

Annexure 1: Global Navigational Satellite Systems

GNSS consists of constellation of several series of Satellites launched by various countries. Core Satellite navigation systems currently are GPS (United States), GLONASS (Russian Federation), Galileo (European Union) and Compass (China). Global Satellite Based Augmentation Systems (SBAS) currently available Omnistar and StarFire. Regional SBAS includes WAAS (US), EGNOS (EU), MSAS (Japan) and GAGAN (India). Regional Satellite Navigation Systems includes China's Beidou, India's NAVIC, and Japan's proposed QZSS.

These Satellites are revolving the earth at an altitude of 20200 km to provide complete coverage. GNSS signals are free, available round the clock, anywhere on the globe and in all seasons. Line of sight is not necessary and there is no need to measure distances. Minimum four satellites must be tracked to get the X, Y, Z coordinates (latitude, longitude, altitude) and three Satellites for X, Y coordinates (latitude, longitude).

GARMIN GPS 12/72, eTrex10 Handheld GPS, are the models being used in the forest department for navigation and recording purposes.

I. Procedure for use of Garmin 12/72 Handheld GPS

The GARMIN GPS Hand Held Instrument consists of following Buttons:

GOTO:	Used for navigation
RED LIGHT:	This is ON/OFF Button
QUIT:	Goes back one screen
PAGE:	Goes one screen front (It contains 5 screens)
MARK:	To save the location
ENTER:	To save the coordinates information
FOUR ARROWS:	Cursor movement
DISPLAY SCREEN:	Displays the page wise information

Press and hold **red light** button for 2 seconds to switch on/off the instrument.

1. **This Instrument contains Five Screens / Pages as follows:**
 - a. **First Screen:** GPS information page. This screen gives the Number of Satellites Tracked i.e., Number of Satellites and their Position on hemisphere, North Direction, Status of Battery Charge. Also gives the Time, Position i.e., Northing and Easting (Latitudes and Longitudes), Altitude i.e., Height above the Mean Sea Level in Meters, Trip, Speed i.e., km/hour, Track, True North Bearing (Position information from true north).
 - b. **Second Screen:** Map page. It contains the information about the Map, Zooming Scale, Panning, Options.
 - c. **Third Screen:** Compass or Pointer page. Compass displays the direction of the compass, Distance, Bearing, Track, Speed, and ETA.

- d. **Fourth Screen:** High way page.
- e. **Fifth Screen - Main Menu.** Press two times the Menu button then Main Menu page and Trip computer page appears. There we find units, time, position format etc.
2. Operations:
- a) **To Change the Location format and datum** (hddd.ddddd⁰ and WGS84 datum): Press Page till Main Menu appears > Select Setup Menu > Select the Location Tab > Location Format > Press Enter > Select the required format using UP and DOWN arrows > Similarly Change the datum.
 - b) **To store a position of the waypoint:** After switch the ON the instrument > Wait till the position appears in the FIRST screen > Press ENTER / MARK Button for 2 sec.> Change the Name and symbol if required > Press Enter Button.
 - c) **To create a way point:** Press ENTER / MARK Button for 2 sec > Mark Waypoint page will be displayed > Enter the position, Symbol, label > OK > enter the desired latitude, longitude or to change the name of the location use UP and DOWN arrows.
 - d) **To Navigate:** Press GO TO Button > Select Waypoint from the list > Press Enter Button > It Displays the Compass with Bearing and Distance.
 - e) **To conduct survey in track mode: Area Calculation:** Go to Main menu page > press 'Tracks' > press menu> track setup menu will be displayed > select options 'WRAP when full/ Stop when full/off', set the record interval > displays the total extent of the area traversed. (Before going start survey select Option 'WRAP when full/ stop when FULL'; after completion of survey select 'OFF' option)
3. Downloading of GPS/ GNSS data using GPSTrackmaker software:
- a. Connect GPS instrument to computer > Open GPSTrackmaker Software > GPS > Garmin Interface > Click on Product ID > Select All or feature by feature i.e., waypoints or tracklogs or routes > capture > Select location.
 - b. After downloading open the file in the GPSTrackmaker and save it to either .kml/kmz file or ArcView Shapefile and upload.

II. Procedure for use of Garmin eTrex 10 Handheld GNSS

The **GARMIN eTrex 10 Handheld GNSS** consists of following Buttons:

Menu	:	All Operations & All Settings
Up & Down Keys	:	Goes Up & Down Selection
Back	:	Goes Back one Screen
Light Button	:	ON/OFF & Back Light
Joystick	:	Select Operations

To ON/OFF the instrument: Press and Hold **Light Button** for 2 Seconds.

First Screen: GPS Information and Settings Page. This Screen Gives the **Setup, Mark Waypoints, Track Manager, Compass, Satellite, Waypoint Manager** etc and Icons are Visible.

1) Instrument Setup: Select this by using Joystick. Options available are

- a) **System**: Select WAAS/EGNOS ON/OFF (Select **On Mode** by using Joystick).
- b) **Language**: English (And press Back Button)
- c) **Display**: Backlight & Contrast adjustment.
- d) **Tracks**: Track Log / Record Methods /Recording Interval Settings.
- e) **Units**: Distance/ Speed / Elevation - Set to **Metric**
- f) **Time**: Time Format / Time Zone Settings – Setup> Time> Time Format (12 Hr or 24 Hr)
> Time Zone (Select Automatic or enter GMT+5:30)
- g) **Position**: **Position Format**: Should be hddd.ddddd⁰
 - i. **Map Datum**: WGS84
 - ii. **Map Spheroid**: WGS84
- h) **Heading**: Display / North Reference /Go to line

After Completion of above Settings Goes to Back Main Screen.

2) Storing, Editing and Deleting a Waypoint using Mark Waypoints: Select this by Using Joystick and single press.

- a) **To save the waypoint** without changes, select **Done**.
- b) **To make changes to the waypoints**: Change the item to edit like Way point Number etc and Press **Done**.
- c) **To edit a waypoint**: To perform this a way point must be created as explained above. Select Waypoint Manager > Select Waypoint > select an item to edit > Enter new information > Select Done.
- d) **To delete a way point**: Select Waypoint Manager > Select Waypoint > Select Menu – Delete – Yes.
- e) **Waypoint averaging to improve accuracy**: It allows increasing the accuracy of the waypoint through averaging. Select **Waypoint Averaging** > Select Waypoint > Move to location > Select **Start** > When the sample confidence status bar reaches 100, select **Save**. For best results, collect 4 to 8 samples for the waypoint, waiting atleast 90 minutes between samples.

3) Recording in Track Mode: Go to **Setup / Tracks**

- a) Set the **Track Log / Record Methods /Recording Interval Settings**
- b) Press Back Button two times Now you are in Main Screen.

- c) Go to **Track Manager** Complete the Survey.
- i. Select **Setup > Tracks > Tracklog**
 - ii. Select **Record** (with or without showing map)
 - iii. Select **Record Method**
 - iv. Select an option
 - Select **Auto** (to created tracks at a variable rate that creates an optimum representation of your track)
 - Select **Distance** (to record tracks at a specified distance)
 - Select **Time** (to record tracks at a specified time)
 - v. Select **Record Interval**
 - vi. Complete an action: Select an option mentioned above > record tracks > enter time or distance > Select **Done**.

4) Navigation: Go to **Way Point Manager > Select Where to ? > Select Destination ? (Waypoint) > Select Go ? > Press Back Button and GO to Compass**

5) Compass: Press **Compass** Screen > Press **Menu Button Various options appear like** Change Data Fields, Change Dash Board, Set up heading, Restore Default

- a. Select **Change Dash Board**: Select Dash Board (Small dash Board)
- b. Select **Change Data Fieed**: Select Data Field below Shown.

Way Point Dest	Location (Lat/ Long)
Bearing	Way Point Next

6) Data Downloading: Install Base Camp software in System/ Connect GPS to System/ Download the data.

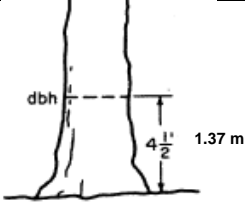
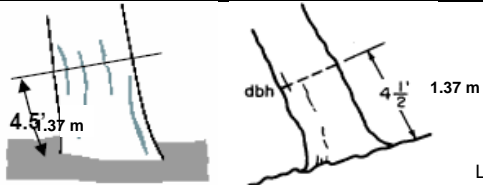
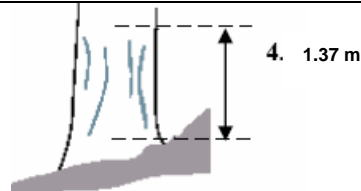
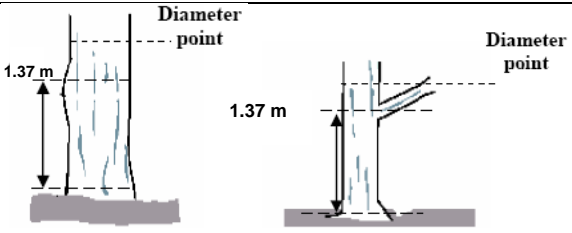
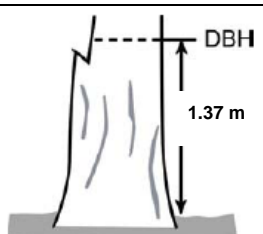
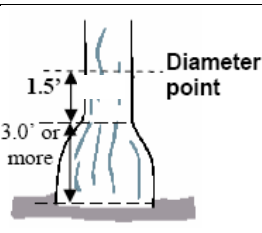
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Annexure 2: Measurement of Girth

In forest inventory work, tree diameter or girth has been traditionally measured at 1.37 meters above the ground or root of the crown if the root crown is exposed, a point defined as diameter at breast height (DBH) or girth at breast height (GBH). The exact position of BH is also dependent of individual tree form and topography. For measurement of diameter calipers or tapes are used. For measurement of girth calipers are used.

The following situations may be encountered in measurement:

<p>Diameter on flat ground: Measure at 1.37 m above the ground.</p>	
<p>Leaning tree: Measure at 1.37 m from the ground along the bole.</p>	 <p style="text-align: right;">Leaning tree on sloping ground</p>
<p>Tree on slope: Measure at 1.37 m from the ground along the bole on the uphill side of the tree.</p>	
<p>Tree with irregularities at BH: On trees with swellings, bumps, depressions, and branches at BH, girth will be measured immediately above the irregularity at the place it ceases to affect normal stem form.</p>	
<p>Missing wood or bark. Do not reconstruct the girth of a tree that is missing wood or bark or at the point of measurement. Record the girth of the wood and bark that is still attached to the tree.</p>	
<p>Tree with butt-swell or bottleneck: Measure these trees 45 cm (1.5') above the end of the swell or bottleneck if the swell or bottleneck extends 1.0 m (3.0') or more above the ground.</p>	

<p>Forked tree:</p> <p>Trees forked below 1.37 m. Trees forked in this region are treated as distinctly separate trees. Distances and azimuths are measured individually to the center of each stem where it splits from the stump. Girth is measured for each stem at 1.37 m above the ground.</p> <p>Trees forked at or above 1.37 m. Trees forked in this region count as one single tree. If a fork occurs at or immediately above 1.37 m, measure girth below the fork just beneath any swelling that would inflate GBH.</p>	
<p>Live wind thrown tree: Measure from the top of the root collar along the length to 4.5 feet.</p>	

Precautions to be taken while measuring GBH using tape: (i) Tape should not be old or worn off (ii) Lie flat against the tree and not twisted (iii) Lie in a plane perpendicular to the axis of the tree, otherwise over estimated (iv) No climber, or shrub vitiate the girth measurement.

Precautions to be taken while measuring DBH using calipers: (i) to be placed on the tree with movable arm well opened (ii) Reading is taken before the caliper is removed (iii) Take two readings in case of the stem is elliptical in shape and average (iv) Must be placed at right angles to the axis of the tree, otherwise over estimated (v) Two movable arms should be in contact with the tree and at right angles to the measuring arm. Even the scale arm should touch the tree.

Annexure 3: Measurement of Height

Height measurements are collected for every tree, sapling and tree of each species encountered in the **whole plot**. For each plant, measure total height, or the distance from the top of the crown to the ground. For this purpose *Ravi altimeter* will be used. The *Ravi altimeter* has five scales – two for the heights graduated to distances, one for the degrees, one for the slope correction and one for the slope percent.

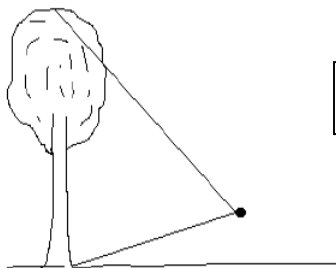
Tree height determination requires altimeter readings of both tree top and base levels. The values will be added if they have the opposite sign and subtracted from one another if they have the same sign.

The use and operation of Ravi altimeter is as follows

- Measure 20/30 m distance from the base of the tree in a direction such that top and bottom are visible.
- Hold the instrument firmly in one hand, support with other hand and sight the top/bottom of the tree through eye (the instrument holding side) with other eye closed.
- After the top/bottom is sighted, close sighting eye, open other eye and observe the needle to stabilize. Click the locking pin gradually without shaking the instrument.
- See the appropriate scale in the altimeter and note down the reading.

The following cases may be encountered while measuring tree height.

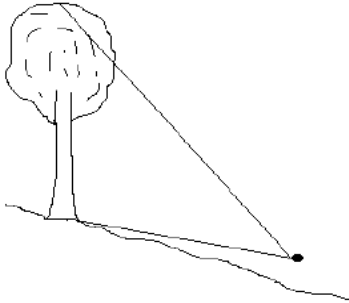
Case I - On a Flat ground: Record the top height and add the height of the eye level.



Total Height = Top Height + Height of the eye level.

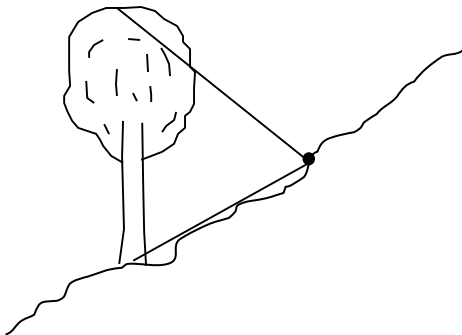
Case II - On a Sloping Ground: Height of the tree top and bottom has to be recorded.

- **Case II a:** If the observer is on the downhill side and below the base of the tree, the base value is subtracted from the top value.



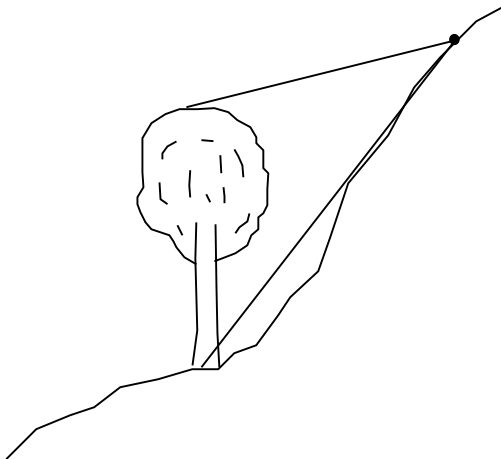
$$\text{Total Height} = \text{Top Height} - \text{Bottom Height.}$$

- **Case II b:** If the observer is on the downhill side and above the base of the tree, the base value is added to the top value.



$$\text{Total Height} = \text{Top Height} + \text{Bottom Height.}$$

- **Case II c:** If the observer is on the downhill side and above the base and top of the tree, the top value is subtracted from the base value.



$$\text{Total Height} = \text{Bottom Height} - \text{Top Height.}$$