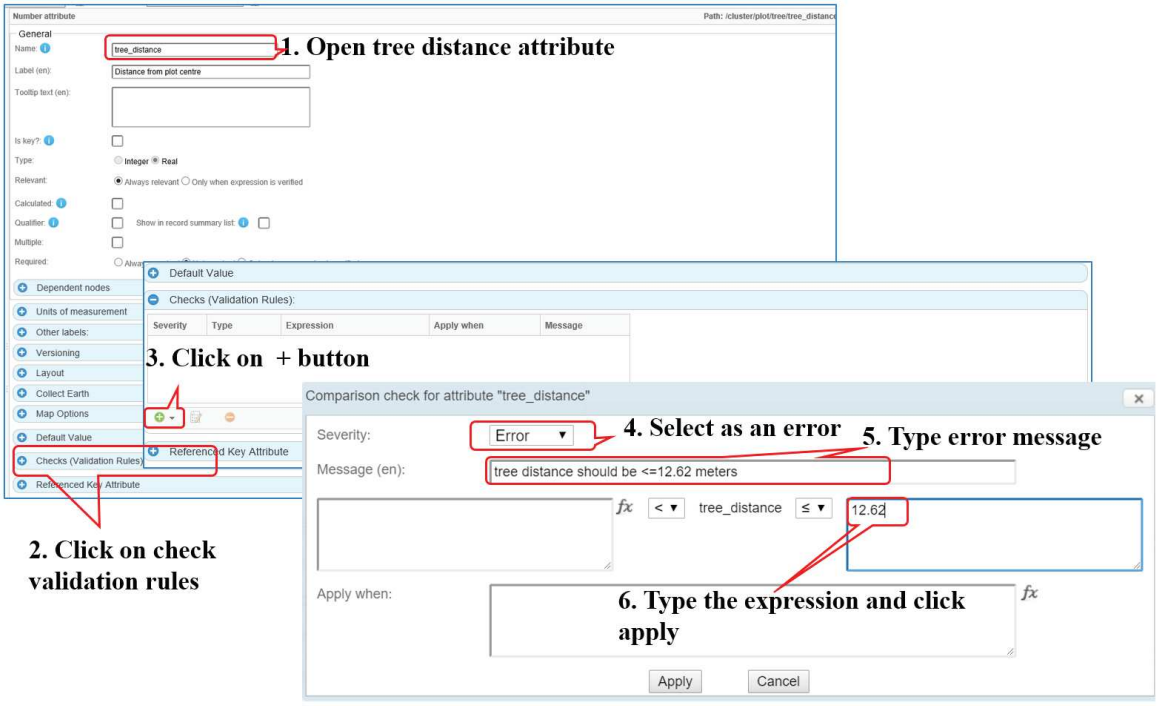


Figure 102: Adding validation rule to tree distance

9.3 Adding validation rules for diameter

The minimum diameter of a tree to be enumerated is 10 cm and we should not be enumerating trees less than 10 cm diameter. Accordingly, we add a validation rule to notify the person collecting or entering data that the information s/he entered is valid or an error. To perform this task, select **tree dbh** from **tree entity**, click on **blue (+)** in front of **check validation rules**, a table to insert validation rule will pop up. In this table, click on **green (+)** button, a new pop-up window will open. In this pop-up window, in severity option select **error,** type the **error message** viz. ***tree dbh should be >= 10 cm*** (this message will appear if the tree dbh entered by the person that is less than 10 cm). Finally click **Apply** to save validation rule.

Similarly, sometimes we commit a mistake by typing very large figure in tree diameter which is very rare in natural conditions (say 250 cm dbh). So, we insert a warning message to data collector or person entering data to re-check what s/he entered is valid. To perform this task, click on **green (+)** button in the table for adding validation rule and in severity option in pop-up window, select **warning,** type the **warning message** viz. ***diameter very* large** (this message will appear as notification to person who is entering or collecting data to verify. Finally click **Apply** to save validation rule and **Save** to save all changes that we made (Figure 103).

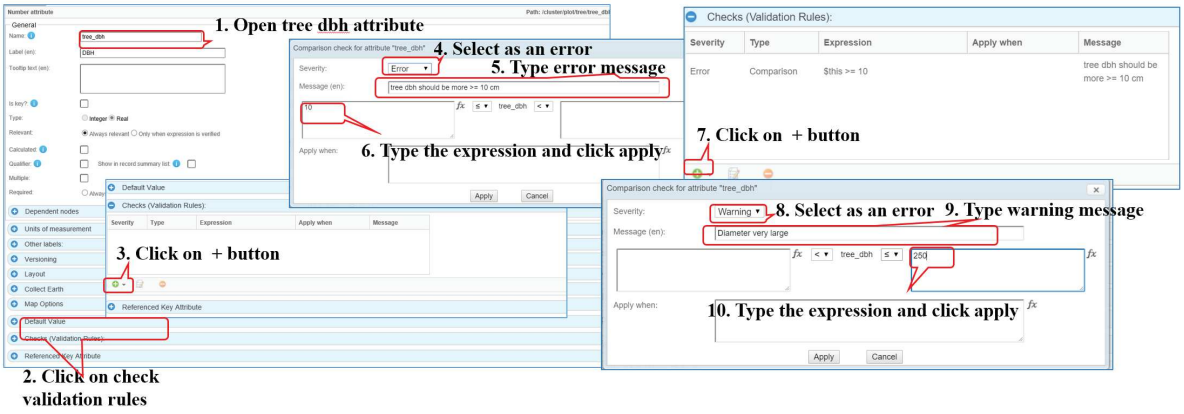


Figure 103: Adding validation rules for tree dbh

Similar validation rules may be added to other attributes. We can export the validation report and verify while data cleansing.

10 Exporting the survey

If you wish to export an existing survey, click on **survey designer** on Collect home page and click on **list of surveys**. Existing surveys will open and select your survey to be exported. As soon as the survey is highlighted, **Edit, Export and Advanced functions** will appear above your list of survey. Click on **Export**, a new window will pop-up with export type and export mode parameters. In the export type, select either publish or unpublish survey, (published survey in this case) and in the export mode do as necessary

i. select Collect Desktop (backup) to preserve a copy of survey or if you wish import into another PC.
ii. Select Collect Earth if you want to use the survey with collect earth software
iii. Select Collect Mobile for uploading in tablet for data collection

In this case, we have selected Collect Desktop and then click Export button and download the collect survey (Figure 104).

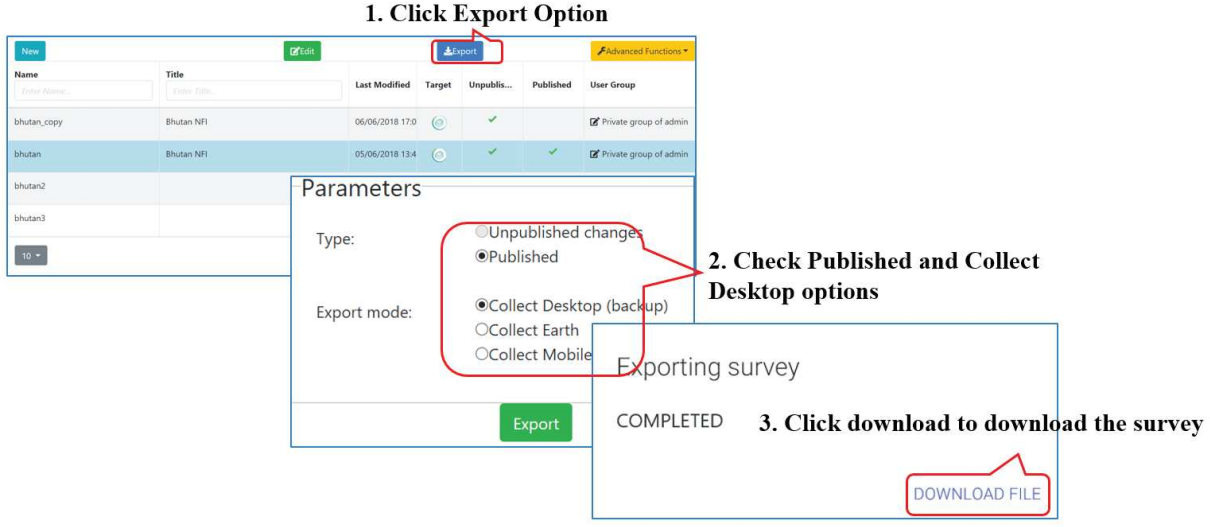


Figure 104: Exporting a survey

11 Importing the survey

If we have a Collect survey, such as exported and downloaded in Section 10, you can import into the Collect platform. To import the survey, click on **Survey designer** on Collect home page and click on **Import of surveys**. A blank window will open on the side. Click on the blank area and it will prompt you to select a survey to be imported. Choose the survey form your directory containing survey to be imported and click open. Survey name will be displayed on screen, which is Bhutan_copy_1 in our case, then click import and survey gets imported into your collect system as illustrated in Figure 105.

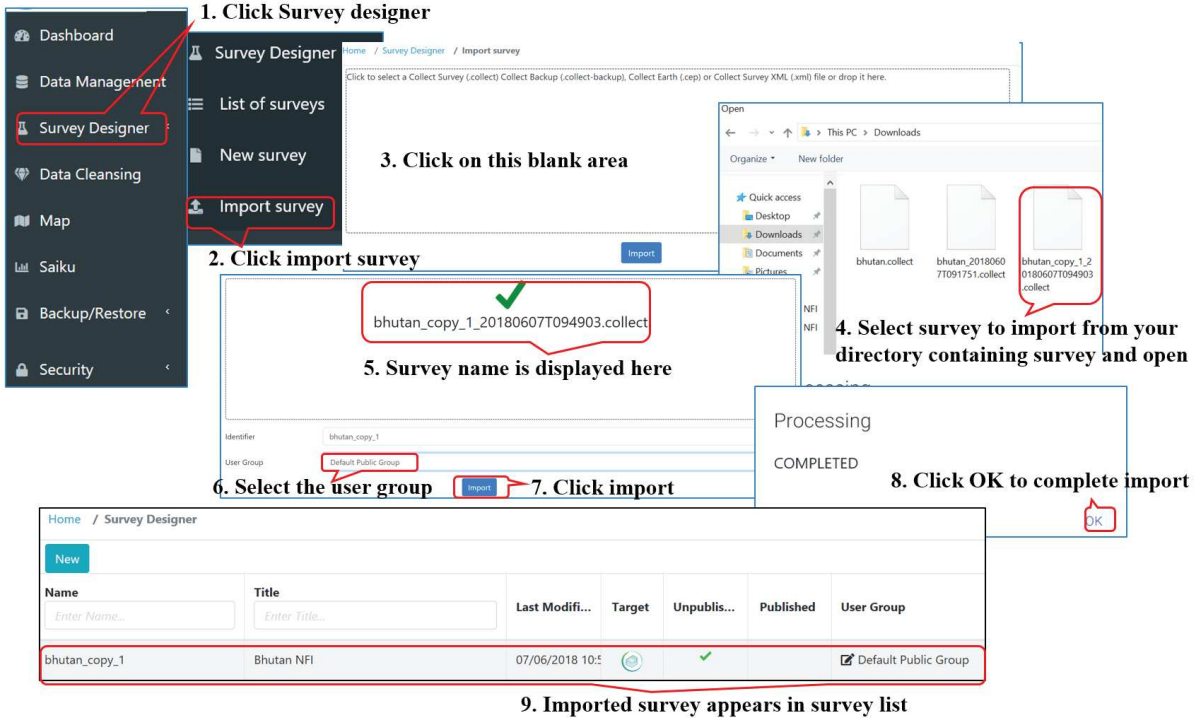


Figure 105: Importing the survey into Collect

12 Collect dashboard

Collect dashboard provides and simple information on the data collection and workflow related to the survey of our interest. To view the information on particular survey, click on dashboard and select the published survey. The dashboard will display activities carried in the survey by day, month and year (Figure 106).

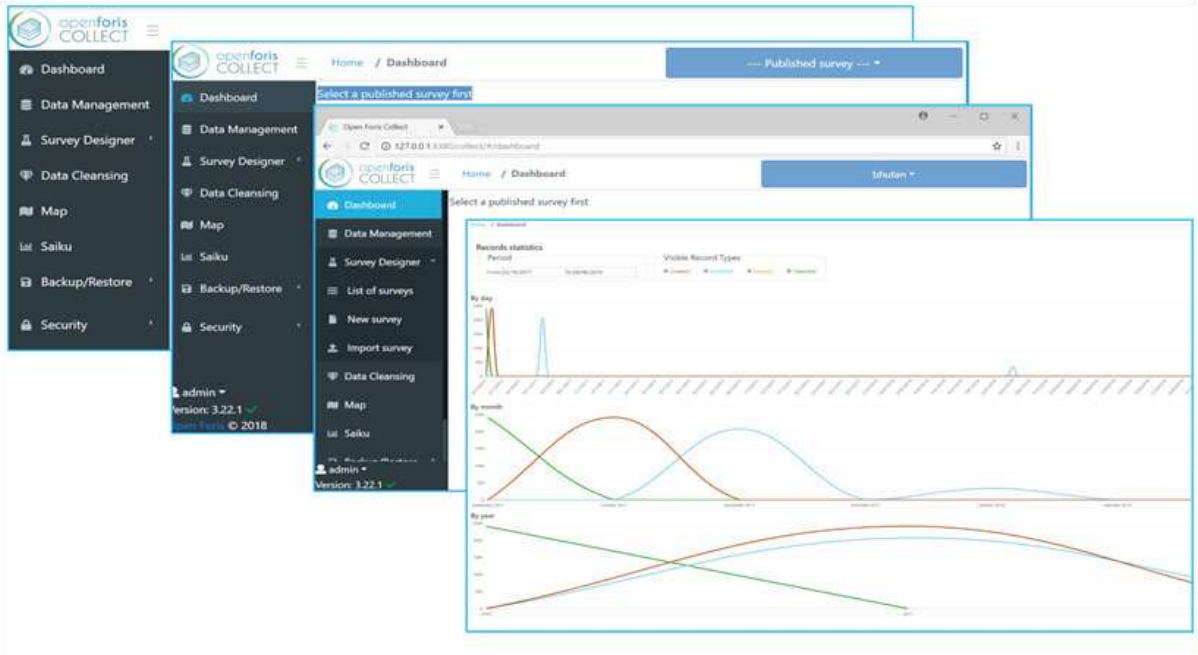


Figure 106: Collect Dashboard Preview

13 Data Management

Data management is the integral part of the Collect. It is the starting point for data entry and data management. In this Section, data can be entered, edited and managed. The overall work-flow of the data management is illustrated in Figure 107.

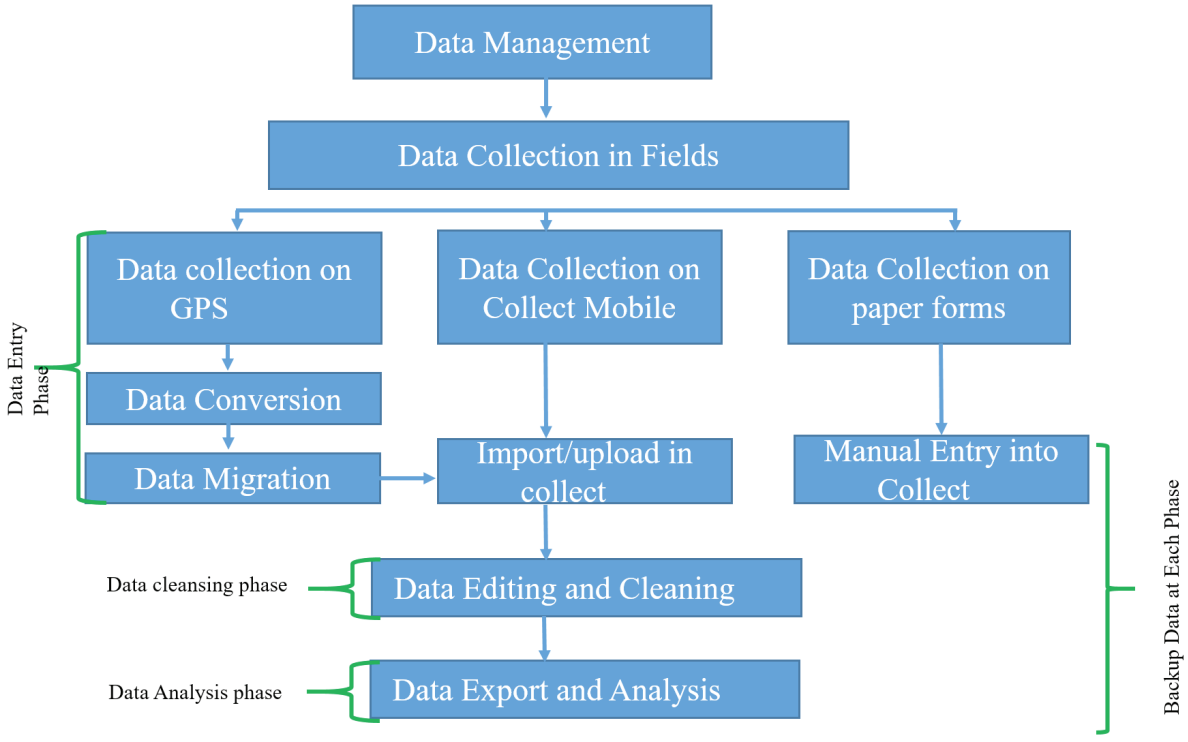


Figure 107: Data Management Work Flow

13.1 NFI Conversion and Data Migration into Collect

The National Forest Inventory data was collected using Trimble Juno Handheld GPS and very little amount of data was collected in paper forms where use of Juno GPS was not possible for technical and management issues. The data collected with Juno GPS is not compatible with Collect and cannot be transferred to the Collect directly. Therefore, some form of data conversion was required to enable us to transfer data downloaded from GPS to collect platform. The data conversion methods are described below.

13.1.1 Data Conversion

Data collected using Trimble GPS comes in Trimble Standard Storage format (.ssf) and it is not readable in Collect or any other software while collect accepts only .csv file or Collect back up file generated from Collect Mobile. Therefore, entire data collected in Juno GPS is converted individually into database file (.dbf) which can be opened in MS Office Excel, Access or other software using Pathfinder Office. Each individual .ssf file under each cluster plot are opened in Pathfinder Office and exported as sample database files and stored in a separate folder called .dbf created for each cluster plot under each dzongkhag.

13.1.1.1 Create a output director and folder

Firstly, create an empty folder to store .dbf file and name as nfi_dbf_file, then create a subfolder in nfi_dbf_file folder and name Dzongkhag name e.g. Gasa_nfi_dbf_file. Then create another subfolder in each Dzongkhag and name by cluster plot number (e.g CP0001, CP0002,). This is demonstrated in Figure 108.

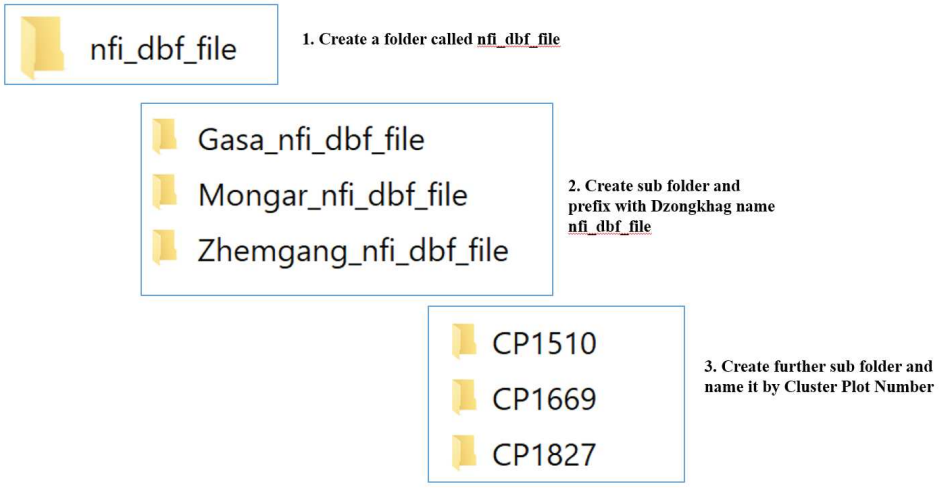


Figure 108: Creating folders and subfolders to store .dbf file

13.1.1.2 Open GPS pathfinder Office and .ssf file

Open your pathfinder office (Figure 109), go to file on the tool bar and click on open, locate your data directory and open folder containing data from Juno GPS (cluster plot in this case, viz. CP1510), which contains several .ssf file, select one of the file and click open as illustrated in Figure 110.

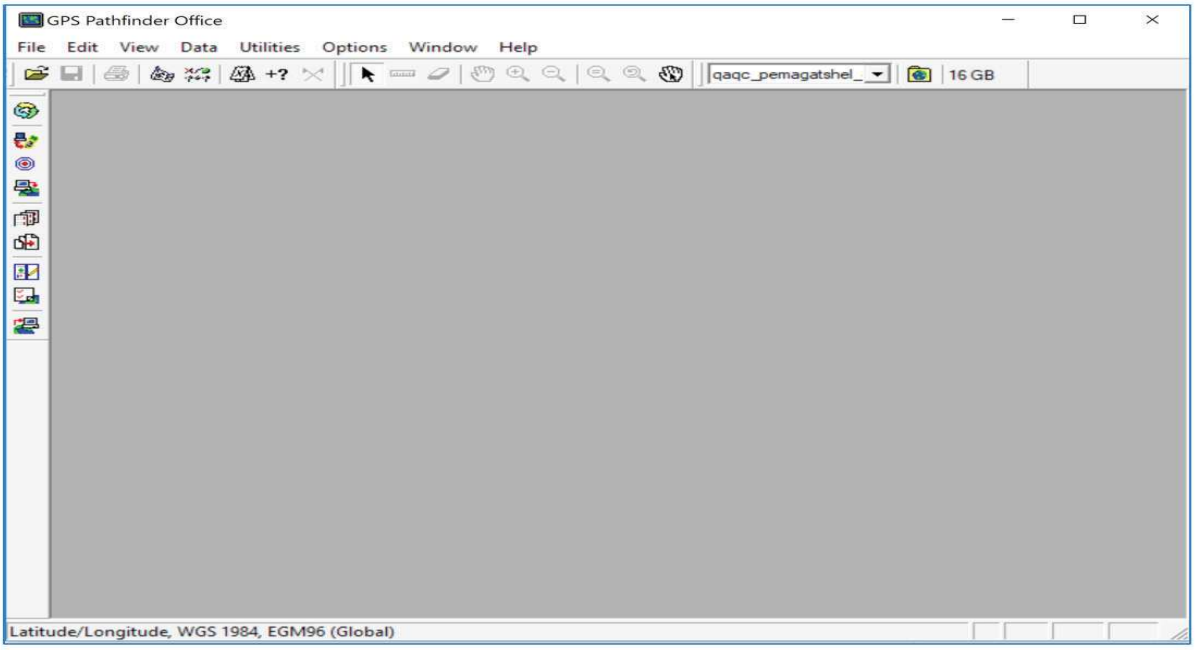


Figure 109: GPS Pathfinder office

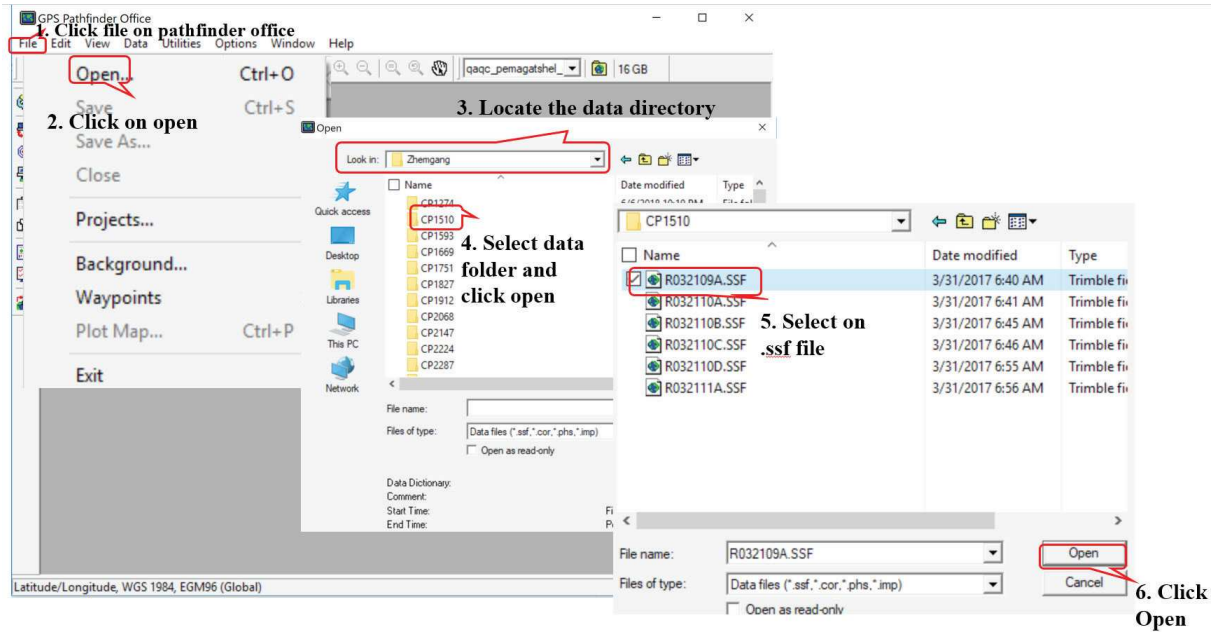


Figure 110: Opening a .ssf file data in GPS Pathfinder Office

13.1.1.3 Data viewing and visualization

To visualize the data, go to view option in pathfinder office tool bar and click on view on the tool bar and click map as illustrated in Figure 111. This is very important as some of the file can be empty.

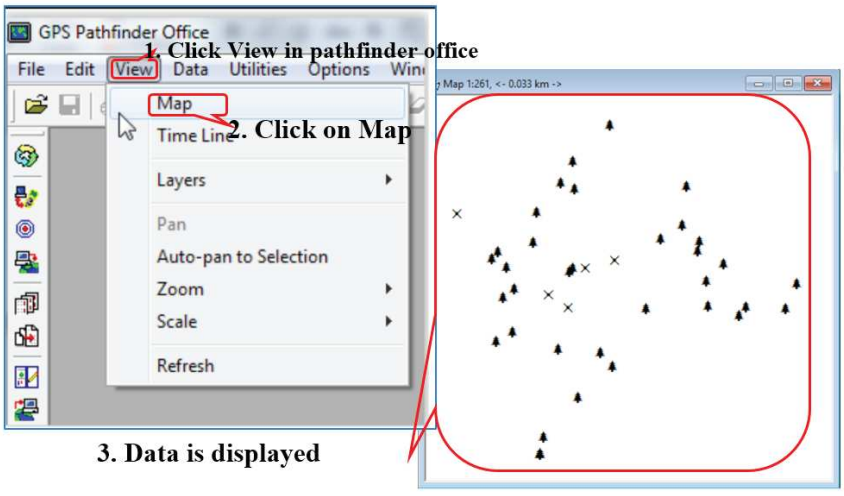


Figure 111: Data visualization in GPS Pathfinder Office

13.1.1.4 Data export as dbase file

To export the data as dbase file, go to utilities option in pathfinder office tool bar and click on export. Browse the output directory, select output file type and click OK to export as illustrated in Figure 112.

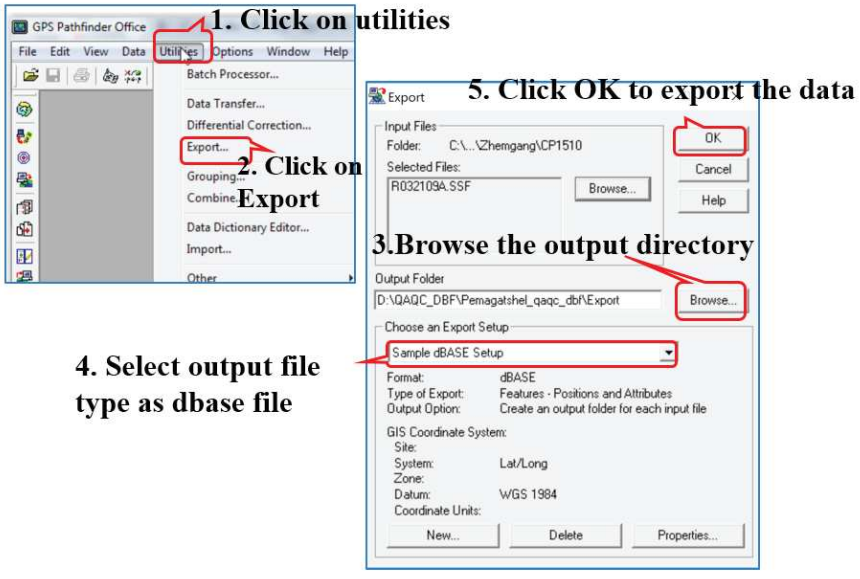


Figure 112: Export .sff file as .dbf file

NOTE: Repeat this procedures for all data dzongkhag wise and CP wise as per the folders created in Section. Ensure that the .ssf file exported from particular CP is stored as dbase file in folder named with same CP number in output directory.

13.1.2 Data Migration

The Collect Developer of the FAO has developed a java based data migration tool for Bhutan NFI (suitable only for current NFI survey design). Verify whether your PC has preinstalled java application (If not download and install java and install Collect (if not installed previously).

13.1.2.1 Migration tool configuration

Open C drive from my computer, then open opt folder, followed by *openforis* folder, then copy migration tool kit folder and paste in *openforis* folder with collect. Copy a folder containing .dbf file and paste here along with migration tool kit. However, you can also keep in other location as desired (Figure 113).

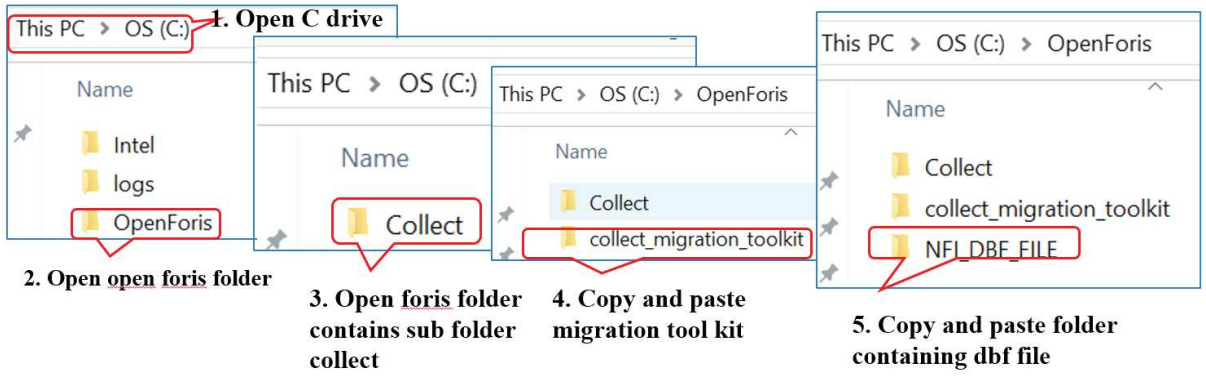


Figure 113: Configuration of migration tool and data

13.1.2.2 Define data paths

Open the migration tool kit and open params.properties file in notepad. In this file, you have to define input data path and output data path. Input data path location of folder containing your .dbf file and output data path is folder where you want to store the data migrated. In our case, input data path is *C:/OpenForis/NFI_DBF_FILE* while output data path is predefined in migration tool kit, which is ***C:/OpenForis/collect_migration_toolkitoutput***. In the params.properties, change the data path accordingly for input and output data path. In the same file, change collect.db.url=jdbc:sqlite***:PATH_TO_OUTPUT_COLLECT_SQLITE_DB_FILE*** to collect.db.url=jdbc:sqlite:*C:/OpenForis/collect_migration_toolkit/output/collect.db.* Save the changes and close the notepad (params.properties file) (Figure 114).

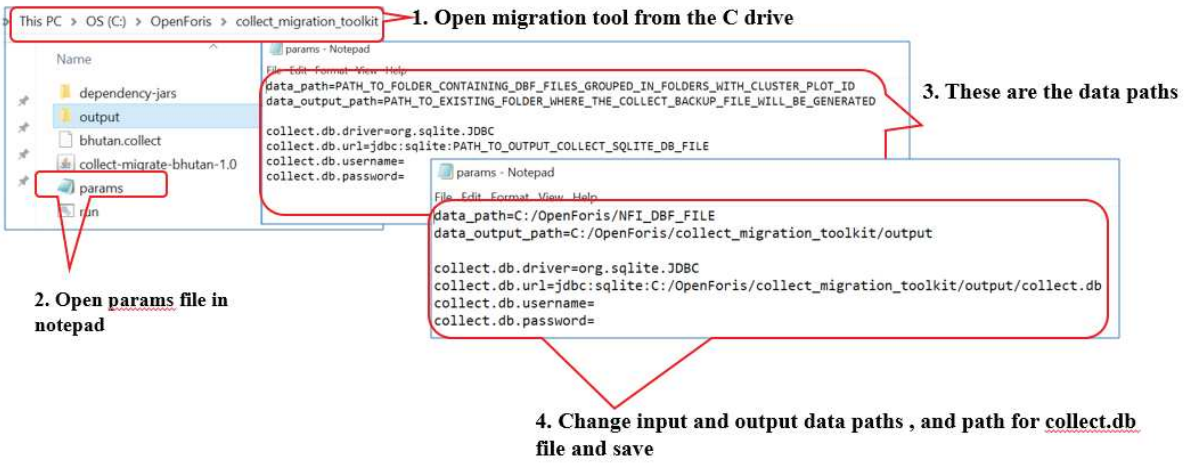


Figure 114: Defining data paths

13.1.2.3 Migrating the data

In the migration tool kit, run the run.bat file by doubling clicking on command line language. The data will be migrated successfully into your output folder as illustrated in Figure 115.

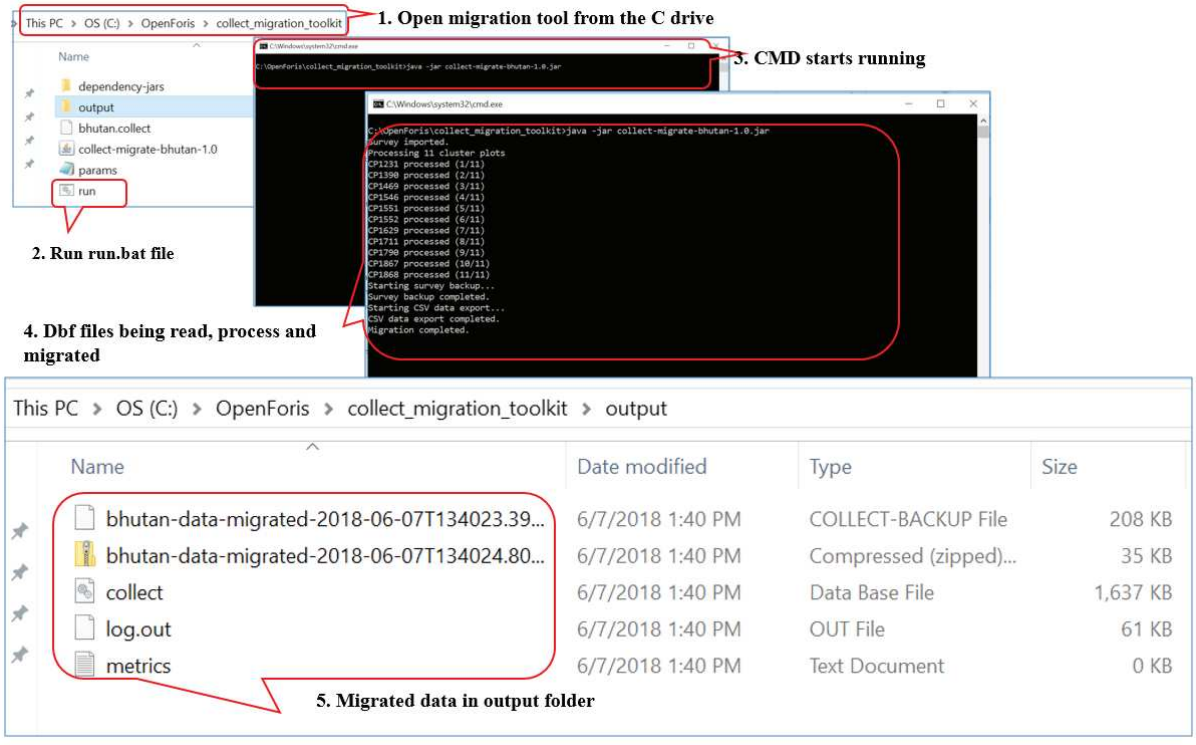


Figure 115: Data migration process

13.2 Importing Data into Collect

If the data is collected using Collect Mobile you directly upload the data to Collect without having to go through Section 12.1. Similarly, if the data is collected in paper forms, the data has to enter manually into the Collect platform

13.2.1 Importing data collected by GPS into Collect

The data migrated in Section 11.2.3 can be imported into Collect. To import the data, go to Data management in Collect home page. Then select the published survey by clicking on the published survey option. A new window with several menus, such as *New, Validation Report, Export, Import and Workflow* will be displayed. Click on the Import menu, you can import data as either Collect format or csv/Excel format.

13.2.1.1 Importing data as Collect-data and Collect-back up

Click on the import option in the data management window, select Collect format, a new window will open and click on the blank area in the new window and select the file to be imported, the file appears on the window, click on generate import summary. The data import summary will open in a new window in tabular format. Finally click import option on the data summary window to complete the data import as illustrated in Figure 116.

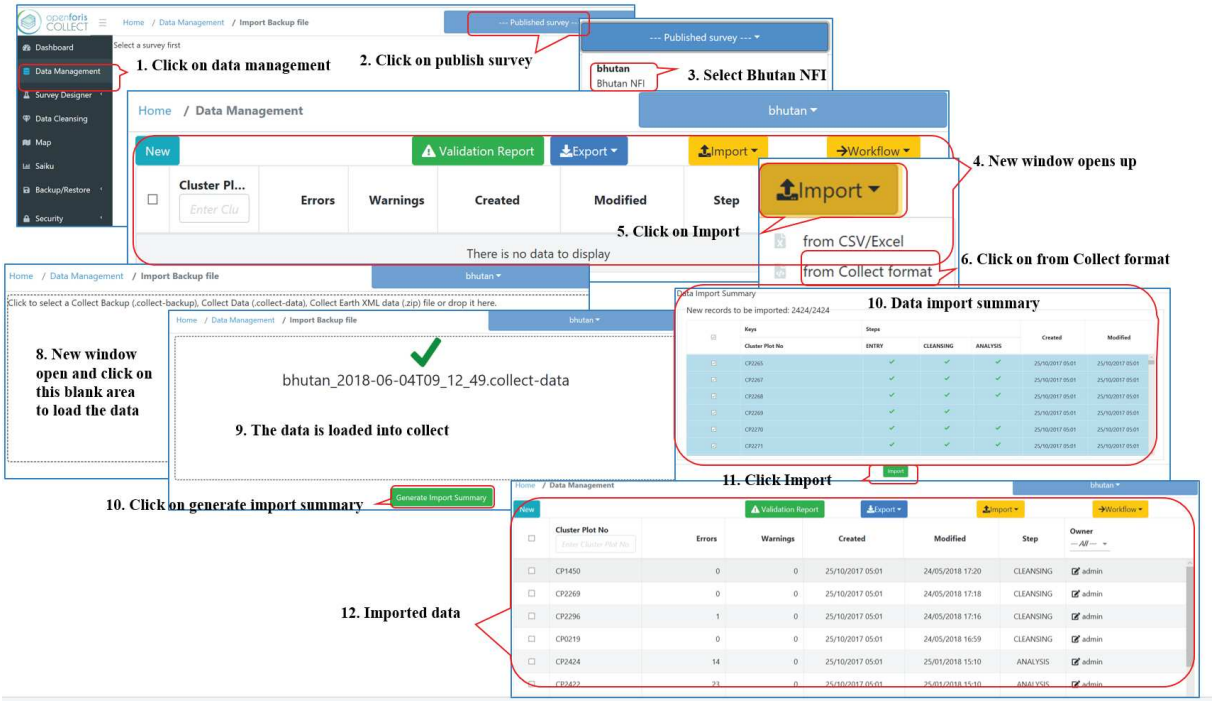


Figure 116: Importing the data into collect using collect-backup data

13.2.1.2 Importing data as csv/excel file

To import csv/excel file, click on the **import** in data management window after selecting a survey Bhutan (name of your published survey) and select import **from CSV/Excel.** A new window will open with heading **Parameters.** In this parameters table, in the **Import type Section** click on drop-down button, and three options of *Update existing record, Insert New records and Import multiple CSV/Excel file in a single Zip file.* (Figure 117).

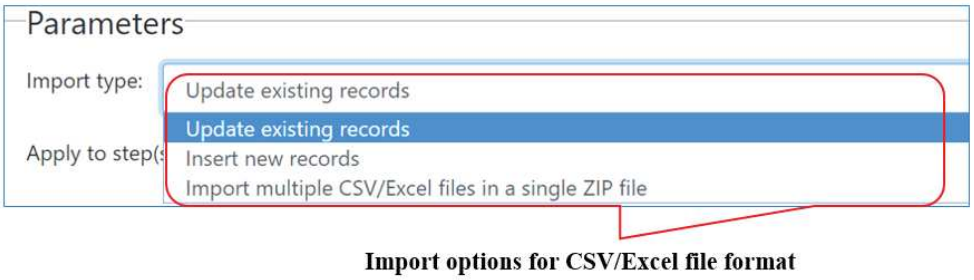


Figure 117: Import option for .csv/ excel file

13.2.2 Updating the existing record/importing by single record

If you wish to import individual file or to update the existing record, select **update existing records** in import type. By doing so, all existing records will be displayed as illustrated in Figure 118. Select the record you want to update viz. **cluster**, the file get uploaded, click on **Import** button below the loaded file, the import processes and click **OK** to complete the import. This approach can also be used for data cleaning purpose. The cleaned individual records can be updated with this approach.

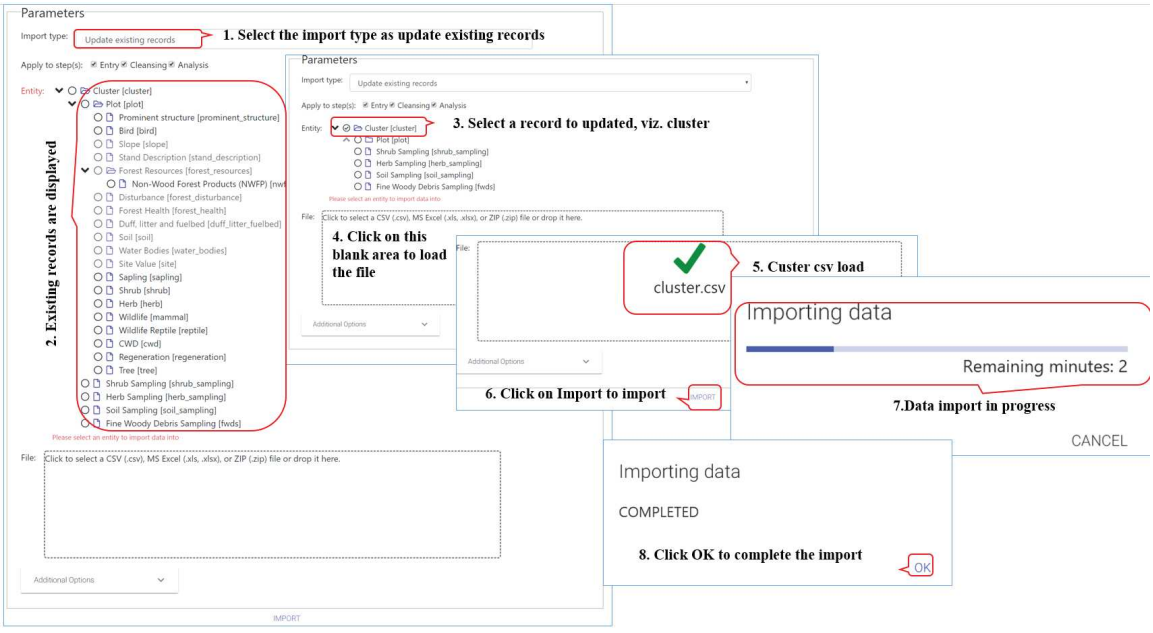


Figure 118: Updating the existing record or importing by single record

13.2.3 Importing as new record

If you wish to import individual file as a new record, select **insert new records** in import type. It will take you to a new window, click on the blank area as illustrated in Figure 119. Select the record you want to insert (viz. **cluster**, the file get uploaded, click on **Import** button below the loaded file, the import processes and click **OK** complete the import.

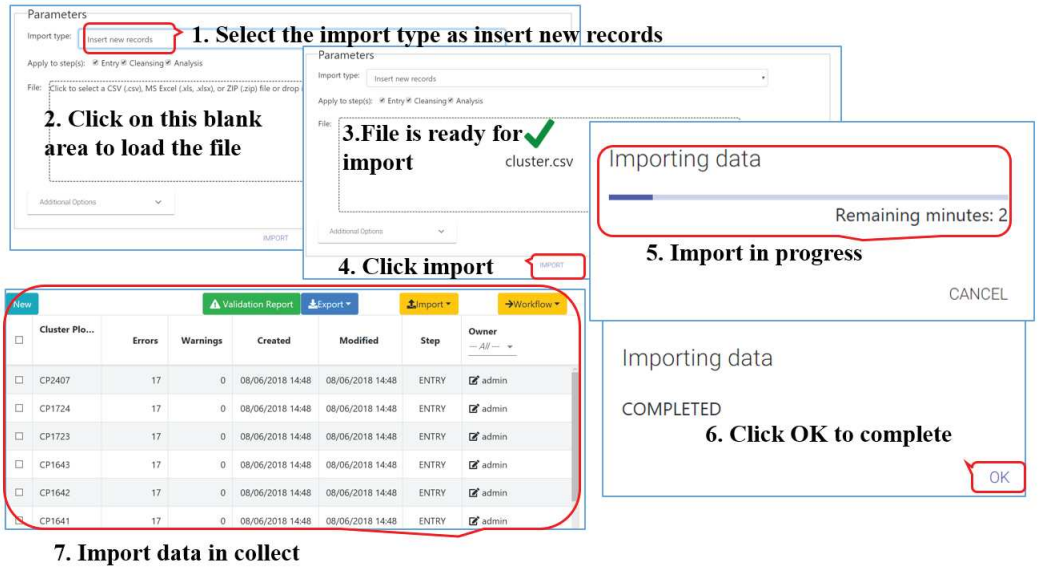


Figure 119: Inserting a new record

13.2.4 Importing as zip file

The CSV data can be imported as a zipped file. To import as zipped folder/single csv file click on import and select from CSV/Excel. In the import type, select **Import multiple CSV/Excel file in a single Zip file**, Click on **blank area** to load the zip file to be imported as illustrated in Figure 120. The files gest loaded. Click Import button below the load file and click Ok to complete import once done.

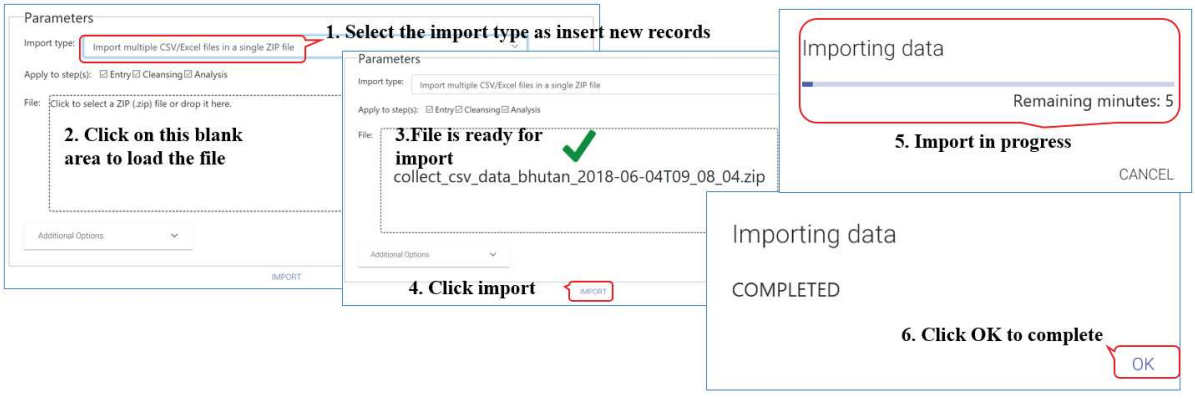


Figure 120: Importing multiple csv file

13.3 Manual data entry

If the data is collected in paper forms, we need to enter them manually. To add the data manually, go to data management in Collect home page, select published survey, click on New, select cluster and manually type the data and click save to save the data entered. All the boxes with missing information or error are bordered in red automatically. Refer Figure 121 for reference.

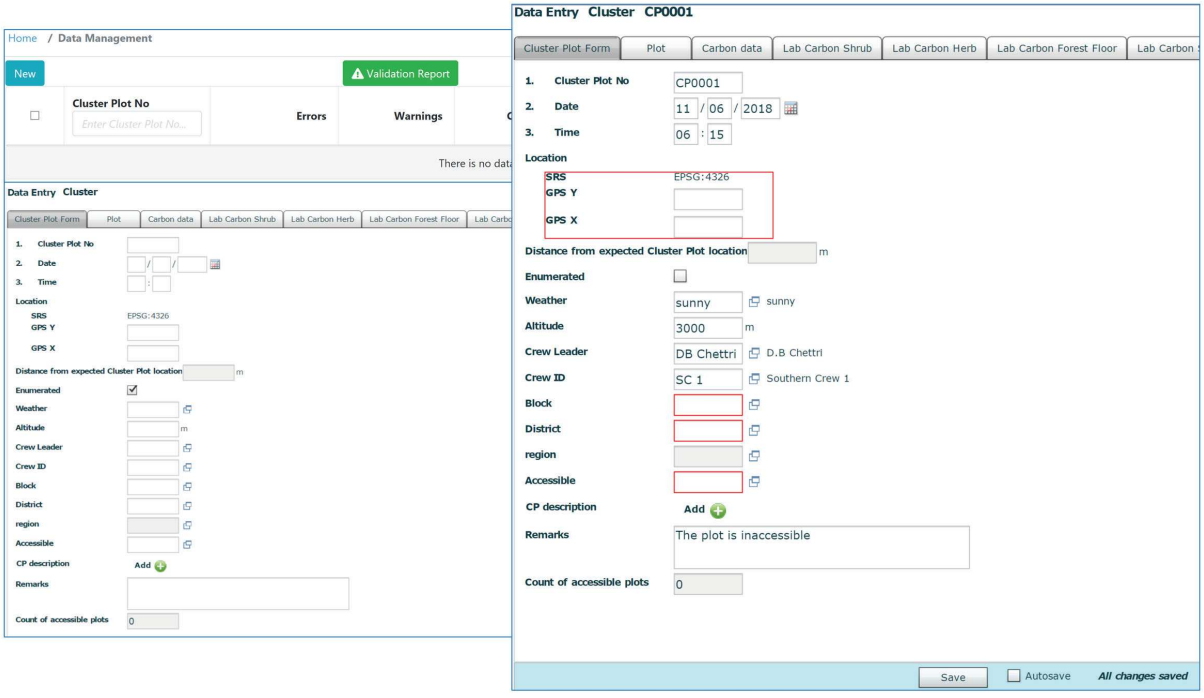


Figure 121: Manual Data Entry

14 Data Work flow

There are three data phases in Collect; Entry phase, cleansing phase and analysis phase. All data imported earlier or imported from Collect mobile are in the stage of entry phase. You can also edit the data in entry phase in the collect itself. To use the data cleansing tool, we need to submit the data to cleansing phase. Similarly, for analysis, we need to submit to analysis phase. All these task are performed in Data management tool. To promote and demote the data phases, click on the **Data management** menu, select a **Published survey**, go to **work flow,** click on drop-down button, in the promote record section, select **entry to cleansing** and then from cleansing to analysis following the onscreen instruction provided, your data is ready for analysis . See the illustration in Figure 122. Similarly, we can demote the data levels. Brief description on each phase of data is as follow

14.1 Data entry

This is the phase where we enter the data manually or import as CSV/Excel or Collect format data. Data are entered into the system is exactly as they appear on paper field forms or in collect mobile or GPS. In this stage, the data is neither interpreted nor corrected during this phase. The missing and incorrect data are kept as it is. On completion of the data entry and re-verification of errors (if any) from the field forms, the data record is submitted to data cleansing. It is recommended to export the copy of data and archive it or back up.

14.2 Data Cleansing

This is the data phase, where we need some form of expertise to correct or impute the data. Any missing or invalid values are corrected in this phase. This includes, correction of the scientific names of trees, shrubs, herbs, etc., verification and resolving any errors. On completing the Data cleansing process, the records are submitted to data analysis.

14.3 Data Analysis

In this phase, data is ready for analysis. We can export the data in appropriate format and perform analysis in Calc or R or Excel. If during analysis, some data are found to be incomplete or missing, then reject and demote to cleansing phase, re-clean and submit to analysis one more time and perform the analysis after exporting the data.

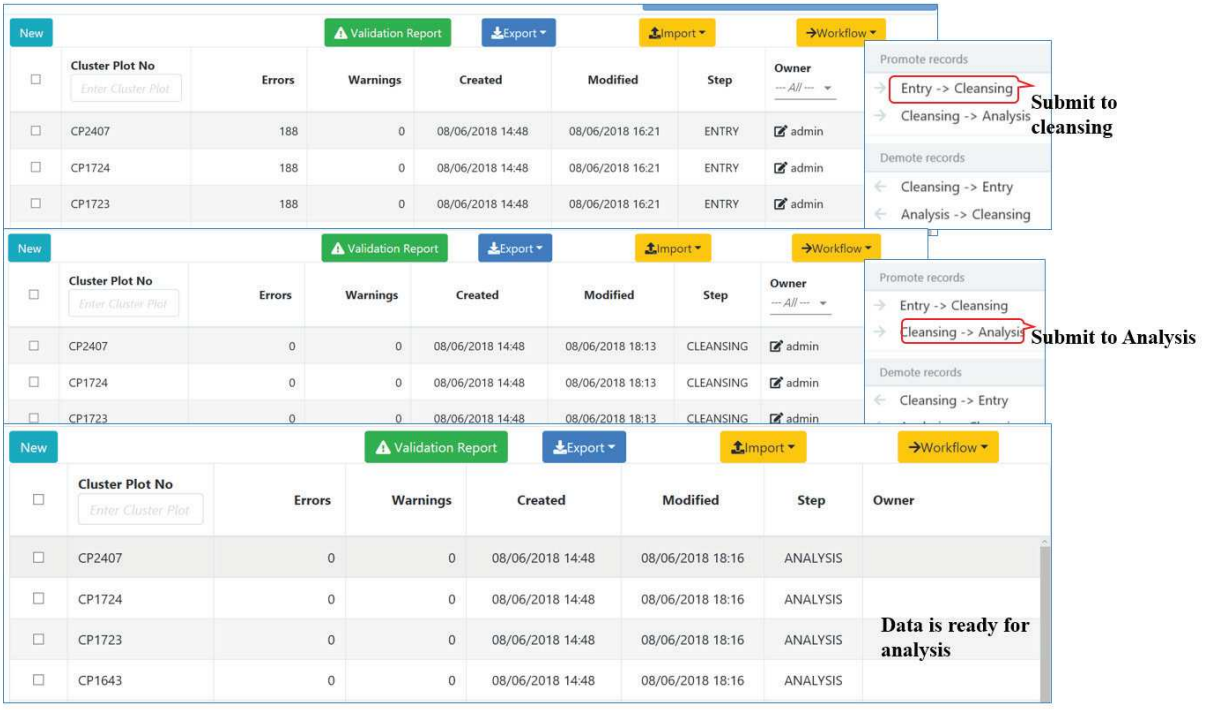


Figure 122: Data workflow

15 Data backup/restore

In the Collect home page, click on backup/restore, then click on backup. A new window will pop up and in the new window click on **generate backup**. A backup of the data is generated and follow on screen instruction to download the file. The backup comes in Collect-backup format as illustrated in Figure 123.

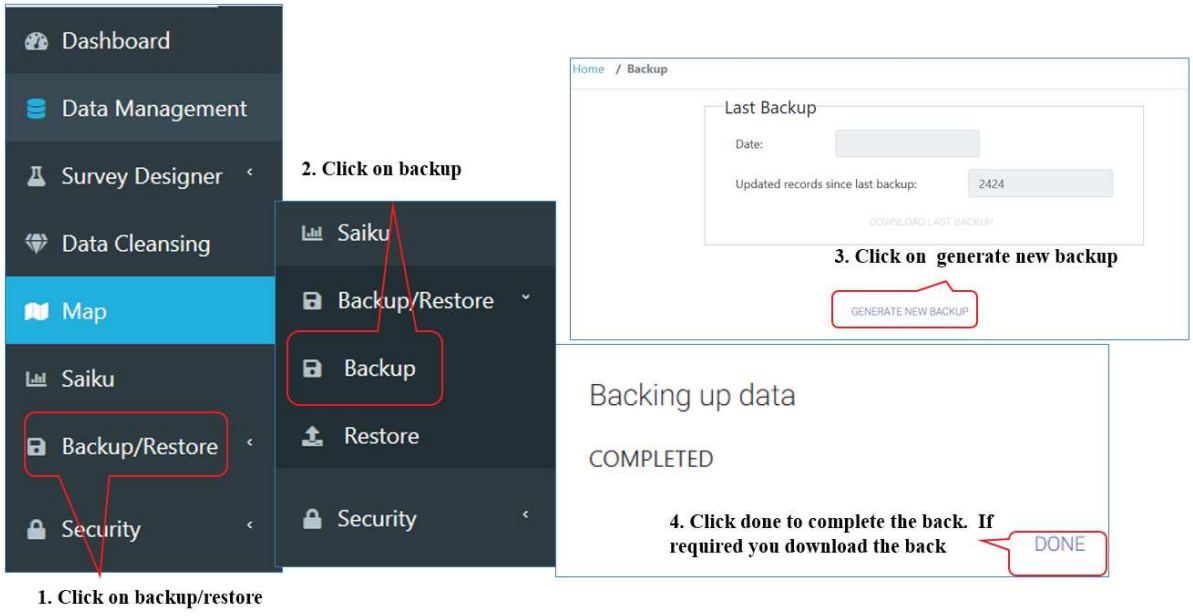


Figure 123: Generating new backup

16 Using Collect Data Cleansing tool

This is another very important tool in the Collect platform. To start the data cleansing tool, we need to submit our data to cleansing phase. To perform this task, go to data management, select **Published survey** and from the **workflow** option, click on drop-down button and under **Promote** records option, click Entry to Cleaning as demonstrated in Figure 124.

Figure 124: Submitting data to cleansing phase

16.1 Using data cleaning tool

To use the data cleaning tool, click Data cleansing menu in the Collect home page and select the survey for which data is ready for cleaning and cleansing and click apply. A new window will open as illustrated in Figure 125. The data cleansing tool has five features of Data Cleansing Home, Data Queries, Data Reports, Data Cleansing Steps and Data Cleansing Chains. However, this process was not use in case of NFI. Therefore, detail description is not provided here. However, you can refer Collect Handbook available online for details.

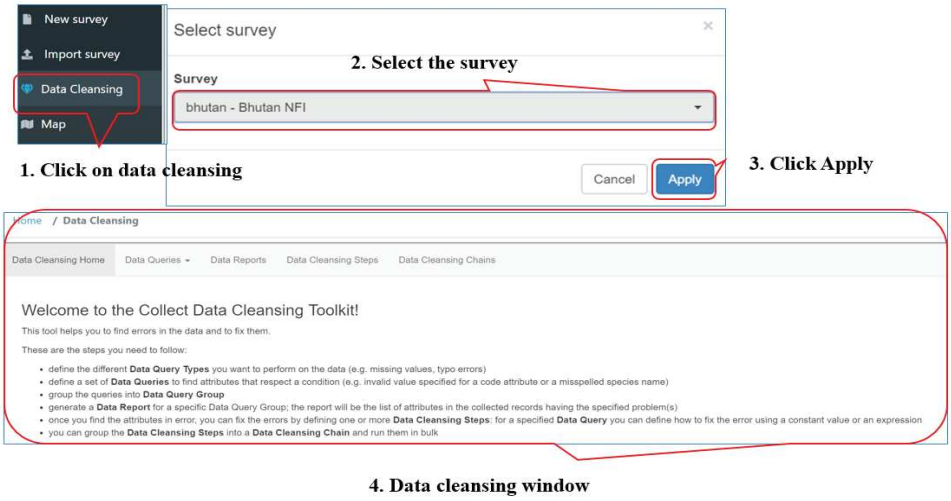


Figure 125: Collect data cleansing tool

16.2 Alternative data cleansing method

Alternatively, the data cleaning can be done outside of the Collect. To do so, you need to export the Collect data as .csv zipped file and export record by record. To export the data, go to **Data management,** select the **Published survey**, click on **Export**, there are two option to export i.e export ***to CSV/Excel*** and Export ***to Collect/Calc format***. For the purpose of data cleaning, select export to **CSV/Excel option.** A **parameters** of export window will open. Select what phase of data (***entry, cleansing and analysis***) to be exported (viz. Entry in this case). We can either export entire data as zip folder or by individual record. Select **all entities** to export all records together and click **export** button on the bottom of the export window. If we select the **export only selected entities**, then specify the entity to be exported from the list of entities and click **export.** The export of data progresses and when done, **download** exported data (Figure 126).

Now open CSV file and manually clean each entity. When done, import back to Collect following the steps described in Section 13.2 earlier.

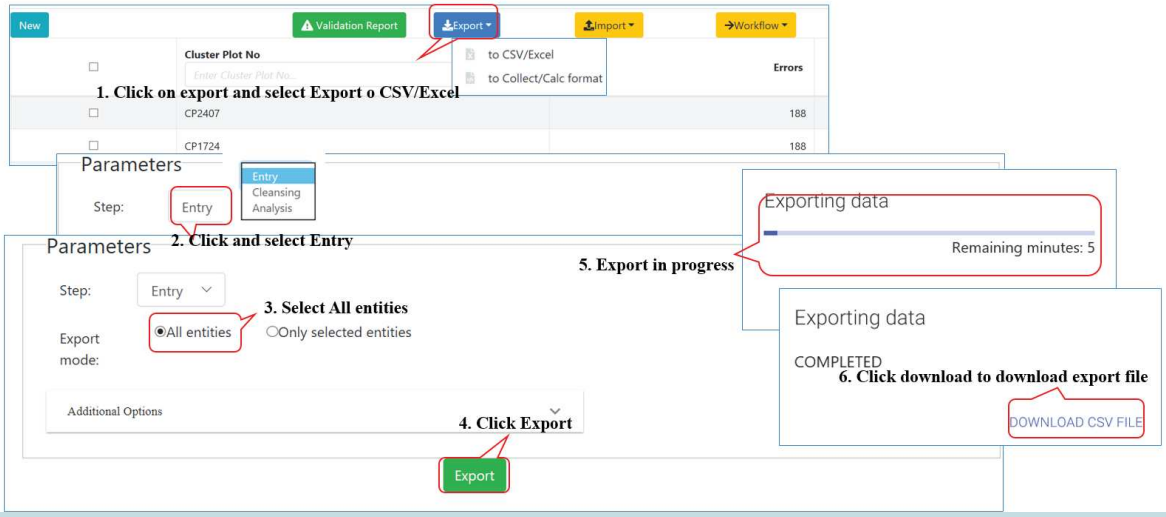


Figure 126: Exporting the data for cleaning

17 Exporting data from collect

The data from the collect can be exported in two formats

i. CSV/Excel format and
ii. Collect/Calc format

For the independent analysis using other software like R-program, Python, SPSS, excel, the data in analysis level have to be exported in CSV/Excel format. However, if the analysis have to done with another openforis software called **Calc,** the data in analysis level should be exported as Collect/Calc format. This is because the Collect doesn't accept other file formats. For exporting data as CSV/Excel format, refer Section 14.2. The procedure for exporting the data as Collect / Calc format also follow the same steps except that the data format is different.

18 Data Visualization using Saiku

Saiku server is a web-based open source software that facilitates data visualization and querying and Collect has customized inbuilt link to Saiku server. This application has an ability to generate descriptive statistics of the data.

18.1 Getting Started with Saiku

In the main collect home page, select Saiku to start running Saiku, select the published survey, viz. ***bhutan*** , select English as default language (if not preselected), click on Generate Saiku Database. Saiku starts generating data base. The Saiku table will open automatically. If nothing happens, click on start Saiku as illustrated in Figure 127.

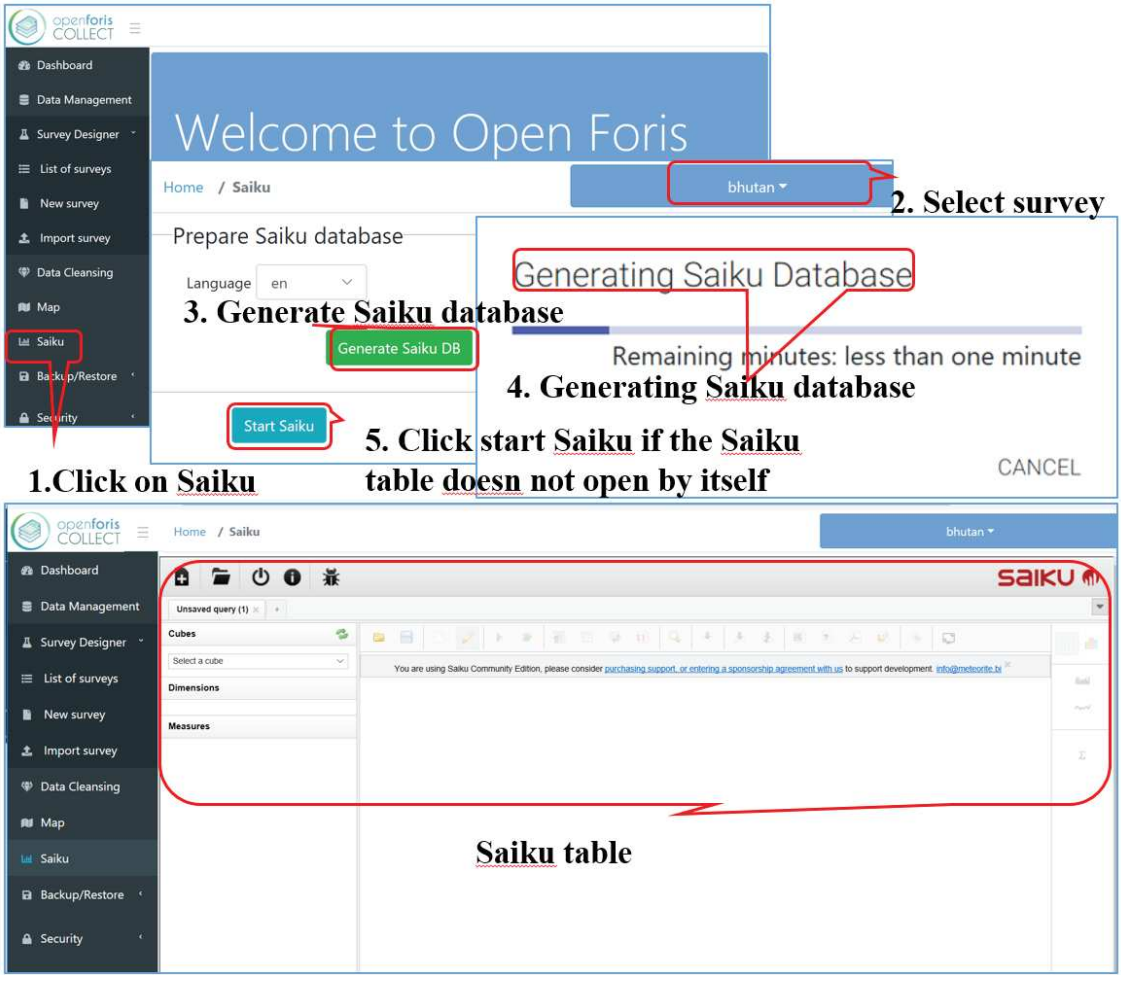


Figure 127: Starting Saiku

18.2 Querying in Saiku

The Saiku opens in a web browser. Refresh **Cubes,** select a feature in **Cubes** that we are interested in. The features to be selected in **Cubes** are records and sub records in the survey (e.g Cluster, plot. Tree. Shrub. Mammals, etc.). We can select cubes from any of the three phases of Data (data Entry, Data cleansing and Data analysis phase). However, it recommended that we use the data from data analysis phase. For the purpose of demonstration, we will start with Cluster. Select **Cluster** in cubes, the features in ***Dimensions and Measures*** will appear on the screen as illustrated in Figure 128.

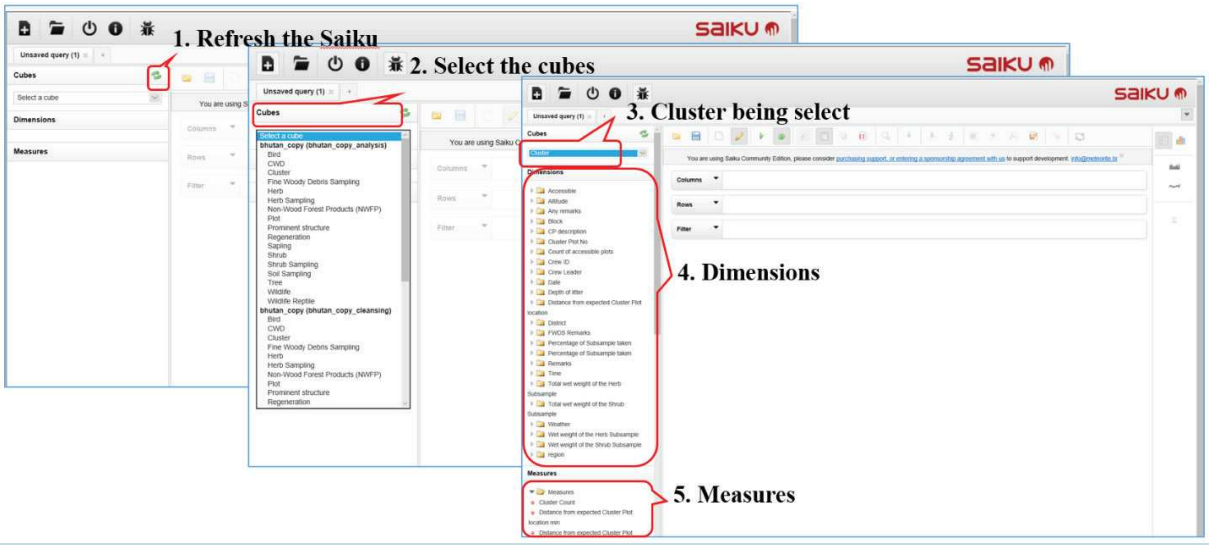


Figure 128: Starting Querying in Saiku

18.3 Generating table in Saiku

In Saiku, we can generate results either in table or charts, depending on our requirement we can select the results mode by clicking table mode and chart mode (Figure 129). By default, the result is always generated in table.

Let say, we are interested to look at the number of cluster plots in each Dzongkhag, go to districts, drag district and place in rows from dimensions and, from measures select and drag cluster counts and place it in columns, a table with cluster count will be generated (Figure 130). The result can be exported as excel or CSV file. To export the table, click on (excel option) to export as excel or on (comma option) to export as CSV. Change the download directory (if required) and type the name of the export file (cluster_plot_count_by_district) and save (Figure 131). To verify whether our export was successful, go to your download directory and open the file.

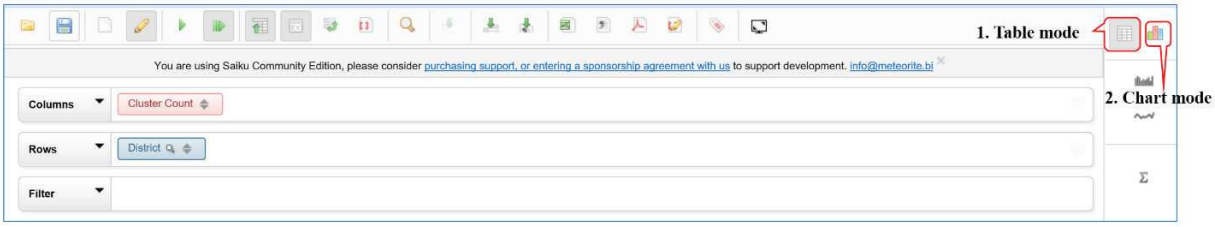


Figure 129: Changing the result display mode

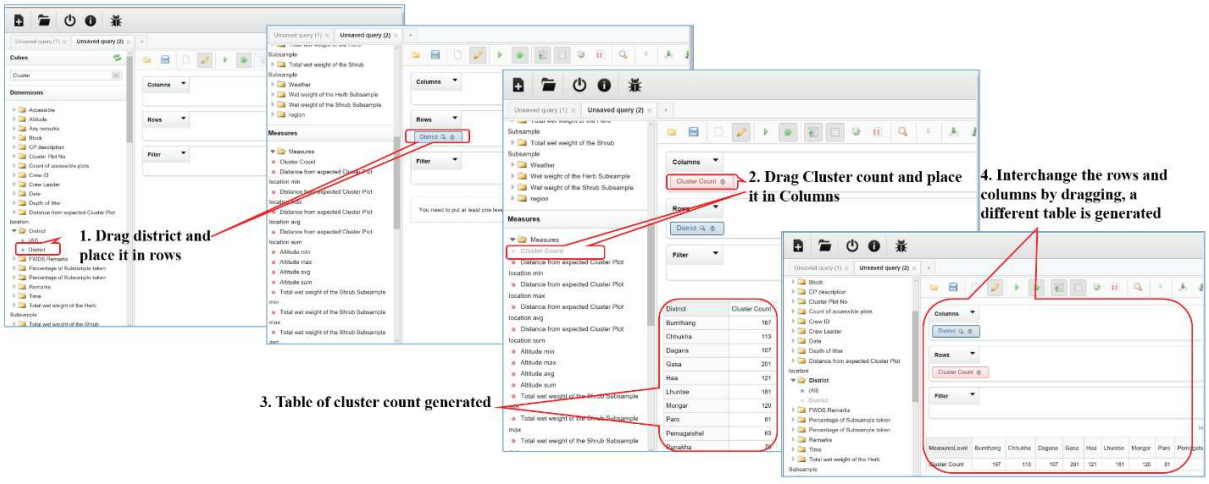


Figure 130: Generating Saiku Tables

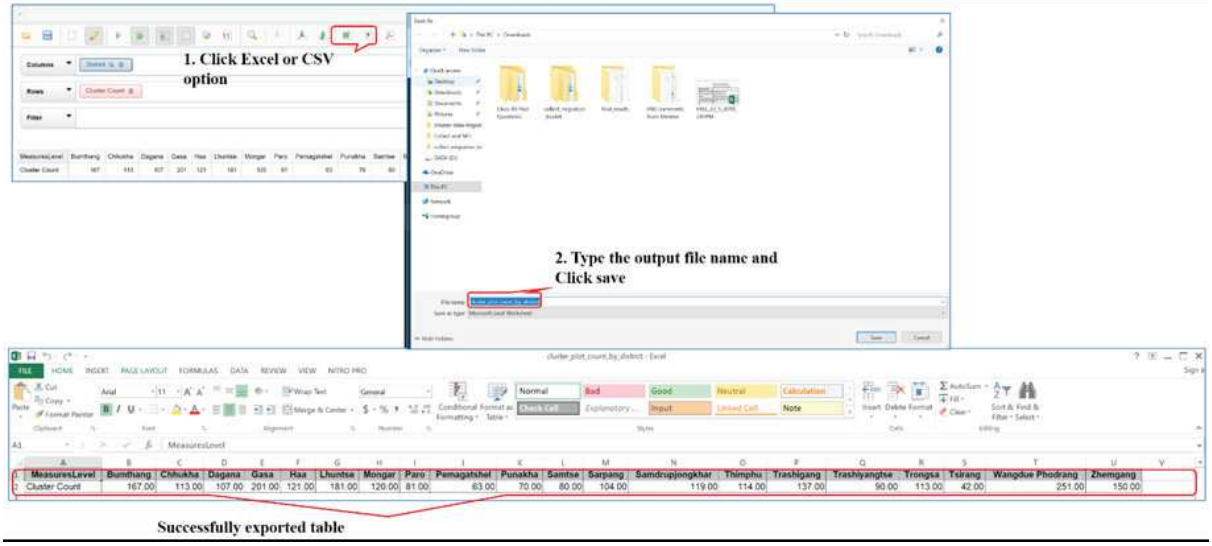


Figure 131: Exporting table from Saiku

18.4 Saving and opening the query

The queries can be saved in the Saiku for future reference. To save the query, click on save query button , type the name of the query and click Save. To Open the query, click on open queries button , select the query to be opened and click open, the save query table will be displayed (Figure 132)

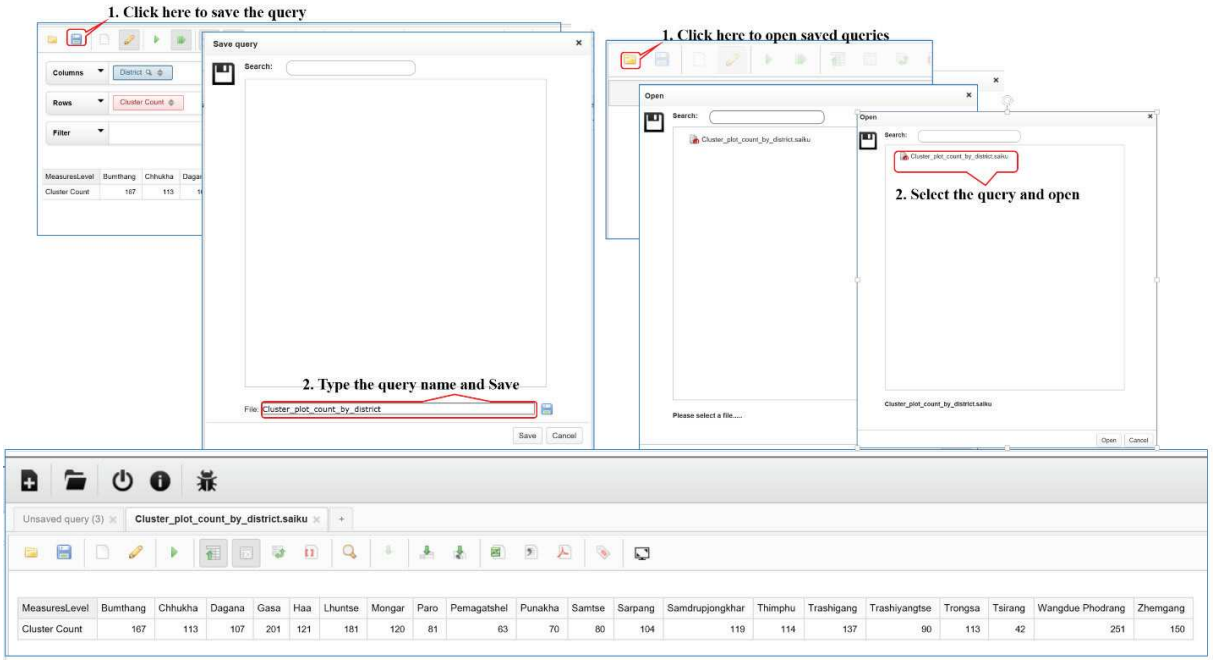


Figure 132: Saving and opening the save query

18.5 Generating graphs in Saiku

The result generated in the tables can also be generated in charts. This can be done by selecting the chart mode in the Saiku as illustrated in Section 17.3. The results in the table will be displayed in charts. Saiku have several chart options, you can select the chart option based on need (Figure 133). The charts can also be exported from the Saiku using the export option located above the chart types.

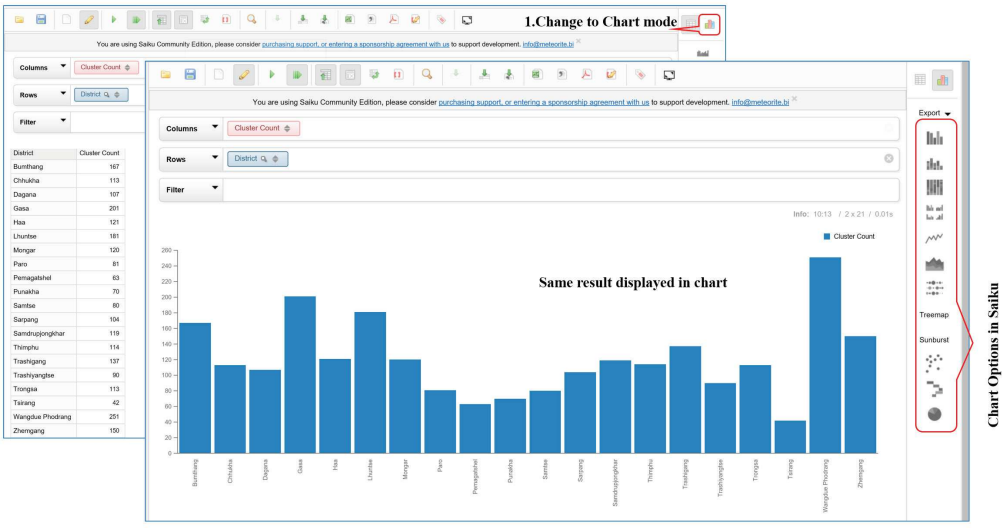


Figure 133: Displaying the charts

18.6 Multiple queries in Saiku

The Saiku has an ability to generate results on multiple queries. For example, we want to see accessible plots by district, minimum, maximum and average altitude recorded in each Dzongkhag. To perform this task, select cluster in the cubes, districts and accessible in dimensions, cluster count, minimum, maximum and average altitude from dimensions. We can also filter the results. Let say, we need only Bumthang, Gasa, Chukkha and Zhemgang Dzongkhag and only accessible plot count. Click on filter button with accessible, a new window will pop-up, select yes and click OK. Cluster plot count for only accessible plot will be displayed. Now filter the Dzongkhag by clicking on filter button and selecting four dzongkhags. The results will display all accessible cluster plot with minimum, maximum and average altitude for four Dzongkhags cluster plot count (Figure 134).

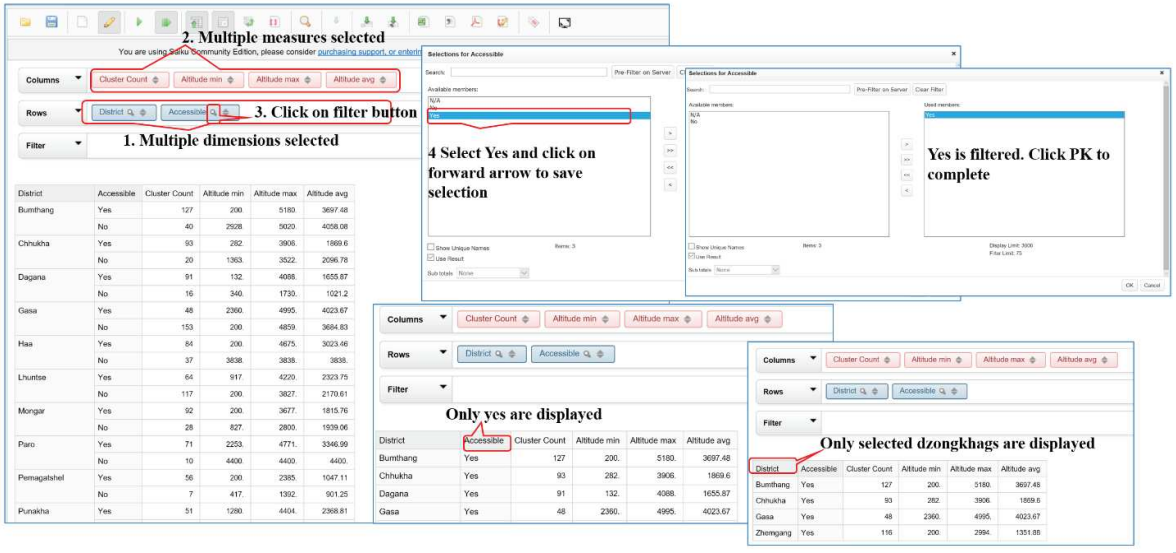


Figure 134: Multiple querying in Saiku

19 References

FRMD, (2012). Field Manual National Forest Inventory of Bhutan. Department of Forests and Park Services, Ministry of Agriculture and Forests, Thimphu.

FRMD, (2014). A Field Guide for Aboveground Understory and Soil carbon Assessment. Department of Forests and Park Services, Ministry of Agriculture and Forests, Thimphu.

Open Foris Collect Handbook (Version March 2018) available at url: http://www.openforis.org/fileadmin/docs/collect/OF_Collect_MANUAL_20180313.pdf (last accessed on 11.6.2018)

Openforis Collect User's Manual (version November 2016) Available at url: http://www.openforis.org/fileadmin/docs/collect/OF_Collect_MANUAL_October2016_WEB.pdf (last accessed on 11.6.2018)

Openforis Collect User's Manual (version November 2014) Available at url: http://www.openforis.org/fileadmin/docs/collect/Open_Foris_Collect_Manual_Nov_2014.pdf (last accessed on 11.6.2018)

Annexure I:
Plot description paper form

July '12 | NATIONAL FOREST INVENTORY FIELD FORMS | 'F

7. PLOT DESCRIPTION FORM

Plot Identification

1. Cluster Plot No. C P

2. Plot Name Elbow North East

(Tick the appropriate)

3. Date / / 4. Time / hrs

Plot Description Form

1. Topographic position

a. Ridge Top b. Upper Side Hill c. Middle Side Hill d. Lower Side Hill

e. Flat Land g. River Bed g. River Banks i. Gorge/Ravine (*Inst. Tick appropriately*)

2. Aspect

a. Northern b. North-Eastern c. Eastern d. South-Eastern

e. Southern f. South-Western g. Western h. North-Western

i. No aspect

3. Slope

a. Slope Up b. Slope Down

(*Inst. Mention slope in degrees*)

4. STAND DESCRIPTION

a. Stand Height(in meters) b. Canopy Closure %

c. Land Ownership

i. GRF ii. GRF-Protected iii. GRF-FMU iv. GRF-CF v. GRF Leased

vi. Private vii. Thromde viii. Dont know

d. Land ownership Note

e. Land Cover Code
(Inst. Enter appropriate code for land cover)

f. Vegetation Composition

(Inst. Enter appropriate code for vegetation composition)

g. Forest Type

(Inst. Enter appropriate code for Forest Type)

h. Forest Stand Structure

a. Open b. Stand Initiation c. Stand Exclusion

d. Understorey Reinitiate e. Complex Old Growth f. Others

i. Main Understorey Type

a. Moss b. Grass c. Herbs d. Bamboo e. Shrubs

f. Others

(*Inst. Tick appropriately*)

j. Understorey Percent

i. None ii. <2% iii. 2-5% iv. 10-40% v. >40%

(*Inst. Tick appropriately*)

FOREST RESOURCES

1. NWFP 1 : _____ (*Inst. Mention name of NWFP*)

Cover Percent:

NWFP2 : _____ (*Inst. Mention name of NWFP*)

Cover Percent:

NWFP 3: _____ (*Inst. Mention name of NWFP*)

Cover Percent:

NWFP 4: _____ (*Inst. Mention name of NWFP*)

Cover Percent:

NWFP 5: _____ (*Inst. Mention name of NWFP*)

Cover Percent:

2. Bamboo Yes ☐ No ☐ *(Tick against Yes, if Bamboo is found and vice-versa)*

Bamboo Scientific Name ..... *(If Bamboo is found)*

Bamboo cover percent

a. None ☐ b. >10% ☐ c. 10-20% ☐ d. 20-50% ☐ e. >50% ☐

Bamboo Regeneration

a. Dense ☐ c. Medium ☐ d. Scattered ☐ e. Not Applicable ☐

3. Cane Cover Percent

a. None ☐ b. <2% ☐ c. >2% ☐

Cane DBH

a. Unspecified ☐ b. <2cm ☐ c. >2cm ☐

4. Daphne Cover

a. None ☐ b. <2% ☐ c. >2% ☐

Snag

a. Yes (1-5 snags) ☐ b. Yes (5-10 snags) ☐ c. Yes (More than 10) ☐ d. No Snags ☐

Fallen Tree

a. Yes (1-5 Trees) ☐ b. Yes (5-10 Trees) ☐ c. Yes (More than 10) ☐ d. No Fallen Tree ☐

DISTURBANCE

1. Forest Fire Incidence

a. Yes, Heavy Fire ☐ b. Yes, Moderate Fire ☐ c. Yes, Light Fire ☐ d. No Fire ☐

Fire Type

a. Underground ☐ b. Surface ☐ c. Crown ☐ d. Not Sure ☐ e. Not Applicable

2 Grazing Evidence: a. Yes ☐ b. No ☐

Grazing Incidence:

a. Slight ☐ b. Moderate ☐ c. Severe ☐ d. None ☐

3. Timber Extraction

a. Yes, Clear Cutting ☐ b. Yes, Selective Felling ☐ ☐ c. Yes, Group Felling ☐ d. Others ☐

e. No Felling ☐

4. Mining:

a. Yes Surface Collection b. Yes Quarry ☐ c. No ☐

5. Transmission Lines: a.Yes ☐ b.No ☐

6. Garbage

a. Food Wrappers ☐ b. Pet Bottles ☐ c. Construction Dumps ☐ d. All ☐ e. None ☐

FOREST HEALTH

1. Pest and Disease Evidence	Yes	☐	No	☐
2. Mistle Toe	Yes	☐	No	☐
3. Dieback Fir	Yes	☐	No	☐
4. Bark Beetle	Yes	☐	No	☐
5. Others	Yes	☐	No	☐

DUFF, LITTER AND FUELBED

1.Litter depth value	☐	*(in cm)*
2. Humus depth value	☐	*(in cm)*
3. Fuelbed depth value	☐	*(in cm)*
4. Litter cover percent	☐	
5. Bare soil cover percent	☐	

SOIL

1. Stoniness

a. None ☐ b. Rare <10% ☐ c. Few, 10-20% ☐ d. Common, 20-30% ☐ e. Many, 30-60% ☐

f. Abundant, >60% ☐

2. Soil Drainage

a. Poorly Drained ☐ b. Moderately Drained ☐ c. Well Drained ☐

3. Top Soil Moisture

a. Dry ☐ b. Slightly Moist ☐ c. Moist ☐ d. Wet ☐ e. Flood ☐ f. Others ☐

4. Top Soil Colour

a. Dark ☐ b. Reddish ☐ c. Yellowish ☐ d. Others ☐

5. Top Soil Colour Chart ☐

6. Top Soil Texture

a. Sand ☐ b. Sandy loam ☐ c. Loam ☐ d. Silt loam ☐ e. Silt ☐

f. Clay loam ☐ g. Clay ☐

7. Soil Sample Collected a.Yes ☐ b.No ☐

8. Evidence Gully a.Yes ☐ b.No ☐

9. Evidence Erosion a.Yes ☐ b.No ☐

WATER BODIES

1. Stream	Yes	☐	No	☐
2. Waterlogged /marshy area	Yes	☐	No	☐
3. Lake	Yes	☐	No	☐
4. Glacier	Yes	☐	No	☐
5. Pond	Yes	☐	No	☐

SITE VALUE

1. Natural Trail Facility: a.Yes ☐ b. No ☐

2. Scenic: a. Yes ☐ b. No ☐

3. Visitor Evidence

a. Yes, Local ☐ b. Foreign Tourist ☐ c. Yes, Both ☐ d. Yes, Religious ☐ e. None evident ☐

f. Yes, All ☐

4. Site Value

a. Yes, Cultural ☐ b. Yes, Historical ☐ c. Yes, Religious ☐ d. Don't know ☐

5. Site Name : .....

6. Remarks: