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**ПРОЕКТ «ИНТЕГРИРОВАННОЕ УПРАВЛЕНИЕ ЛЕСНЫМИ ЭКОСИСТЕМАМИ В
КЫРГЫЗСКОЙ РЕСПУБЛИКЕ» (IFEMP)**

**КОМПОНЕТ: ПРОВЕДЕНИЕ НАЦИОНАЛЬНОЙ ИНВЕНТАРИЗАЦИИ ЛЕСОВ И
СОЗДАНИЕ ПОТЕНЦИАЛА**

Руководство по полевым работам 2-й Национальной инвентаризации лесов в Кыргызской Республике

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National Forest Inventory execution and Capacity Building

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Deliverable 1.2 Revised field methodology

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1 EQUIPMENT AND MATERIALS

Each field team needs to be equipped with the following instruments and material for field work:

Devices / Materials	Number	Check / Comment	Example
Backpack for devices	1	For stowing field equipment	
GPS Receiver	1	External GPS Antenna with link to mobile tablet.	
Survey vest	1	For having small measuring devices during plot measurement at hand	
Height and distance measurement instrument	1	VERTEX Geolaser 5	
Compass	1	as a substitute for Geolaser or GPS	
Measuring tape (20m)	1	For distance measurement	
Radio (Walkie-Talkie)	1	Work safety investment that ensures communication between the teams for safety, health and supply.	
Metal detector	1	For re-finding metal stakes from NFI#1 and FMP sample plots	

Devices / Materials	Number	Check / Comment	Example
Mobile tablet with integrated camera	1	Mobile tablet. Android operating system, for Field Data Collection App and Field GIS Internet connection – for transferring data	
Rugged case for tablet, Chest Harness and Protective PVC Case Cover	1	The rubber briefcase handle provides a simple yet effective way to carry the device. Cover for protection against rain.	
SD Card (64 GB)	1	Storage device for the field computer	
Diameter tape (Pi band) or/and	1	For DBH measurements beyond 70cm	
Caliper (up to 80 cm)	1	For DBH measurements up to 70 cm.	
Machete	1	For removing branches, ivy, etc.	
Axe	1	For drilling the iron poles into more solid ground	
Small shovel	1	For clearing preparing the litter measurement.	
Iron pole	3 per tract	20 cm iron poles for marking the sample plot positions (including 1 spare pole)	
Pruning saw	1	Tool for marking trees (e.g. DBH mark).	
Signal chalk		For tree numbering	
Signal chalk pen holder	2	For holding signal chalk	
Spray color		Spray for marking paths	

Devices / Materials	Number	Check / Comment	Example
Coloured paper tapes		Coloured paper tapes for marking of trees and flagging, Particularly tear-resistant paper tape, weathered in 1 to 2 years.	
Folding ruler	1	For regeneration assessment.	
Wooden stick with two marks	2	Wooden sticks to be prepared with marks for the measurement height of the DBH and for regeneration height class assessment.	
Age borer/Increment borer	1	For measuring growth increment	
Set of grinding auger (Sharpener)	1	The set should contain: 1 bottle of light oil, 1 bottle of sand for sharpening, Bee wax, sharpening stones	
Binoculars	1	Binoculars: 12X50, Shockproof, waterproof, rubberized.	
Drone	Only 2 for all teams	For documentation of forest types and for documentation of field work.	
Hammer	1	For marking sample plot positions with iron pole.	
Stronger plastic bag	1	To efficiently protect the more sensitive electronic measurement devices in case of heavy rain.	
Replacement batteries	4	New/charged batteries for GPS, Vertex, camera, and other electronic devices	
External battery / power bank	1	External energy supply for Vertex, tablet and other electronic devices	
Car adapter to 220 V	1	charge faster all batteries (gps, camera, transponder, tablets) and power banks	
Box for car transport of measurement instruments	1	for car transport of measurement instruments	

Devices / Materials	Number	Check / Comment	Example
Field manual and overview tables	1	Are also available via the tablet	
Short manual for complicated devices	1 per device	Placed at the mobile computer as PDF and a selection as printouts	
First aid kit	1	Check for completeness and validity	

2 ORGANISATION OF THE FIELDWORK

Field team composition

A field team is composed by 3 field team members plus one driver :

- Team leader (forest engineer with forest inventory experience of more than 3 years),
- Two assistants (with basic forest education and/or basic experience in forest inventory);
- One driver

Preparation and planning

This part of the work is related to the planning phase. It is done ahead of the fieldwork via GIS and remote sensing image interpretation. It is clarified if a plot is located on forest/other wooded land area or on a non-forest area. If not clear on image analysis, the final decision upon this can to be taken in the field (pre-clarification). Further, it is clarified if a plot is accessible via GIS and remote sensing image interpretation.

The outcome of this activity will enable the NFI coordinator to have an exact number of tracts and sample plots that are accessible and have to be visited in the field.

Besides the **pre-clarification**, the GIS team prepares **field maps** for the teams. These are used for the navigation to the tract and the plots.

Using the field maps and the known number and location of the accessible tracts, the NFI field-work coordinator prepares a **time and work plan**. It assigns each team a certain number of tracts to measure within a certain time frame

Logistics

The logistics have to be planned carefully by the NFI field work coordinator and the field team leader. This, because many tracts and plots are located in remote area, not reachable by car.

3 NAVIGATION AND SAMPLE PLOT ESTABLISHMENT

3.1 Navigation to the sample plot

The navigation to the tract begins from the nearest road that is accessible by car, or from the camp that is set up close to the tracts.

To assist this purpose, the GIS teams prepare a field map for each tract.

The field team leader selects out of the three plots the most suitable plot to start the measurement on the tract and the sequence of the measurement of the other two plots. On tracts where only one or two plots are to be measured in the field, merely these are approached and assessed.

The field team leader has to identify the best way to approach the sample point: prior to going in the field the field team leader consults local state forest enterprise staff in case the tract / plot is located in an state forest enterprise staff or in other cases from a local people. If needed the locals or the local state forest enterprise staff will accompany the field team.

The Field GIS app that is installed on the mobile tablet will be used to support and facilitate the navigation.

The use of the Field GIS app is presented in the Annex 6.4 and a separate hand book.

3.2 Refinding previous inventory plot (NFI#1, FMP)

In case a plot has been assessed by the NFI#1 or by a previous FMP inventory the team needs to re-find the exact center of the NFI#1 / FMP inventory that was marked by a metal stake.

In order to re-find the exact location first, using the GPS the team needs to reach this target location. As there is always a locational error both from the current GPS measurement and from the previous inventory GPS measurement the teams first need to watch out in a distance of up to 20 -25 meters for

- reference trees or objects used by the previous NFI#1 / FMP inventory
- specific tree configurations using a plot map that shows the location, species and diameter of the trees on the plot at the status of the previous NFI#1 / FMP inventory

Once the location is, using this technique, roughly identified, the metal detector is used to find the metal stake that was established during the previous NFI#1 / FMP inventory.

Procedure for former NFI plots

Once the target location is reached an intensive search for marked reference objects and trees up to 10 minutes is obligatory. Using the tree plot map from the software to check for specific tree configurations has to be used as well. If reference objects can be found, the plot center has to be first measured in using the azimuth and distance from the reference objects (all that where found). Clearly identified specific tree configurations could be used as well for that purpose using azimuth and distance of identified trees. Next step is to locate the NFI#1 metal stake using the metal detector.

If the metal stake of a NFI#1 plot could be found, a new plot center for circular plot measurement will be established in 12 meters distance along the middle line of the plot and the metal stake of the NFI#1 will be removed (if feasible): The new center NFI#2 is measured in 12 m north (plot at south west corner), east (plot at north west corner), south (plot at north east corner) west (plot at south east corner) and the metal stake will be placed there.

Then from this new center, three reference points are measured in, NFI#1 reference points can be utilised if appropriate, otherwise new ones have to be selected. A photo is taken from the reference objects in addition.

If the metal stake cannot be found but the centre can be well re-established based on reference points and is approved by the tree plot map the approximate NFI#1 plot center is used to measure in the NFI#2 center.

Procedure for former FMP plots

The teams need to be provided with the information if metal stakes have been used in the latest FMP inventory.

Once the target location is reached an intensive search for marked reference objects and trees up to 10 minutes is obligatory. Using the tree plot map from the software to check for specific tree configurations has to be used as well. If reference objects can be found, the plot center has to be first measured in using the azimuth and distance from the reference objects (all that where found). Clearly identified specific tree configurations could be used as well for that purpose using azimuth and distance of identified trees.

If metal stakes have been used in the latest FMP inventory, the next step is to locate the NFI#1 metal stake using the metal detector.

If it can be found this is the center of the NFI#2 plot.

If the metal stake cannot be found but the centre can be well re-established based on reference points and is approved by the tree plot map this approximate center position is used to establish the NFI#2 plot and a metal stake is place there.

If a plot center could be found is recorded in the field "Re-finding of NFI#1 or FMP plot".

Final steps

If the plot center could be found it will be used for the remeasurement of the plot.

The GPS coordinates of the location of the NFI#2 metal stake or the reused FMP metal stake are recorded using an the **averaging mode of the GPS device (min. 1 minute)** and reference points are as well measured in (if possible the same that have been used in the previous inventory) and a photo is taken from the reference objects in addition.

If a plot could be refound it is recorded in the field "Re-finding of NFI#1 or FMP plot".

If a plot center could not be found is recorded in the field "Re-finding of NFI#1 or FMP plot" and a new sample plot is established.

3.3 Establishment of a new the sample plot

The tracts and sample plots are designed as permanent sample plots.

This means that the center location of the sample plot have to be marked for re-finding the center. This allows re-measurements of the exactly same trees in the next NFI#3.

After having reached the target location a decision is made on that location on the establishment of the center.

Then ensuring the sample plot location is done by 3 means.

Measuring the GPS coordinates

The first step is to measure the GPS coordinates of each sample plot. The GPS coordinates of the sample plot in the field always differ from the planned coordinates due to terrain and strength of the GPS signal, which is always associated with a certain error. To reduce this error, GPS coordinates are taken using the **average function of the GPS device (min. 1 minute)**.

Marking the center with a metal stake

As soon as the center of the sample plot is identified, it will be marked also by placing a metal stake in the ground. The metal stake has a length of 20-30cm and has a diameter of 15mm. It is drilled in the ground just below the surface.

The purpose of placing the metal rod in the ground is to facilitate the re-measurement of the plot in the following inventory.

In order to locate the metal stake, a metal detector is needed.

If the center of the sample plot is on a rock or location where it is not possible to place the metal rod, it is placed on the nearest position possible ; the azimuth and distance to the real center is measured. The trees are measured from the real center.

Measurement of reference points

Three reference objects that are located outside of the plot are identified. They are selected and recorded in clockwise direction in adequate distribution. Those could be, for example, rocks or remarkable trees. Their azimuth and distance to the plot center is measured, marked with colour and recorded, the reference objects are described and an image of the reference points is taken.

4 TRACT & PLOT DESIGN

An NFI tract consists of three plots as shown in Figure 1.

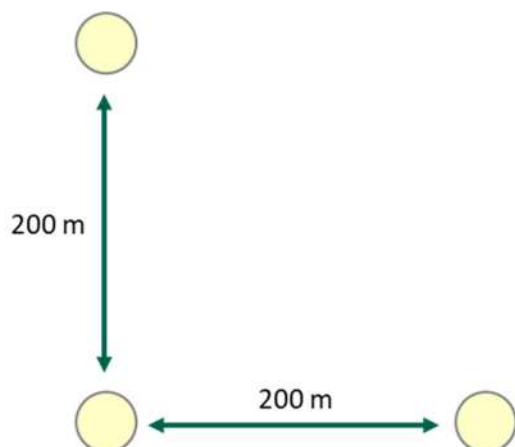


Figure 1 NFI#2 standard plot: Three plots with a distance of 200 m

In case of an NFI#1 tract 4 plots are measured (to enable a higher remeasurement rate compared to a reduction to 3). The plot centers are established 12 m along the plot orientation of a NFI#1 plot that has a rectangular extend of 20m by 250m. The 4 plot centers will thus be situated in ca. 500m distance of each other (see Figure 2).

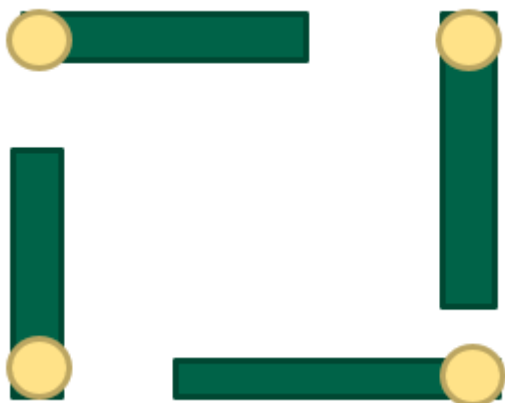


Figure 2 NFI#2 plot allocation in case of a NFI#1 tract

A tract is visited if at least one of the three (four) plots are selected for field visit by the pre-clarification. All plots identified to be visited in the field will be assessed by the field teams.

A standard plot consists of three concentric and one eccentric circle, see Figure 3.

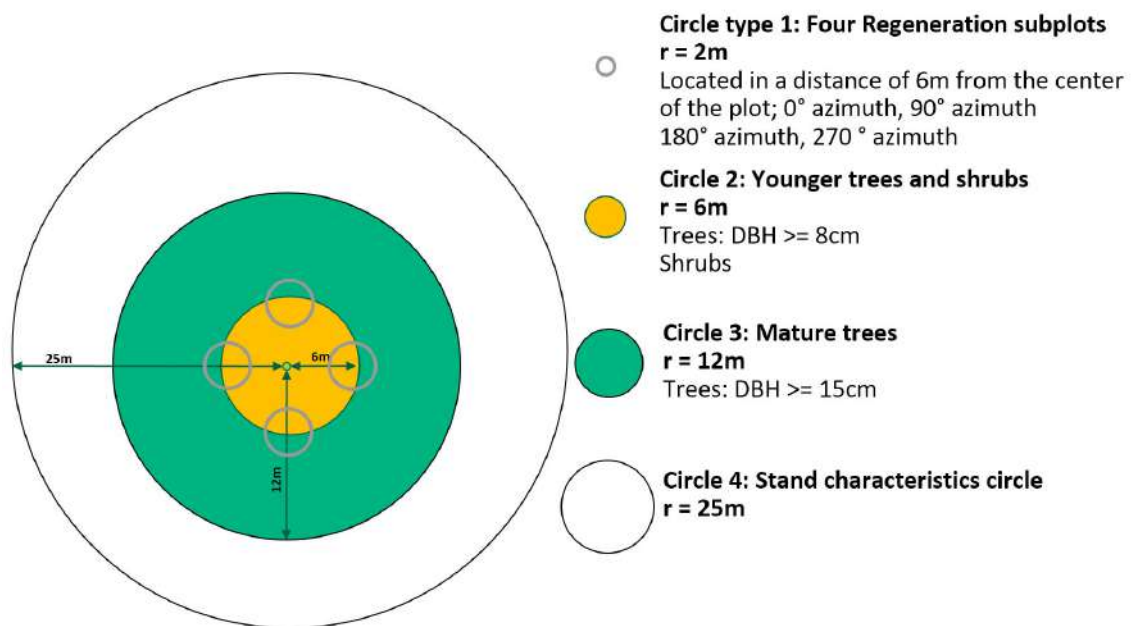


Figure 3 NFI#2 plot design

Two circles are dedicated to tree measurement:

Outer tree circle: $r = 12.00$ m

Inner tree circle: $r = 6.00$ m

The plot includes 4 regeneration circles that are located 6 m north, east, west and south of the center each with $r = 2$ m. Details are described in chapter 5.5.

The stand characteristics circle is used to characterize the stand, the plot is located in: $r = 25$ m

To integrate the NFI#1 grid (established in degree based distances) and NFI#2 grid (established in km based distances) for each NFI#1 tract the tract of the NFI#2 grid closest to the NFI#1 tract is removed and the final grid thus corresponds to a grid with the density of the NFI2 tract grid.

Table 1 and Table 2 below provides an overview of all field attributes.

Table 1 NFI#2 tract and plot level attribute table

Tract attributes	Basic plot level attributes	Stand characteristics circle attributes	Sample plot of 12 m radius attributes	Sample plot of 6 m radius attributes	Regeneration plot attributes
Attributes already available ahead of the field work in the data base and the field tablet with references to the chapter they are defined.		Field attributes with references to the chapter they are defined.			
<ul style="list-style-type: none"> – Tract ID (5.1.1) – Tract Type (5.1.2) 	<ul style="list-style-type: none"> – Sample Plot ID (5.2.1) – Plot Type (5.2.2) – GPS target coordinates (5.2.3) – Plot pre-clarification result (5.2.6) – Oblast (GIS) (5.2.9.1) – Rayon (GIS) (5.2.9.2) – State forest enterprise (GIS) (5.2.9.3) – Nature Protection category (GIS) (5.2.10.1) – Altitude above sea level (GIS) (5.2.17) – Forest growth regions (GIS) (5.2.10.2) 	<ul style="list-style-type: none"> – Forest and other wooded land (5.2.13) – Coverage with trees and shrubs (5.2.14) – Terrain relief (5.2.20) – Micro relief, terrain shape (5.2.21) – Traces of erosion (5.2.22) – Growth location (5.3.1) – Conifer, broad-leaved mixture (5.3.2) – Origin (5.3.2) – Forest type group, Forest formations (5.3.4) – Crown coverage with trees and shrubs (5.3.5) – Crown coverage with trees (5.3.6) – Two dominating tree species (5.3.7) – Forest types (Fehler! Verweisquelle konnte nicht gefunden werden.) – Development stage (5.3.9) – Age assessment method (5.3.10) – Age (5.3.11) – Walnut portion (5.3.12) – Layer structure (5.3.13) – Undergrowth (5.3.14) – Disturbance/ Forces in the forest stand (5.3.15) – Resistance of the forest stand (5.3.16) 	<ul style="list-style-type: none"> – Tree measurements; trees with dbh \geq 15cm (5.7) – Stump attributes; stump diameter \geq 20 cm (5.8) – Down dead wood \geq 20cm at the thicker end (5.9) – Plot cut by a border line (5.2.15) – Slope incline (5.2.18) – Exposition (5.2.19) – Grazing (5.3.19) – Coverage with shrubs (5.4.1) – Single shrub species (5.4.2) – Single shrub species coverage (5.4.3) – Height of shrub species (5.4.4) 	<ul style="list-style-type: none"> – Tree measurements; trees with dbh \geq 8 cm (5.7) – Stump attributes; stump diameter \geq 10 cm (5.8) – Down dead wood \geq 10cm at the thicker end (5.9) – Ground cover type & ground cover percentage (5.3.17) – Litter depth (5.3.18) 	<ul style="list-style-type: none"> – Nature of the young forest (5.5.1) – Young forest species counting (5.5.3)
Field attributes with references to the chapter they are defined.					
<ul style="list-style-type: none"> – Field Team Leader (5.1.3) – Recording of the navigation to the tract (5.1.4) – Tract Start Time (5.1.5) – Tract End Time (5.1.6) – Tract Comment (5.1.7) 	<ul style="list-style-type: none"> – GPS Coordinates of the Sample Plot Center (5.2.45.2.10.2) – Reference points establishment (5.2.5) – Accessibility of the sample plot (5.2.7) – Re-finding of NFI#1 or FMP plot (5.2.8) – Start Time of Measurements on the Sample Plot (5.2.11) – Standard photographs of sample-plot (5.2.12) – Forest and other wooded land (5.2.13) – Coverage with trees and shrubs (5.2.14) – Border line measurement (5.2.16) 				

Table 2 NFI#2 tract attributes assessed in the field on trees, stumps and down deadwood

Tree attributes	Stump attributes	Down dead wood attributes
Attributes already available ahead of the field work in the data base and the field tablet with references to the chapter they are defined.		
<ul style="list-style-type: none"> – Tree number and other attributes of previous NFI#1 or FMP inventory (5.7.2) 		
Field attributes with references to the chapter they are defined.		
<ul style="list-style-type: none"> – Tree number NFI #2 (5.7.1) – Tree number and DBH NFI #1 or previous FMP inventory (5.7.2) – Identification of trees to be measures (5.7.3) – Status of the tree on re-measures plots, trees living at NFI #1 (5.7.4) – Azimuth (5.7.5) – Distance (Fehler! Verweisquelle konnte nicht gefunden werden.) – Tree status (5.7.7) – Tree species identification (5.7.8) – DBH of single trees (5.7.9) – Layers, Vertical structure of the stand (5.7.10) – Damage of the tree (5.7.11) – Tree Kraft Class (5.7.12) – Tree height (5.7.13) – Age core length (5.7.14) – Age (5.7.15) – Increment cores 10 years length (5.7.16) – Age and increment measurement quality (5.7.17) – Marketability – stem quality class (5.7.18) – Length of the marketable stem (5.7.19) – Burls (5.7.20) – Decay Class (5.7.21) 	<ul style="list-style-type: none"> – Azimuth (5.7.5) – Distance (Fehler! Verweisquelle konnte nicht gefunden werden.) – Type of stump (5.8.2) – Stump diameter (5.8.3) – Stump height (5.8.4) – Stump age (5.8.5) – Stump markation (5.8.6) – Stump decay class (5.8.7) 	<ul style="list-style-type: none"> – Down Dead-Wood Diameter (5.9.1) – Down Dead-Wood Length (5.9.2) – Down Dead-Wood Decay Class (5.9.3)

The attributes assessed for trees, stumps and down dead wood will enable the calculation of both wood volumes and biomass.

5 ASSESSMENT OF VARIABLES

5.1 Tract variables

5.1.1 Tract ID

Description:	Each tract has its own pre-defined unique code, which is used for its identification.
Observation area	Tract

5.1.2 Tract type

Description	Type of tract in relation to NFI#1	
Code list	Code	Class
	1	NFI#1 tract
	2	Newly established tract integrating an FMP plot
	3	Entirely new tract
Observation area	Tract	

5.1.3 Field Team Leader

Description	Full name of the field team leader who is conducting fieldwork on this tract is indicated.
Observation area	Tract

5.1.4 Recording of the navigation to the tract

Description	Field teams must have the navigation device (GPS) always switched on. As soon as the field team starts walking from the point, where they leave the car or camp, GPS coordinates are recorded as “way-points”. While walking “tracking modus” is used.
Unit/accuracy	x / y coordinates
Observation area	Tract

Description	Every time when GPS coordinates (waypoints) are recorded, the GPS error has to be recorded as well.
Unit/accuracy	meter
Observation area	tract; sample plot

5.1.5 Tract Start Time

Description	The starting time and date are recorded when the team starts walking from the road / camp to the tract to define the total time spent on fieldwork.
Unit / accuracy	HH-MM / 1 minute
Date format	DD-MM-YY

Observation area	Tract
------------------	-------

5.1.6 Tract end time

Description	The end time and date are recorded when the team finishes field-work and returns to the car at the road or camp.
Unit / accuracy	HH-MM / 1 minute
Date format	DD-MM-YY
Observation area	Tract

5.1.7 Tract comment

Description	<p>Here you can comment if there are any specific notes about the tract, such as location, placement, access, topography, etc.</p> <p>Please further note here and explain if and why more than one day was needed to finish the tract.</p>
-------------	---

5.2 Basic sample plot variables

5.2.1 Sample Plot ID

Description	Pre-defined code of the sample plot, which is used for its identification, is recorded.
Observation area	Sample plot

5.2.2 Plot type

Description	Type of plot in relation to NFI#1 and FMP	
Code list	Code	Class
	1	NFI#1 plot
	2	FMP plot
	3	Newly established plot
Observation area	Sample plot	

5.2.3 GPS target coordinates

Description	Target coordinates (X / Y)
Comment	Provided ahead of field work
Unit accuracy	X / Y coordinates
Observation area	Sample plot

5.2.4 GPS Coordinates of the Sample Plot Center

Description	Coordinates (X / Y) are recorded by GPS in the center of the sample plot along with the GPS error.
Unit / accuracy	X / Y coordinates
Observation area	Sample plot

5.2.5 Reference points establishment

Description	Three reference objects that are located outside of the plot are identified. They are selected and recorded in clockwise direction in adequate distribution. Those could be, for example, rocks or remarkable trees. The azimuth and distance to the plot center is measured, marked with colour and recorded and an image of the reference
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	point is taken. Further the reference point is characterized in a text field.
Unit / accuracy	Azimuth: degree, one degree; Distance: m/cm
Observation area	Sample plot

5.2.6 Plot pre-clarification result

Description	Clarifies if a plots needs to be visited based on the pre-clarification	
Code list	Code	Class
	1	Field plot – Forest or other wooded land & accessible
	2	Field plot – Mostly forest or other wooded land & accessible
	3	Not a field plot - Forest or other wooded land & not accessible
	4	Not a field plot - Mostly forest or other wooded & not accessible
	5	Not a field plot - – Clearly non-forest
	This is not a field attribute it is based on the pre-clarification and provided ahead of field work	
Observation area	Sample plot	

5.2.7 Accessibility of the sample plot

Description	Accessibility of a sample plot assessed in the field; if it can be reached without risk for the health of the field teams even if the pre-clarification has predicted accessibility.	
Code list	Code	Class
	1	Yes - the sample plot is accessible
	2	No - due to legal restrictions - the sample plot is not accessible due to legal restrictions (e.g. military area)
	3	No - due to natural restriction - the sample plot is not accessible due to natural restrictions
	Remark: Eventually several routes have to be tried.	
Observation area	Sample plot	

5.2.8 Re-finding of NFI#1 or FMP plot

Description	In case of re-measurement of NFI#1 or FMP plot it is recorded if a plot center was re-found (metal stake found)	
Code list	Code	Class

	1	Plot center was re-found
	2	Plot center not re-found
	3	Plot is not a NFI#1 or FMP plot
	Only on re-found plots trees from previous inventory need to be identified,	
Observation area	Sample plot	

5.2.9 Administrative units

5.2.9.1 Oblast

Description	The ID and name of the oblast is given in which the sample plot center is located
Origin	GIS
Comment	An adjustment check is made in the field

5.2.9.2 Rayon

Definition	The ID and name of the rayon is given in which the sample plot center is located
Origin	GIS
Comment	An adjustment check is made in the field

5.2.9.3 State forest enterprise (Leskhoz)

Definition	The ID and name of the leskhoz is given in which the sample plot center is located
Origin	GIS
Comment	An adjustment check is made in the field

5.2.10 Other GIS attributes

5.2.10.1 Nature protection category

Description	Specifies the protection category.	
Code list	Code	Class
	1	State Nature Reserves (IUCN Category I);
	2	State Nature Parks (IUCN Category II)
	3	State Natural Monuments (IUCN Category III);

	4	State nature habitat/species management areas/ Sanctuaries, Zakaznik (IUCN Category IV);
	5	State Botanical gardens, Dendrological and Zoological parks
	6	Biosphere Territories
Origin	GIS	
Observation area	An adjustment check is made in the field.	

5.2.10.2 Forest growth regions

Definition	The ID and name of the forest growth region is given in which the sample plot centre is located. See Forest typology in the Kyrgyz Republic (Grisa et al.2008).
Origin	GIS
Observation area	Not a field attribute.

5.2.11 Start Time of Measurements on the Sample Plot

Description	Time recording starts when the sample plot is accessed and fieldwork starts.
Unit/ accuracy	HH-MM / one minute
Observation area	Sample plot

5.2.12 Standard photographs of sample-plot

Description	One picture is taken from the south looking north, through the center point of the sample plot from ca. 20 meter distance and one picture from 5 meter distance. If visibly of the center plot from 20 meter is not given a closer location is checked for visibility, first 15m, then 10m, then 7m.
Observation area	Sample plot

5.2.13 Forest and other wooded land

Description	Specifies, if a plot visited in the field is forest or other wooded land	
Code list	Code	Class
	1	Forest
	2	Other wooded land (mainly shrubs)

	3	Other land
Observation area	Sample plot center & stand characteristics circle	

The Forest and other wooded land definition is given in the Annex 6.2.

In case in the field it is observed that there is no forest or other wooded land, the land cover/land use needs to be explained in a **text field**.

5.2.14 Coverage with trees and shrubs

Description	Clarifies if a plot classified as forest or other wooded land will be subject to stand characteristics, tree and shrub measurement.	
Code list	Code	Class
	1	Forest/ Other wooded land covered with trees, shrubs, regeneration of trees and shrubs
	2	Temporarily un-stocked area (expected to be covered with trees/shrubs within short time, e.g. after harvesting or fire)
	3	Forest road or other type of forest infrastructure (e.g. nursery).
	In case of codes 2 the entire 12m plot is relevant. Code 3 is assigned if the plot center is located on a forest road (main forest road, > 4m in width). In this case a borderline measurement has to be made if not all of the plot is covered by the forest road.	
Observation area	Sample plot center & stand characteristics circle	

5.2.15 Plot cut by a forest border line

Description	In case the area of the sample plot (circle with 12 radius) is not fully positioned in the forest or other wooded land, or cut by a forest road (main forest road, > 4m in width), or if part is inaccessible, but the center is then a borderline is measured in.	
Code list	Code	Class
	1	Yes
	2	no
Observation area	Circle with 12 radius.	

5.2.16 Border line measurement

A borderline is assessed if one of the following border types occur:

1. Forest road (main forest road, > 4m in width) or other type of forest infrastructure
2. Non-forest (see Figure 4)

3. Inaccessible forest area (e.g. steep rocks)

The azimuth and distance of each borderline (two in maximum) have to be measured from the centre of the plot.

To assess the borderline minimum two, maximum three points are measured in clockwise direction. Two points are used in case the border is a straight line, three points to consider for a clear bend.

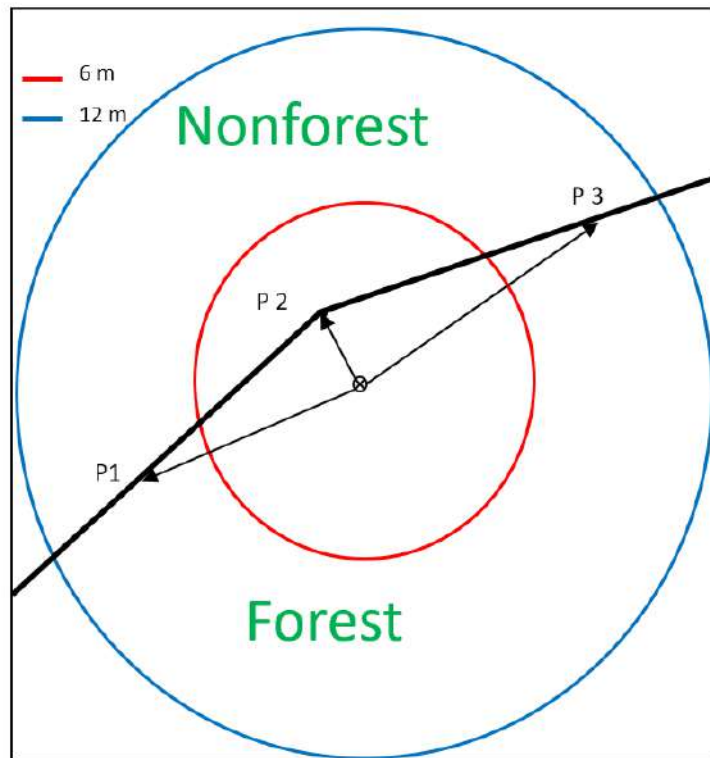


Figure 4 Borderline assessment

Visualized is an example of a forest – nonforest border.

5.2.17 Altitude above sea level

Description	The altitude of a sample plot is its height (z-) coordinate.
Origin	GIS
Unit/accuracy	meters, cm
Observation area	Not a field attribute.

5.2.18 Slope incline

Description	The slope incline is the inclination of the slope within the sample plot area measured in percent (%).
Unit / accuracy	Percent, 1
Observation area	Within 12 m radius of the sample plot.

5.2.19 Exposition

Description	The exposition is the direction of the line of greatest slope decrease.
Units / accuracy	Degrees, 1
Observation area	Within 12 m radius of the sample plot.

5.2.20 Terrain relief

Description	The terrain relief describes the shape of the earth's surface and is determined on the whole stand area around the sample plot.	
Code list	Code	Class
	1	mountainous
	2	level/flat
Observation area	Stand characteristics circle.	

5.2.21 Micro relief, terrain shape

Description	The sample plot micro relief is the relief of the stand characteristic circle	
Code list	Code	Class
	1	flat (inclination less or equal to 10 %)
	2	upper part of slope
	3	middle part of slope
	4	lower part of slope
Remark	The sample plot micro relief is a slope if the stand characteristic circle has a maximum inclination of more than 10 %.	
Observation area	Stand characteristics circle.	

5.2.22 Traces of erosion

Description	Traces of erosion are visible signs of the erosion process.	
Code list	Code	Class
	1	yes (visible signs of erosion exist)
	2	no (erosion can not be observed)
Observation area	Stand characteristics circle.	

5.3 Stand attributes

5.3.1 Growth location

Definition	The growth location is the general location of a stand. The information gives hints about the growth conditions.	
Code list	Code	Class
	1	Mountain
	2	Valley/lowland
	3	Stream-side
Observation area	Stand characteristics circle	

5.3.2 Conifer, broadleaved mixture

Description	The conifer, broadleaved mixture of a forest stand.	
Code list	Code	Class
	1 conifer	70 and more
	2 mixed	eye-determined
	3 broadleaf	70% and more
Observation area	Stand characteristics circle	

5.3.3 Origin

Description	The origin indicates the nature of the prevailing species in the stand.	
Code list	Code	Class
	1	natural (> 80 % of trees developed out of natural regeneration of forest tree species)
	2	mixed (20 – 80 % of trees developed out of natural regeneration)
	3	artificial (< 20 % of trees developed out of natural regeneration)
Observation Area	Stand characteristics circle	

5.3.4 Forest type group / Forest formations

Description	The forest type group is based on the forest typology defined in the forest typology and corresponds to the forest formation of forest ecological system the forest types are grouped in the forest typology in the Kyrgyz Republic (Grisa et al.2008).	
Code list	Code	Class
	1	Walnut forests
	2	Pistachio and almond sparse forests
	3	Apple forests
	4	Maple forests
	5	Hawthorn forests
	6	Juniper forests
	7	Spruce forests
	8	Fir forests
	9	Riverside and river-bed forests
	10	Shrub forests
	11	Other
Observation area	Stand characteristics circle	

5.3.5 Crown coverage with trees and shrubs

Description	Percentage of the stand area that is covered by the crowns of trees and shrub. This attributes is also linked to the land cover assessment.
Code list	The crown coverage is estimated in 10% classes (0, 10, ..., 90, 100).
Observation area	Stand characteristics circle

5.3.6 Crown coverage with trees

Description	Percentage of the stand area that is covered by the crowns of trees. This attributes is also linked to the land cover assessment.
Code list	The crown coverage is estimated in 10% classes (0, 10, ..., 90, 100)
Observation area	Stand characteristics circle

5.3.7 Two dominating tree species

Description	Two dominating <u>tree</u> species of the stand are identified (considering the relative crown coverage <u>of trees and shrub cover</u>). This will allow any grouping by dominating species in the analysis stage. This attributes is also linked to the land cover assessment. Minimum one species is recorded, maximum 2 (covering >= 10 % crown coverage of trees)
Code list	See tree and shrub species list in the annex
Percentage	Percentage, 10 %
Observation Area	Stand characteristics circle

5.3.8 Forest Typology

Depending on the selection of the forest type group, the forest type defined in the forest typology (Grisa et al.2008) is identified.

Table 3 Types of walnut forests

11	Walnut forest with false brome grass
12	Walnut forest with additional moistening
13	Walnut forest with spruce and fir species
14	Walnut forest with hawthorn species
15	Walnut forest with maple and apple species

Table 4 Types of pistachio and walnut forests

21	Pistachio forest with high grasses and cereals
22	Pistachio forest with absinth and cereals
23	Pistachio forest on eroded slopes
24	Almond forest with high grasses and cereals
25	Almond forest on rocky slopes

Table 5 Types of apple forests

31	Apple forest with hawthorn species
32	Apple forest with maple species
33	Apple forest of park-like nature

Table 6 Types of maple forests

41	Maple forest with walnut species
42	Maple forest with apple species

43	Maple forest on watershed areas and steep slopes
44	Maple forest on talus

Table 7 Types of hawthorn forests (Crataegus)

51	Hawthorn forest on fertile soils
52	Hawthorn forest with apple species
53	Hawthorn forest with pistachio species
54	Hawthorn forest with hackberry on talus
55	Hawthorn forest on dry habitats

Table 8 Types of juniper forests

61	Juniper forest of elfin-wood form
62	Juniper forest, moistened with high grasses
63	Juniper forest, dry with low-stem grasses
64	Juniper forest of river-bed valleys
65	Juniper forest (open) with shrubs
66	Juniper forest on rock debris
67	Juniper forest on rocks

Table 9 Types of spruce forest

71	Spruce forest with high-stem grasses
72	Spruce forest of high mountains
73	Spruce forest with mosses
74	Spruce forest with rowan species
75	Spruce forest with low-stem grasses
76	Spruce forest of riverbed valleys
77	Spruce forest (open) with shrubs
78	Spruce forest of juniper species
79	Spruce forest on rocks

Table 10 Types of fir forests

81	Fir forest with additional moistening
82	Fir forest with motley grass and mosses
83	Fir forest with spruce and broad-leaved species
84	Fir forest with spruce and shrubs
85	Fir forest with spruce of riverbed valleys
86	Fir forest on rocks

Table 11 Types of riverside and riverbed forests

91	Sea-buckthorn forest with motley grass
92	Willow forest with motley grass
93	Poplar forest
94	Elaeagnus forest with shrubs
95	Birch forest on springs
96	Mixed tree riverside forest and riverbed forests
97	Mixed shrub riverside and riverbed forests

Table 12 Types of shrub forests

101	Spirea+ephedra+cherry shrubs
102	Honeysuckle+contoneaster+spirea shrubs
103	Rose shrubs
104	Exochorda shrubs
105	Barberry shrubs
106	Raspberry shrubs
107	Aflatunia shrubs
108	Caragana shrubs

Table 13 Other

111	Poplar plantations
112	Other conifer
113	Other broadleaved
114	Other mixed (31 – 69 % conifers)

5.3.9 Development stage

Description	The development stage characterizes the diameter development and structure.	
Code list	Code	Class
	<i>Simple structured stands:</i> The development stage is given according to the average diameter (d_{100}) of the 100 thickest trees of the stand, estimated on the 25 m plot	
	1	$d_{100} \leq 8$ cm
	2	$8 \text{ cm} < d_{100} \leq 20$ cm
	3	$20 \text{ cm} < d_{100} \leq 35$ cm
	4	$35 \text{ cm} < d_{100} \leq 50$ cm

	5	$d_{100} > 51$ cm
	<i>Complex structured stands:</i>	
	6	Forest with complex structure and diameter distribution
	7	Shrub forest (as 5.3.4 Forest type group / Forest formations)
Observation area	Stand characteristics circle (25 m)	

5.3.10 Age assessment method

Age is assessed in *all simple structured* stands and forest with complex structure as assessment of the age of the trees with average diameter (*see attribute development stage*). It is not assessed in the forest formation "shrub forest".

GRAPH

In case of re-measurement of plots of the forest management inventories the age information from the last forest management inventory will be utilized, considering the number of years that passed since this measurement was taken. If this age is not plausible and if no age from FMP is available other methods are used: whorl counting and tree ring counting on stumps, or tree cores. The method used has to be recorded.

Field teams use whorl counting for young conifer and poplar stands, stump method is use when fresh stumps are available. In the remaining cases bore cores are taken.

Description	Age assessment method.	
Code list	Code	Class
	1	Updated age from previous FMP inventory
	2	Whorl counting or stump tree ring counting
	3	Bore cores
Unit / Accuracy	Age in years.	
Observation Area	Stand characteristics circle	

5.3.11 Age

Definition	Age
Origin	FMP inventory: GIS; Stump or whirl counting: at the plot
Unit / Accuracy	Year/ year

Age is only handed in, if it is not assessed with method (3) bore cores (see 5.3.10)

Based on the FMP measurements, per plot the age is assigned as the average of the two dominating species to inform the teams to enable a plausibility check (see attribute above).

In case of whorl counting and stumps the estimated average age is entered.

In case bore cores are taken, the age is entered as a tree attribute in the tree section only.

5.3.12 Walnut portion

Description	In forests where walnuts occur, the percentage of walnut trees is specified.	
Code list	Code	Class
	1	61 – 100 % of walnut trees
	2	21 – 60 % of walnut trees
	3	> 0 – 20 % of walnut tress
	4	0%
Observation area	Stand characteristics circle	

5.3.13 Layer structure

Description	The structure is the vertical layering of a forest stand on the area of the stand characteristics circle. Undergrowth is not considered as a layer.	
Code list	Code	Class
	1	One layer (see figure below).
	2	Two layers (the second layer is of young forest trees, planted under (see figure below).
	3	Multi-layered (more than two layers of tree; see figure below, picture 4 to 6).
Observation area	Stand characteristics circle	

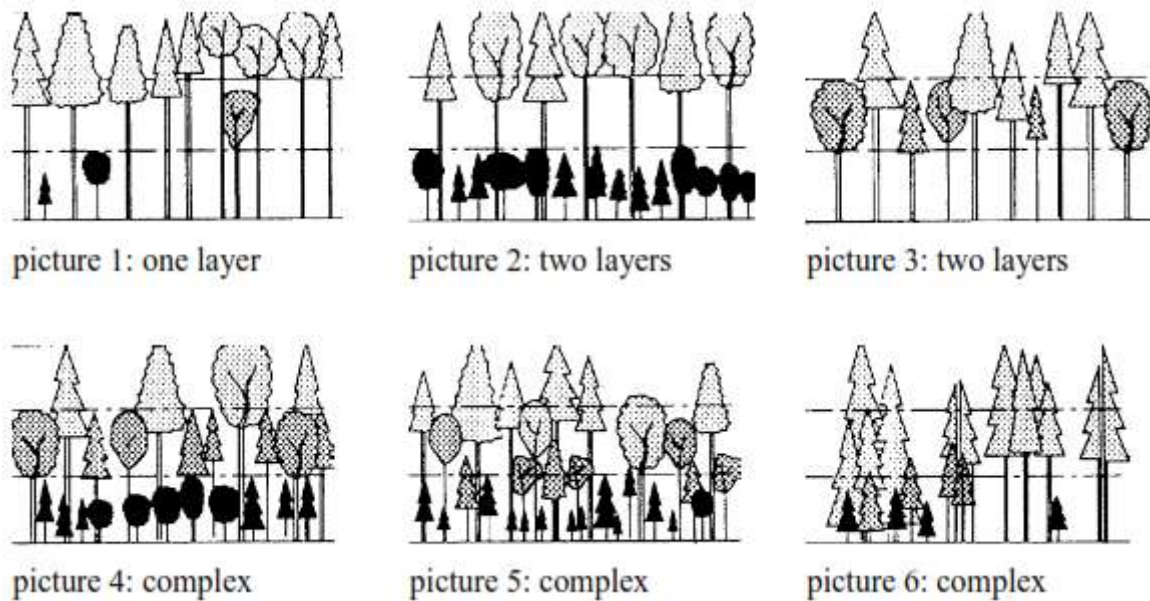


Figure 5 Examples for the structure definitions one layer (picture 1), two layers (picture 2 and 3) and complex (pictures 3, 4 and 5).

5.3.14 Undergrowth

Definition	The undergrowth density is estimated as percent (%) of the crown cover area of undergrowth species (Coverage of small trees and shrubs under the canopy, not part of a stand layer).	
Code list	Code	Class
	1	Absent
	2	Thin (up to 33 % of the area is covered by undergrowth species)
	3	Middle (34 to 66 % of the area is covered by undergrowth species)
	4	Thick (67 % and more of the area is covered by undergrowth species)
Observation area	Stand characteristics circle	

5.3.15 Disturbance/Forces on the forest stand

Definition	In order to estimate the vitality of the forest forces or pressures that exert pressure or influence on the stand are determined. One or several of the following options have to be selected together with the degree of severity.		
Cause	Detailed description		
Code list	Code	Class	Levels of severity
Natural human- induced	1	Snow (snow pressure on trees and branches)	0 not existent 1 weak 2 middle 3 strong

	2	Wind (wind pressure or treetops)	0 not existent 1 weak 2 middle 3 strong
	3	Landslide (signs of movement of ground masses slope downwards)	0 not existent 1 weak 2 middle 3 strong
	4	Rockfall (signs of movement of stones of all sizes slope downwards)	0 not existent 1 weak 2 middle 3 strong
	5	Avalanches (signs of movement of snow slope towards)	0 not existent 1 weak 2 middle 3 strong
	6	Fire (danger of natural or human caused fires)	0 not existent 1 weak 2 middle 3 strong
	7	Wild animals (influence of animals other than domestic)	0 not existent 1 weak 2 middle 3 strong
	8	Other	0 not existent 1 weak 2 middle 3 strong
	9	Antropogenic (harvesting, grazing, other)	0 not existent 1 weak 2 middle 3 strong
Observation area	Stand characteristics circle		

5.3.16 Resistance of the forest stand

Description	In order to estimate the vitality of a stand, its resistance to the above-described influencing forces or pressures are determined.			
Code list	Code	Class	Level of severity	Explanations
	1	Species (are the species of the stand themselves adapted to possible pressure?)	1 weak 2 middle 3 strong	See Annex.
	2	Height-diameter ratio (indicates the mechanical resistance of a tree stem to wind and snow pressure)	1 weak 2 middle 3 strong	
	3	Crown length (the longer the better)	1 weak 2 middle 3 strong	
	4	Crown shape (is the crown symmetric or with deformations?)	1 weak 2 middle 3 strong	
	5	Vertical axis (is the tree standing upright, are stem deformations indicating landslide?)	1 weak 2 middle 3 strong	
	6	Roots (does the ground allow strong root systems, do the tree species built strong and deep roots in this specific ground?)	1 weak 2 middle 3 strong	
	7	Height (indicates the development status of the tree stand)	1 weak 2 middle 3 strong	
	8	Gaps (in the stand, formed by fallen trees may be a sign on instability!)	1 weak 2 middle 3 strong	
	9	Structure of the stand (complex structure is considered to have highest resistance)	1 weak 2 middle 3 strong	
10	Sanitary status of the stand (not assessed in the field: Combined from 5.3.15 Disturbances + N trees with damages (5.7.11))	1 weak 2 middle 3 strong		
Observation area	Stand characteristics circle			

5.3.17 Ground cover type & ground cover percentage

Description	To assess the ground cover <u>for each</u> of the following classes the coverage in % is assessed in 10% classes within the 6-m radius plot	
Code list	Class Code List	Class
	1	Litter
	2	Stones

	3	Rocks
	4	Vegetation of grass, herbs and fern
	5	Moss
	6	Water (ponds; creeks)
	7	Bare soil
Observation area	Sample plot of 6 m radius	

Description	Coverage percentage code list	
Code List:	Code	Class
	1	10%
	2	20%
	3	30%
	4	40%
	5	50%
	6	60%
	7	70%
	8	80%
	9	90%
	10	100%
Units / Accuracy	Percent / 10%; summing up to 100% over all classes.	
Observation area	Sample plot of 6 m radius	

5.3.18 Litter depth

Description	<p>The litter depth is measured in the centre of each of the 4 established regeneration plots with the ruler after preparing a split with the spade.</p> <p>The depth values are averaged and entered.</p> <p>For the analysis, data will be grouped to classes, since an assessment with cm accuracy is not possible, but easier for the entry.</p>
Unit / Accuracy	cm/1 cm
Observation area	Sample plot of 6 m radius

5.3.19 Grazing

Description	Grazing is any damage caused to plants by animals.
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	<i>Specification:</i> signs of grazing like paths, traces, excrements, damaged trees, grazed grass, etc.	
Code list	Code	Class
	1	yes (there are signs of grazing)
	2	no (there are no visible signs of grazing on the referring area)
Observation area	Stand characteristics circle	

5.4 Shrub attributes

5.4.1 Coverage with shrubs

Description	Percentage of the stand area that is covered by shrubs. This includes both shrubs that form the main layer (e.g. in case shrub forests) and shrubs that occur under the tree canopy.
Observation area	Sample plot of 12 m radius
Code list	The coverage is estimated in 10% classes (0, 10, ..., 90, 100)

5.4.2 Single shrub species

Description	Shrub species that's absolute area coverage exceeds 10% are recorded
Assessment	Identification of the shrub species from the species list.
Observation area	Sample plot of 12 m radius

5.4.3 Single shrub species coverage

Description	Coverage of a single shrub species in % of the absolute area.
Unit /Accuracy	Coverage percent / 10% classes
Observation area	Sample plot of 12 m radius

5.4.4 Height of shrub species

Description	The average height of the recorded shrub species is the estimated.
Unit/ Accuracy	m/ half meters
Observation area	Sample plot of 12 m radius

5.5 Regeneration

The regeneration is measured on 4 circular plots, with radius of 2 m. The 4 plots are located in 6m distance and plot (1) at 0° azimuth plot (2) at 90° azimuth plot (3) at 180° azimuth and plot 4 at plot (4) at 270° azimuth from the plot center.

In case one of the 4 plot is located fully or partly outside of the plot due to borderline it is not measured and it is recorded that it could not be measured.

In forest types “Shrub forest”, “Fir forest” and “Spruce forests” only plot (1) in the north is established. Even in “Shrub forest” regeneration assessment means that only tree species are assessed.

In case this plot in the north is located fully or partly outside of the plot due to borderline it is not measured and it is recorded that it could not be measured the plot is established in East, South or West in 6 meter distance, checking in this order where the establishment of a full regeneration circle is possible..

Only tree species are included in the basic regeneration assessment.

5.5.1 Regeneration assessment

Definition	Records if the circle could be measured.	
Code list	Code	Class
	1	Measured
	2	Not measured, since partly or entirely located outside due to borderline of the plot.
Observation area	Regeneration sample plot 1,2,3,4	

5.5.2 Nature of the young forest

Definition	The nature status of the young forest trees for the entire circle is given.	
Code list	Code	Class
	1	Natural regeneration
	2	Artificial regeneration (plantation)
	3	Natural and artificial regeneration (there is natural regeneration together with artificial regeneration)
Observation area	Regeneration sample plot 1,2,3,4	

5.5.3 Young forest species counting

Description	<p>The young forest trees are divided into 4 classes depending on height and diameter. Assessed are origin and vitality of the young forest plants.</p> <p>Radius and height classes are identified using the marked wooden stick with the mark at 0.1 m, 0.5m and 1.3m the radius using the logger tape.</p> <p>The code number of the young forest species is given according to the species list and trees of the same height class <u>are counted and recorded</u></p>
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	-by height class -by origin -by vitality as defined below (up to 4 by 2 by 2 =16 classes) per species.	
Code list	Code	Height class
	1	0.10 to 0.49 m
	2	0.50 to 1.29 m
	3	1.30 m and higher DBH up to 4.9 cm
	4	1.30 m and higher DBH 5 cm to 7.9 cm
	Origin - seed: the plant origins from seed - vegetative: the plant is of vegetative origin Vitality - s: strong plant - w: weak plant	
Observation area	Regeneration sample plot 1,2,3,4	

5.6 General considerations on tree and stump measurement

All trees, living or dead trees and stumps are measured in with azimuth and distance. Living and dead trees and stumps are sequentially numbered. Measurement and numbering starts in the north in clockwise direction.

In case a plot is a re-measured the tree numbers from the previous inventory are maintained and new trees receive a new NFI#2 number.

5.7 Tree measurements

5.7.1 Tree number

Description	<p>The tree number is the executive number for each tree on the sample plot.</p> <p><i>Specification:</i> The number goes from 1 to the total number of measured trees on the sample plot</p> <p>A shrub that exceeds the necessary minimum diameter for trees is measure as well and recorded as a tree and is referred to with the term tree in this entire chapter. .</p>
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Observation area	Sample plot of 12 m radius
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5.7.2 Tree number and other attributes of previous NFI#1 or FMP inventory

Description	Tree number from trees to be re-measured from previous inventory.
Observation area	Sample plot of 12 m radius

Besides the tree number of the previous inventory the species, the DBH, the azimuth and distance of living trees of the former inventory is provided.

5.7.3 Identification of trees to be measured

The sample plot consists of two concentric circles. The large outer circle has a horizontal radius of 12m. The small inner circle has a horizontal radius of 6 m.

In the inner circle all trees with dbh \geq 8 cm are assessed.

In the outer circle all trees with a dbh $15 \geq$ cm are assessed.

5.7.4 Status of the tree on re-measured plots, trees living at NFI#1

Description	On re-measured plots the status of the tree, comparing the current and the NFI#1 or FMP-status has to be recorded.		
Code list	Code	Class	Explanation
	1	Living and re-measured	Tree measured at NFI 1/FMP was identified and re-measured
	2	Tree cut and stump measured	Tree measured at NFI 1/FMP was identified and harvested. Stump measured.
	3	Tree dead and re-measured	Tree measured at NFI 1/FMP was identified and measured as dead tree.
	4	In-growth or on-growth tree	Tree to be measured that was not measured at NFI 1/FMP due to too low diameter at NFI 1. In-growth: trees that have DBH \geq 8cm in NFI#2 but not yet in the previous inventory On-growth: trees with DBH \geq 15 cm in NFI#2 that have not been measured in the previous inventory
	5	Tree missed to be recorded in previous inventory	Tree to be measured that was not measured at NFI#1/FMP, diameter too large that ingrowth is possible.

	6	Tree recorded in previous inventory but not to be included in the sample	Tree located outside the 6m / 12 m circles according to its current diameter.
	7	Former forked tree (two stems), now one stem tree, former stem not re-measured	Tree data sets from previous tree will not be continued.
	8	New tree, former forked tree (two stems), now one stem tree	Tree replacing two former forked trees.
Observation area	Sample plot of 12 m radius		

5.7.5 Azimuth

Description	The azimuth is the angle measured from the sample plot center to a tree referred to geographic north. The magnetic inclination is considered by the measurement instrument. <i>The mid of tree/stump at ground level defines the place where the tree is located and the azimuth is measured to.</i>
Unit/Accuracy	Degree / 1°
Observation area	Sample plot of 12 m radius

5.7.6 Distance

Description	The horizontal distance of a tree/stump from the plot center is measured. <i>The mid of tree/stump at ground level defines the place where the tree is located and the distance is measured to.</i>
Unit / accuracy	m / decimal
Observation area	Sample plot of 12 m radius

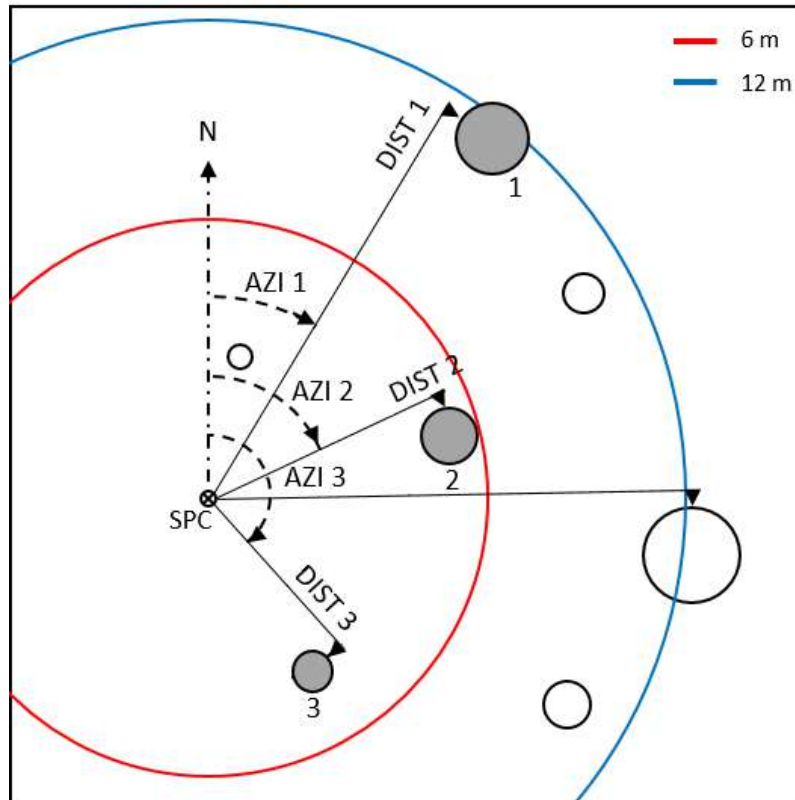


Figure 6 Measurement of the distance between the sample plot center (SPC) and a tree. Filled circles indicate trees that are in and unfilled indicate trees that are out due to their diameter or distance.

5.7.7 Tree status

Description	Every tree is assigned to a relevant class: The tree class influences the variables measured for each tree.	
Code list	Code	Class
	1	Standing tree, living
	2	Standing dead tree
Observation area	Sample plot of 12 m radius	

5.7.8 Tree species identification

Description	Identification of the tree species.
	Dead trees: In case of dead trees where the species cannot be identified due the classes other conifers or other broadleaved will be assigned.
Unit/Accuracy	Selection from a drop-down list/ list in the annex.
Observation area	Full sample plot.

5.7.9 DBH of single trees

Description	<p>The DBH is the diameter of a tree stem measured at breast height (1.3 m)</p> <ul style="list-style-type: none"> ▪ Measuring exactly at height of 1.3 m is highly important; a stick with a mark at 1.3 meter height should be used. ▪ The measurement height is marked with the pruning saw to enable an exact re-measurement at NFI #3. ▪ Regularly the diameter is measured by the diameter tape. ▪ The diameter is measured with a caliper or a tape can not be used due to branches, e.g. in case of large part of juniper trees ▪ The caliper is held perpendicular to the stem axis with the axis of the caliper pointing towards the sample plot center and is measured against the clockwise direction. ▪ The measurement is entered in cm/mm (e.g. 25.5) <p>In case the tree has abnormal shape at the usual measurement height of 1.3 m, the diameter is measured above or below the deformation. Only if the stem form does not allow for this procedure, the field worker shall indicate an approximate value which is assumed to be representative for a similar tree with normal shape.</p> <p>See annex for the instructions of DBH measurement, specifically the definition of the tree base to identify the measurement height has to be carefully regarded.</p>	
DBH classes according to sub-plots	6 m circle	DBH > 8 cm
	12 m circle	DBH of >15cm
Unit / accuracy	Cm / mm	
Observation area	Full sample plot, living trees, dead trees.	

5.7.10 Layers, Vertical structure of the stand

Description	<p>The stand is vertically divided into three layers of equal height. A tree is part of that layer, in which the top part its crown is located. (See Figure below).</p>	
Code list	Code	Class
	1	Upper layer (tree height more than 2/3 of the stand height)
	2	Middle layer (tree height between 1/3 and 2/3 of the stand height)
	3	Lower layer (tree height less than 1/3 of the stand height)

Observation area	Full sample plot, living trees.
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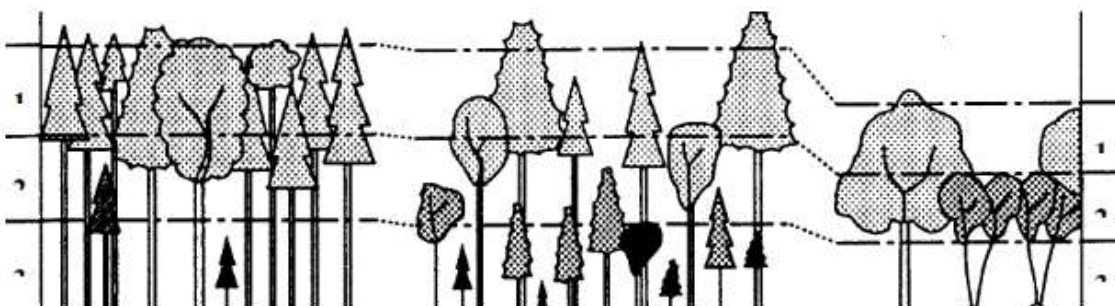


Figure 7 Upper (1), middle (2) and under layer (3) in a forest stand.

5.7.11 Damage of the tree

Description	Tree damage is assessed visually according to classes. In addition, the severity of damage is assessed. Several damage classes can occur on one tree. Multiple choice of damages is possible.	
Code list	Code	Class
	1	Damage through logging and/or skidding activities
	2	Fire damage
	3	Snow damage
	4	Strom damage
	5	Pests / disease
	6	Broken stem
	7	Broken top
	8	Uprooted tree
	9	Other anthropogenic damage
10	Other natural damage	
Observation area	Sample plot of 12 m radius. Living trees.	

5.7.12 Tree Kraft Class

Description	The tree social class is specified according to the definition of KRAFT in the classes 1 (highest dominating tree) to 5 (small trees under the pressure of the other trees) as shown in the figure below.	
Code list	Code	Class
	1	Pre-Dominant
	2	Dominant
	3	Co-dominant
	4	Suppressed
	5	Understory trees
Observation area	Full sample plot, living tree only.	

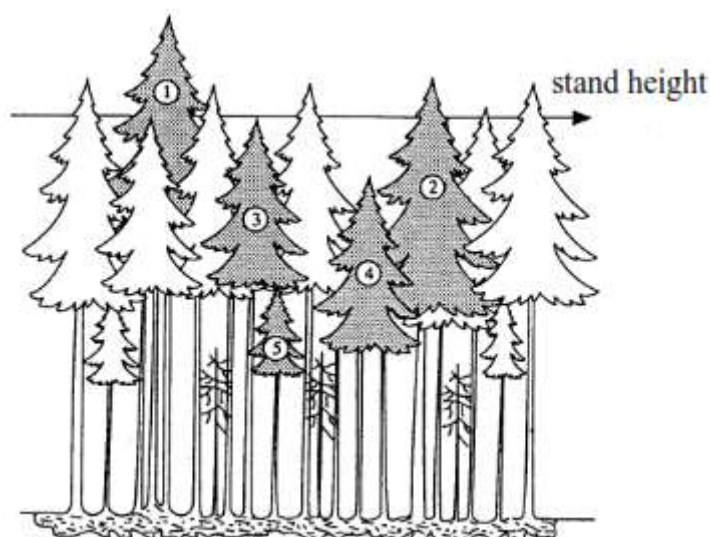


Figure 8 Example of the five tree classes according to KRAFT

5.7.13 Tree height

Description	<p>The total tree height is the distance between the stem foot and the highest point of the tree.</p> <p>The tree height is measured for selected trees on the plot. For the remaining trees height will be determined on height functions based on the measured trees.</p> <p>Selection criteria:</p>
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	<ul style="list-style-type: none"> ▪ Ca. 50% of the trees of each species in every layer is measured, to be selected over the entire diameter range of the species in the layer (if 50% of the trees of a species in a specific layer exceeds 6 trees, only 6 trees are measured). ▪ No leaning trees, only healthy trees with no broken top are measured. <p>In addition the height of trees with broken stems is measured to consider the individually reduced volume (living and dead trees).</p>
Unit/Accuracy	m / with decimal accuracy
Observation area	Full sample plot, living trees, broken dead trees.

For the height measurement the following has to be considered:

- Measuring from an adequate distance: The distance from the tree should be equivalent to the height of the tree.
- Observation of actual tree top; to be carefully identified in case of broad leave trees.
- Observation of the base of a tree (equivalent to the base point used for the identification of the DBH (see illustrations on the DBH measurement in the appendix).

The height measurement is done by the vertex instrument.

5.7.14 Age core length

Description	<p>In the case when age cores are taken (defined in the age assessment method attribute) the length of the core needs to be measured and recorded.</p> <p>Selection: One age core of the mean trees of two dominating species (max two species) is taken (max two cores).</p> <p>Suitable for selection are healthy trees, with no stem brake, no crown brake, no stem damages and no stem deformation at breast height.</p>
Unit/Accuracy	cm/cm
Observation area	Full sample plot, living trees.

5.7.15 Age

Description	In the case when age cores are taken (defined in the age assessment method attribute) the length of the core needs to be measured.
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	The number of tree rings at DBH 1.3 m is counted on the core and entered as counted into the field computer software. Further calculations to estimate the age are part of the analysis done by the software.
Unit/Accuracy	cm/cm
Observation area	Full sample plot, living trees.

5.7.16 Increment cores 10 years length

Increment is measured on selected trees only. Increment is measured on the following trees

- For the two dominating species a mean diameter tree is selected for increment measurement (unless trees are already selected for age). In this case the age core of these trees is taken for increment assessment as well.
- Three additional tree cores are taken (four in case there is only one dominating species) by random selection (to cover over a series of plots all species and social classes): The maximum tree/stump ID is divided by the number of trees that need to be measured and the tree with this number (or tree with the closest lower number that is suitable for selection) is selected for core drilling.

Suitable for selection are healthy trees, with no stem brake, no crown brake, no stem damages and no stem deformation at breast height.

Description	<p>The increment is the growth in diameter of a tree at breast height in a 10 years time.</p> <p>To measure the increment a bore core is taken from the selected trees.</p> <p>The core is taken on the side of the tree towards the plot center at the DBH measurement height.</p> <p>The increment of 10 rings is taken and their length, measured in millimeters is entered.</p> <p>After the measurement the core has to be folded in paper. On the paper the tree and tract and plot number is noted and the wrapped core is placed in a box and provided at the end of a measurement period to the central storage place to enable checks and laboratory analysis.</p>
Unit/Accuracy	mm / 1 mm
Observation area	Full sample plot, living trees.

5.7.17 Age and increment measurement quality

Description	Necessary to identify which bore cores taken for increment or age and increment should to be measured in the laboratory.
Cause of damage	

Code list	Code	Class
	1	High quality – annual rings can clearly be identified.
	2	Moderate quality – difficulties to identify annual tree rings, candidate for measurement in the laboratory.
Observation area	Sample plot of 12 m radius, living trees.	

5.7.18 Marketability - stem quality classes

Description	Trees are assessed according to quality classes, that allows to estimate volume according to quality. Quality is determined by stem shape and damage.	
Code list	Code	Class
	1	Construction timber quality - Tree belongs this category, if the length of undamaged, straight part of stem is ≥ 6 m (minimum upper diameter of 16 cm over bark) and without quality reducing factors.
	2	Construction timber quality - Tree belongs this category, if the length of undamaged, straight part of stem is $\geq 2 - 6$ m (minimum upper diameter of 16 cm over bark) and without quality reducing factors.
	3	Lower timber quality - Tree belongs this category, if construction timber quality is not given.
Observation area	Sample plot of 12 m radius, living trees.	

5.7.19 Length of the marketable stem

Description	In case of a construction timber The length of the high quality part of the stem is assessed. This stem part is even and without damage and quality reducing factors. <i>Specification:</i> For all trees the length of the valuable stem part (construction timber quality) up to a minimum upper diameter of 13 cm is given in steps of 50 centimeters.
Unit/Accuracy	m / 0.5 m
Observation area	Sample plot of 12 m radius, living trees.

5.7.20 Burls

Description	Burls are areas of special abnormal growth that can be found at walnut trees (<i>Juglans regia</i>) and are of high economic value. Burls can be found
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	on the root system of a walnut tree, along the stem and even on the branches. For the assessment of burls, only such burls are taken into account that have a minimum length of 40 cm (parallel to the stem axis) and a minimum diameter of 30 cm. The number of burls is given according to their location (see Figure below.)	
Root location		
Code list	0	no burl can be found
	1	burl exists
Stem location		
Code list	0	number of burls on the stem
	1	burl exists
Observation area	Sample plot of 12 m radius, living <i>Juglans regia</i> trees only.	

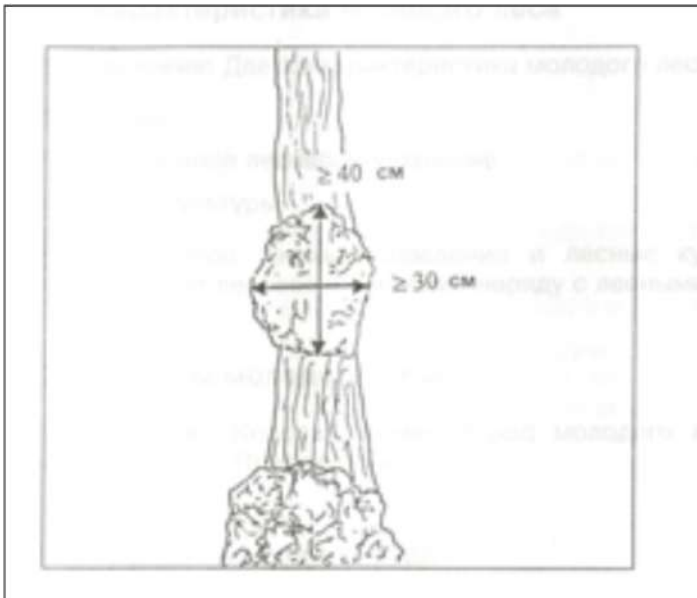


Figure 9 Burl on a stem of *Juglans regia*.

5.7.21 Decay Class

Description	If the tree is standing dead wood.	
Code list	Code	Class
	1	Not decayed - bark is on and wood is hard.
	2	Medium decayed - bark partly is off, wood is soft.
	3	Heavily decayed - bark is completely off, wood is rotten.
Observation area	Full sample plot, dead tree only.	

5.8 Stumps

5.8.1 Identification of stumps to be measured

The sample plot consists of two concentric circles. The large outer circle has a horizontal radius of 12m. The small inner circle has a horizontal radius of 6 m.

In the inner circle all stumps with stump diameter ≥ 10 cm are assessed.

In the outer circle all stumps with stump diameter ≥ 20 cm are assessed.

The attributes azimuth, distance presented in the section tree measurements are used for stumps as well to record their position on the plot.

5.8.2 Type of stump

Description	Stumps classified in coniferous and broad-leaved types. A stump has a height below 1.3 m DBH. Otherwise it is the remainder of a dead tree. For stumps the minimum stump diameter is dbh ≥ 20 cm in the outer circle and ≥ 10 cm in the inner circle.	
Code list	Code	Type
	1	Coniferous
	2	Broad-leaved
Observation area	Sample plot of 6m / 12 m radius	

5.8.3 Stump diameter

Description	Stump diameter is measured at the middle diameter of the stump.
Units/ accuracy	Cm / with decimal accuracy
Observation area	Sample plot of 6m/ 12 m radius

5.8.4 Stump height

Description:	The height of the stump is measured from the ground surface to the top of the stump.
Unit/accuracy:	cm / cm
Observation area	Sample plot of 6m/ 12 m radius

5.8.5 Stump age

Description	Stump age is visually estimated considering the site and species.	
Code list	Code	Class
	1	1 to 2 years

	2	3 to 5 years
	3	> 5 years
Observation area	Sample plot of 6m/ 12 m radius	

5.8.6 Stump markaton

Description	Assessment of stump marking, that is visible on newly felled stumps up to 4/5 years. This assessment is made for stumps with classified stump age of 1-2 years and 3 – 5 years.	
Code list	Code	Class
	1	Sign “EN” - Irregular cut
	2	Sign “CP” - Sanitary cut
	3	Sign “RCP” - Randomly occurring sanitary cut
	4	Sign “PY” Thinning, regeneration cut
	5	No markaton
Observation area	Sample plot of 6m/ 12 m radius	

5.8.7 Stump decay class

Description	If the tree is standing dead wood.	
Code list	Code	Class
	1	Not decayed - bark is on and wood is hard.
	2	Medium decayed - bark partly is off, wood is soft.
	3	Heavily decayed - bark is completely off, wood is rotten.
Observation area	Sample plot of 6m/ 12 m radius.	

5.9 Down Dead Wood

Down wood presents dead pieces of wood that are on the ground of the sample plot.

Minimum length to be considered for measurement is 1 m.

The down dead wood is measured on the sample plot if thicker end of the wood piece is located in the sample plot (12 m).

The thicker end of the wood piece has to exceed the following minimum diameters per sub plot:

- Down dead wood \geq 8 cm at the thicker end is recorded in 12 m radius sub plot.

If the thicker end is outside of the respective plot, this down deadwood is not recorded.

Trees and parts of trees on the ground originating from recent harvest for the purpose of later extraction from the forest, are not recorded.

5.9.1 Down Dead-Wood Diameter

Description	The middle diameter is recorded for each piece of down deadwood that complies with the conditions specified for the measurement of down dead wood.
Unit / accuracy	cm / cm
Observation area	Sample plot of 12 m radius

5.9.2 Down Dead-Wood Length

Description	The length is measured for each piece of down deadwood for each piece of down deadwood that complies with the conditions specified for the measurement of down dead wood.
Unit / accuracy	meter/centimeter
Observation area	Sample plot of 6 and 12 m radius

5.9.3 Down Dead-Wood Decay Class

Description	Down deadwood is estimated according to decay class.	
Code list	Code	Class
	1	Not decayed - bark is on and wood is hard
	2	Medium decayed - bark partly is off, wood is soft;
	3	Heavily decayed - bark is completely off, wood is rotten;
Observation area	Sample plot of 6 and 12 m radius	

5.10 Final plot attributes

5.10.1 Plot comment

Description	Here you can add a comment about information that is not already covered in the measurements, or that is very poorly expressed in the measurements.
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5.10.2 End Time of Measurements on the Sample Plot

Description	Time recording starts when the sample plot is left and field work is finished.
Units / accuracy	HH-MM / one-minute
Observation area	Sample plot center

6 ANNEX

6.1 Tree and shrub species list

ID	Species		
	Russian name	Scientific name	Kirgiz name
CONIFER TREES			
01	Сосна обыкновенная	<i>Pinus sylvestris</i>	Кызыл карагай
02	Ель тянь-шаньский	<i>Picea schrenkiana</i>	Карагай
03	Пихта Семенова	<i>Abies semenovich</i>	Ак карагай
04	Лиственница сибирская	<i>Larix sibirica</i>	Кара карагай
59	Арча зеравшанская	<i>J. seravchanica</i>	Кара арча
60	Арча туркестанская	<i>J. turkestanica</i>	Урук арча
61	Арча полушаровидная	<i>J. semiglobosa</i>	Суур арча
BROAD LEAVED TREES			
06	Дуб черешчатый	<i>Quercus robur</i>	Эмен
07	Ясень согдийский	<i>Fraxinus sogdiana</i>	Шун дарагы
08	Клен туркест-ая	<i>Acer turkestanica</i>	Ак чечек
09	Вяз мелколиственный	<i>Ulmus pumila.</i>	Карагач
64	Вяз шершавый	<i>Ulmus glabra</i>	Карагач
10	Акация белая	<i>Robinia pseudoacacia</i>	Ак акация
11	Береза туркестанская	<i>Betula turkestanica</i>	Кайын
65	Береза тянь-шаньская	<i>Betula tianschanica</i>	Кайын
12	Осина (Тополь дрожащий)	<i>Populus tremula</i>	Бай терек
13	Липа мелколистная	<i>Tilia cordata</i>	Жоко жыгачы
14	Тополь белый	<i>Populus alba.</i>	Ак терек
66	Тополь сизый	<i>Populus pruinosa</i>	Кок терек
67	Тополь таласский	<i>Populus talassica.</i>	Терек
15	Ива белая	<i>Salix alba</i>	Тал
68	Ива вавилонская	<i>Salix babulonica</i>	Мажурум тал
16	Абрикос обыкновенный	<i>Armeniaca vulgaris</i>	Орук
17	Гледичия обыкновенная	<i>Gleditschia triacanthos</i>	Тикен дарагы
18	Груша обыкновенная	<i>Pyrus comminus</i>	Жонокой алмурут
69	Груша бухарская	<i>Pyrus bucharica</i>	Бухара алмуруту
70	Груша регеля	<i>Pyrus regelii</i>	Регеля алмуруту
19	Каркас кавказский	<i>Celtis caucasica</i>	Катыранкы
20	Катальпа	<i>Catalpa ovata</i>	Мурок дарагы
21	Конский каштан обыкновенный.	<i>Aesculus hippocastanum</i>	Каштан
22	Миндаль обыкновенный	<i>Amygdalus communis</i>	Жонокой бадам
71	Миндаль бухарский	<i>Amygdalus buchar</i>	Бухар бадамы

23	Орех грецкий	<i>Juglans regia</i>	Кадимки жангак
24	Платан восточный	<i>Platanus orientalis</i>	Чынар
25	Вишня магалевская	<i>Cerasus mahaleb</i>	Сасык кайын
26	Слива домашняя	<i>Prunus domestica</i>	Кара орук
27	Фисташка настоящая	<i>Pistacia vera</i>	Мисте
28	Черешня обыкновенная	<i>Cerasus avium</i>	Гилас
29	Черемуха обыкновенная	<i>Padus avium</i>	Моюл
30	Шелковица белая	<i>Morus alba.</i>	Ак тыт
72	Шелковица черная	<i>Morus nigra</i>	Кара тыт
31	Яблоня кыргызская	<i>Malus kirgisorum.</i>	Кыргыз алма
73	Яблоня сиверса	<i>Malus sitversii</i>	Сиверс алмасы
32	Боярышник туркестан.	<i>Crataegus turktstan.</i>	Долоно
74	Боярышник понтийский	<i>Crataegus pontica</i>	Сарыайбан
50	Рябина тьянь-шаньская	<i>Sorbus tianschanica</i>	Четин
75	Рябина понтийская	<i>Sorbus pontica</i>	Четин
53	Алча согдийский	<i>Prunus sogdiana</i>	Алча
57	Унаби	<i>Ziziphus jujuba</i>	Жылан жийде
SHRUBS			
33	Арча стелющаяся	<i>Juniperus sabina</i>	Жапалак арча
34	Бересклет	<i>Euonymus verrucosus</i>	Аюу карагат
35	Боярышник кустар.	<i>Crataegus laevigata</i>	Бадал долоно
36	Гребенщик	<i>Tamarix gallica</i>	Балгын
37	Виноград узунакматский	<i>Vitis usunachmatica</i>	Жузум
38	Жимолость	<i>Lonicera nummulariifolia</i>	Шилби
39	Ива кустарниковая	<i>Salix rosmarinifolia</i>	Эчки тал
40	Лох	<i>Elaeagnus angustifolia</i>	Жийде
41	Малина	<i>Rubus idaeus</i>	Кожогат
42	Облепиха	<i>Hippophae rhamnoides</i>	Чычырканак
43	Шиповник	<i>Rosa ssp.</i>	Ит мурун
44	Смородина	<i>Ribes meyeri Maxim</i>	Карагат
45	Карагана	<i>Caragana pruinosa</i>	Тоо куйрук
46	Спирея (Таволга)	<i>Spiraea hypericifolia</i>	Табылгы
47	Кизильник (Ирга)	<i>Cotoneaster ssp.</i>	Ыргай
48	Барбарис	<i>Berberis ssp.</i>	Бору карагат
49	Миндаль кустарн. (колючейший)	<i>Amygdalus spinosissima</i>	Бадамча
51	Абелия	<i>Abelia corymbosa</i>	Аса-муса
52	Ломонос	<i>Clematis orientalis</i>	Коен томук
54	Экзохорда	<i>Exochorda tianschanica</i>	Кара март
55	Афлатуния	<i>Aflatunia ulmifolia</i>	Катын жангак
56	Вишня кустарниковая	<i>Cerasus fruticosa</i>	Бадал чие
62	Саксаул	<i>Haloxylon aphyllum</i>	Сөксөөл
63	Эфедра	<i>Ephēdra intermēdia</i>	Чекенди

96		Other conifer tree	
97		Other shrub species	
98		Other broad leaved trees	

6.2 Definitions of forest and other wooded land

Forest and other wooded land definition, is linked to FAO definitions, and in line with the definition in the national forest law.

Forest

Forest includes natural forests and forest plantations. It refers to land with a tree canopy cover of more than 10 percent and an area of more than **0.2 ha**. The presence of forests is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m. Young stands that have not yet reached but are expected to reach a crown density of 10 percent and a tree height of 5 m are included in forest, as are temporarily un-stocked areas. The term includes forests used for purposes of production, protection, multiple-use or conservation (i.e. forest in national parks, nature reserves and other protected areas), as well as forest stands on agricultural lands (e.g. windbreaks and shelterbelts of trees with a width of more than 20 m), and rubber wood plantations and cork oak stands. The term specifically excludes stands of trees established primarily for agricultural production, for example fruit tree plantations. It also excludes trees planted in agroforestry systems.

Other Wooded Land

Other wooded land is the land either with a canopy cover of 5 up to 10% of trees able to reach a height above 5 m at maturity in situ;

or the canopy cover of trees is less than 5 percent but the combined cover of shrubs, bushes and trees is more than 10 percent. This includes areas of shrubs and bushes where no trees are present.

The category of other wooded land does not include the areas having the tree, shrub or bush and maquis cover of less than **0.2 ha** and width of 20 m and does not include land predominantly under agricultural or urban land use.

If forest and other wooded land occur spatially mixed, the minimum size of continuous forest or other wooded land should be **0.2 ha**.

6.3 Distance measurement on sloped terrain using the tape

Regularly the distance from the plot centre is measured by VERTEX Geolaser 5 that allows the measurement of the horizontal distance directly.

In case it is measured by the tape a slope correction described in the following has to be applied when the horizontal distance is needed, as is the case for distance of the trees and stumps to the sample plot center.

With this measurement there is one specific issue that has to be taken into consideration, that is the measurement of the distance on sloped terrain.

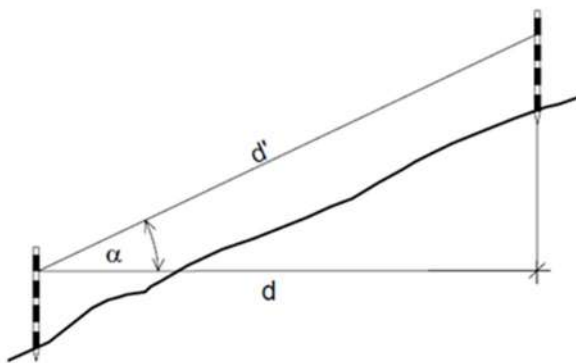


Figure 10 Horizontal distance (d) and direct distance (d')

Please note: This instruction is only valid when measuring the distance with a measuring tape. If the VERTEX Geolaser 5 is used for the distance measurement, it presents directly the horizontal distance.

The figure above displays a typical situation on the field. For the measurement of the NFI the horizontal distance is required. Measuring the distance on a slope, as present in the field will give us an overestimation of the distance, and with that will cause an increase of the size of the plot. Such measurements affect the results of the inventory and increase the error.

To avoid this, the teams measuring the distance on the slope have to convert it to horizontal distance.

This can be done by using the following equation:

$$Dh = Ds * \cos \alpha$$

Dh = horizontal distance

Ds = distance on a slope

Each team has a tablet in the field, and the conversion can be done quickly using the calculator (provided in each tablet).

Another option is to use the slope correction table provided below. Here each distance between 1 and 12m is present and a slope with angles between 1 and 40°. The correct horizontal value can be read from the table.

Hint: Use the table for the plot establishment (Horizontal distance known, distance on slope is searched) and the formula for calculating the distance (horizontal) of the tree location within the plot (Distance on slope known, but horizontal distance is searched)! There is a calculator on the tablet.

Slope correction factors

Angle	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m
0 - 6	-	-	-	-	-	-	-	-	-	-	-
7 - 9	2.02	3.03	4.04	5.05	6.06	7.07	8.08	9.09	11.10	11.11	12.12
10 - 12	2.04	3.06	4.07	5.09	6.11	7.13	8.15	9.17	10.19	11.21	12.22
13 - 15	2.06	3.09	4.12	5.15	6.18	7.21	8.24	9.28	10.31	11.34	12.37
16 - 18	2.09	3.14	4.12	5.23	6.27	7.32	8.37	9.41	10.46	11.50	12.55
19 - 21	2.13	3.19	4.26	5.32	6.39	7.45	8.51	9.58	10.64	11.71	12.77
22 - 24	2.17	3.26	4.35	5.43	6.52	7.60	8.69	9.78	10.86	11.95	13.04
25 - 27	2.23	3.34	4.45	5.56	6.68	7.79	8.90	10.01	11.13	12.24	13.35
28 - 30	2.29	3.43	4.57	5.72	6.86	8.00	9.15	10.29	11.43	12.58	13.72
31 - 33	2.36	3.54	4.72	5.90	7.08	8.25	9.43	10.61	11.79	12.97	14.15

Linear Distance Angle

	7 - 9	10 - 12	13 - 15	16 - 18	19 - 21	22 - 24	25 - 27	28 - 30	31 - 33
1	0.99	0.98	0.97	0.96	0.94	0.92	0.90	0.87	0.85
1.5	1.49	1.47	1.46	1.43	1.41	1.38	1.35	1.31	1.27
2	1.98	1.96	1.94	1.91	1.88	1.84	1.80	1.75	1.70
2.5	2.48	2.45	2.43	2.39	2.35	2.30	2.25	2.19	2.12
3	2.97	2.94	2.91	2.87	2.82	2.76	2.70	2.62	2.54
3.5	3.47	3.44	3.40	3.35	3.29	3.22	3.15	3.06	2.97
4	3.96	3.93	3.88	3.83	3.76	3.68	3.60	3.50	3.39
4.5	4.46	4.42	4.37	4.30	4.23	4.14	4.04	3.94	3.82
5	4.95	4.91	4.85	4.78	4.70	4.60	4.49	4.37	4.24
5.5	5.45	5.40	5.34	5.26	5.17	5.06	4.94	4.81	4.66
6	5.94	5.89	5.82	5.74	5.64	5.52	5.39	5.25	5.09
6.5	6.44	6.38	6.31	6.22	6.11	5.98	5.84	5.69	5.51
7	6.93	6.87	6.79	6.69	6.58	6.44	6.29	6.12	5.94
7.5	7.43	7.36	7.28	7.17	7.05	6.90	6.74	6.56	6.36
8	7.92	7.85	7.76	7.65	7.52	7.36	7.19	7.00	6.78
8.5	8.42	8.34	8.25	8.13	7.99	7.82	7.64	7.43	7.21
9	8.91	8.83	8.73	8.61	8.46	8.28	8.09	7.87	7.63
9.5	9.41	9.33	9.22	9.08	8.93	8.74	8.54	8.31	8.06
10	9.90	9.82	9.70	9.56	9.40	9.21	8.99	8.75	8.48
10.5	10.40	10.31	10.19	10.04	9.87	9.67	9.44	9.18	8.90

11	10.89	10.80	10.67	10.52	10.34	10.13	9.89	9.62	9.33
11.5	11.39	11.29	11.16	11.00	10.81	10.59	10.34	10.06	9.75
12	11.88	11.78	11.64	11.48	11.28	11.05	10.79	10.50	10.18
12.5	12.38	12.27	12.13	11.95	11.75	11.51	11.23	10.93	10.60
13	12.87	12.76	12.61	12.43	12.22	11.97	11.68	11.37	11.02
13.5	13.37	13.25	13.10	12.91	12.69	12.43	12.13	11.81	11.45
14	13.86	13.74	13.58	13.39	13.16	12.89	12.58	12.24	11.87
14.5	14.36	14.23	14.07	13.87	13.63	13.35	13.03	12.68	12.30

6.4 Field GIS APP and use of GPS

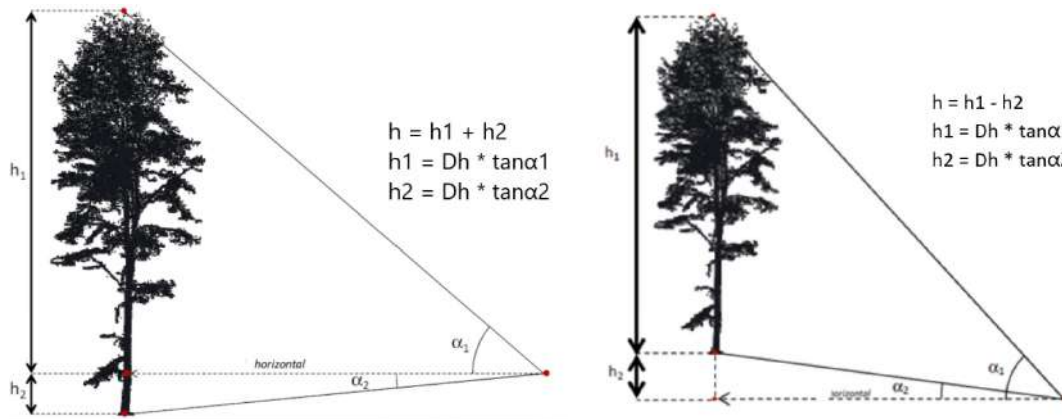
Guidance is provided in separate hand books.

6.5 Measuring tree height

There height can be measured with instruments that use principles based on the rules of trigonometry; three variables are needed to calculate the height of the tree:

- the horizontal distance to the tree
- the angle between the point of view to the base of the tree
- the angle between the point of view and the top of the tree.

Thus when measuring tree heights the tree top and tree base must be visible.

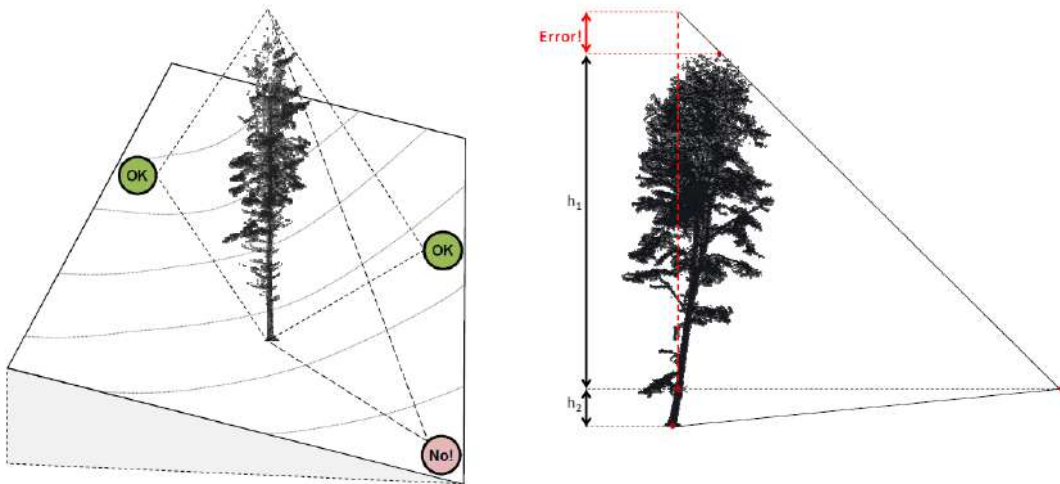


The images above shows the measurement and calculation of the tree height for a normal case. In the second image the measuring approach is shown if the point of measurement is located below the base of the tree.

When measuring tree heights try to:

- be on the same level as the tree
- measure from a distance which is roughly the same as the height of the tree
- measure from a place ca. in the distance of the tree height

Avoid measuring big trees uphill standing below the tree, as this increases the probability of errors because of bad visibility of the tree top and extreme angle measurements! A relative small error in the angle measurement will lead to relative high errors in the calculated height.



In case of oblique trees, measure height from a position perpendicular to the leaning direction. Measuring along the direction of leaning might cause high errors in distance measurements (not the correct distance to the horizontal projection of the tree top!).

6.6 Measuring DBH

The measurement of the Diameter at breast height (DBH) is done at a height of 1.3 meters of the tree.

Special case instructions:

1. Branch or knot at a height of 1.3 m: One diameter is measured above and one below, the diameter is the average of two measurements.
2. Forked tree/twin stem above 1.3 m: It is considered as one single tree.
3. Forked tree/twin stem below 1.3 m: It is considered as two trees. Each stem is measured separately (and gets its own tree number)
4. Bifurcation at 1.3 m: In this case the measurement is taken below the bifurcation
5. Measurement impossible: The diameter at breast height gets the value "0" and the reason is given as remark in 4.15

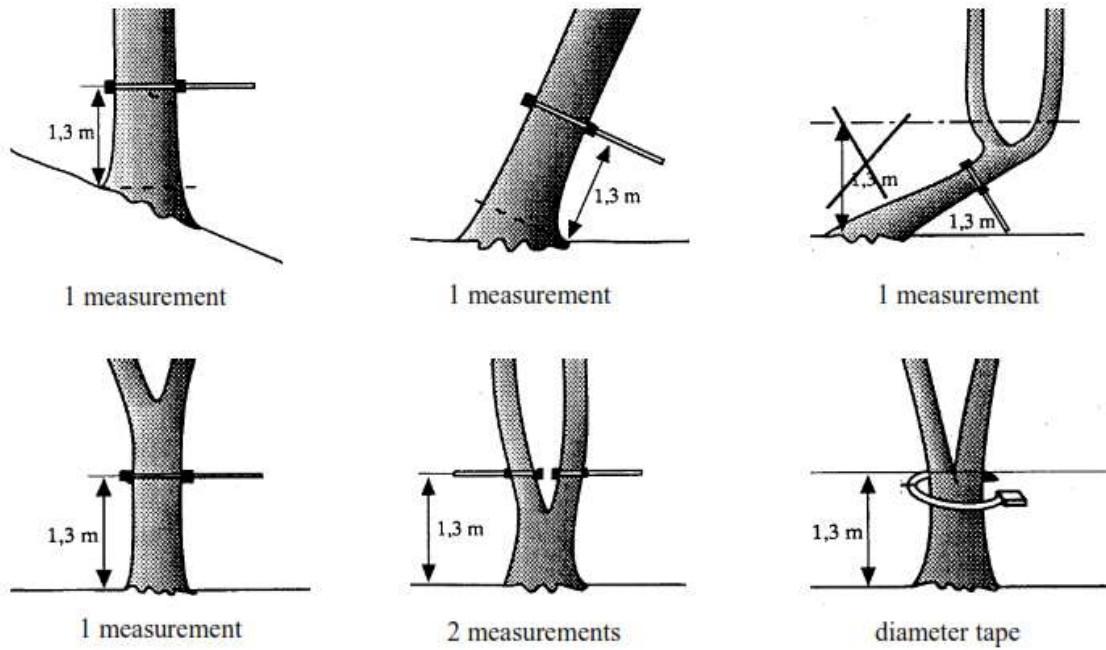
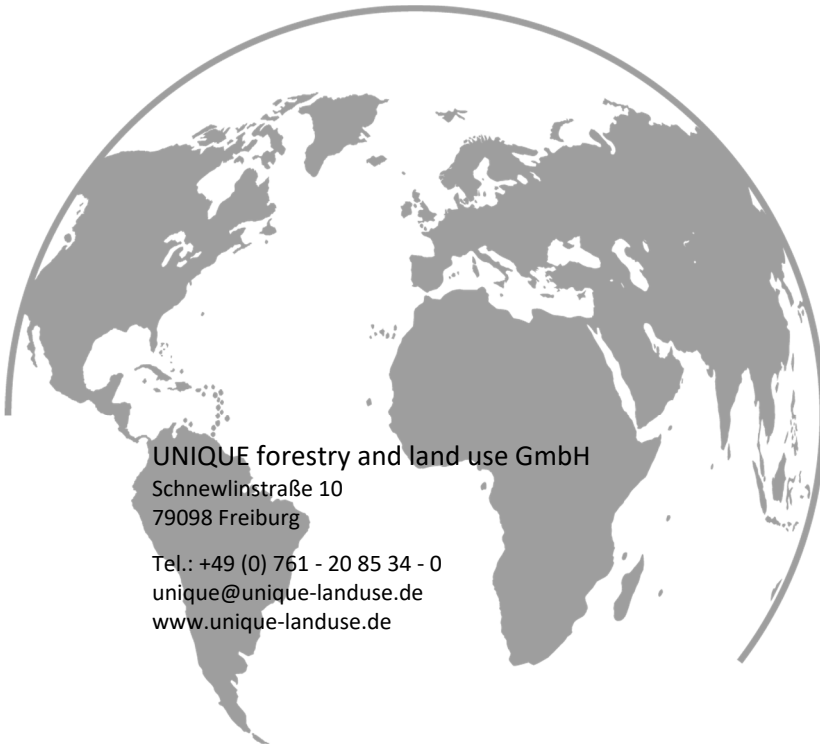


Figure 11 Diameter Measurement Examples

6.7 Red list species from the tree and shrub species list

ID	Species		
	Russian name	Scientific name	Russian name
CONIFER TREES			
03	Пихта Семенова	<i>Abies semenovich</i>	Ак карагай
BROAD LEAVED TREES			
18	Груша обыкновенная	<i>Pyrus comminus</i>	Жонокой алмурут
70	Груша регеля	<i>Pyrus regelii</i>	Регеля алмуруту
22	Миндаль обыкновенный	<i>Amygdalus communis</i>	Жонокой бадам
28	Черешня обыкновенная	<i>Cerasus avium</i>	Гилас
29	Черемуха обыкновенная	<i>Padus avium</i>	Моюл
31	Яблоня кыргызская	<i>Malus kirgisorum.</i>	Кыргыз алма
75	Рябина понтийская	<i>Sorbus pontica</i>	Четин
57	Унаби	<i>Ziziphus jujuba</i>	Жылан жийде
SHRUBS			
37	Виноград узунакматский	<i>Vitis usunachmatica</i>	Жузум
38	Жимолость	<i>Lonicera nummulariifolia</i>	Шилби
46	Спирея (Таволга)	<i>Spiraea hypericifolia</i>	Табылгы



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