

# Ground-truthing protocol

## **Landscape Mosaics** CIFOR-ICRAF Biodiversity Platform

Prepared by Spatial Analysis team

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## Introduction

Ground-truthing is a field work to collect, in a systematic way, data points of description of land cover on the ground and historical land uses gathered from interview, along with the coordinates and digital photos. The collection should represent variation in the landscape in terms of land use systems, biophysical characteristics and socio-cultural characteristics that determine land cover, as seen through reflectance in the satellite imageries.

In interpreting satellite imageries or other remotely sensed data, ground-truthing is essential because it provides the linkages between the spectral data from the satellite imageries and the on-the-ground reality. Some general features can be detected easily from satellite imageries by visual interpretation or simple analysis. However, the more detailed interpretation need more extensive and intensive ground-truthing. The quality and quantity of the ground-truth data, to a large extent, determines the accuracy of land cover maps to be produced from the image analysis, on top of the advances in techniques and human skills in interpreting the satellite data, and the higher resolution of the satellite data.

The on-the-ground reality and remotely sensed data are linked through coordinates of locations visited in the field, recorded by a GPS receiver. Combinations of data taken during the so-called ground-truthing, i.e., descriptions of what is seen in the field, historical land uses from the interview, and photos taken in the particular location, is used in interpreting data captured by the sensors on the satellite by tying them into the same coordinate systems.

The more GPS points are taken, i.e., the more locations are surveyed, the higher confidence we can put on the interpretation of the satellite imageries. The more accurate the GPS receiver is recording the location coordinates, the higher accuracy we can expect from the linking. The better the sampling design is, i.e., the more variation is covered, the more detailed classification can be performed with reasonable level of accuracy.

However, there are technical limitations remain from the nature of the satellite image itself; one will never produce an error free classification. It is not feasible to cover every inch of the large area with fieldwork, but that does not mean that remote sensing data analysis is not useful because it always bears errors with them. Two most important advantages of remote sensing data is that it enables us to cover a large area at reasonably low cost and it provides us with historical data to study dynamics over time.

## **Equipments**

Two gadgets required the groundtruthing field work: a GPS receiver and a digital camera. A set of questionnaire as the survey instrument (see Appendix) is necessary to capture the observation and the interview. Different types of GPS receivers and digital cameras come with specific operating instructions and they should be consulted prior to the field work.

Three particular points people need to check prior and during the taking of any GPS points are:

1. Make sure you set the GPS with the correct projection and datum for the areas you work in;
2. Mark and label the ID for each location in a synchronized way with the photos and questionnaire;
3. Download the data regularly.

For the digital camera:

1. Synchronize the clock with the GPS receiver's clock
2. Download your data regularly and save the files using the ID name.

## **Transect walk/reconnaissance**

Sampling frame is discussed in the focus group discussions using some high resolution images if available. Some suggested steps:

1. List the portfolios of dominant land use systems and how each links to land cover;
2. Identify in the map where is which
3. Discuss variation of biophysical characteristics which are relevant in shaping biomes, e.g., topography, road, micro-climate etc.
4. Discuss variation of socio-cultural characteristics which are relevant to land uses
5. Determine feasible path for transect walk/reconnaissance that cover the above variation, with as many replications as possible for each type within the variation

## **Field protocol**

### ***Selecting an individual point of location***

The most important criteria for a point selection is homogeneity within the location of at least a hectare in size, in terms of canopy cover, and preferably slope, aspect, species dominance, drainage and water availability, understory, and ground cover.

## ***Recording coordinates from a GPS receiver and scenes with a digital camera***

Once you decide to select one particular point, take a photograph from 50 meters of the edge of the site and walk to a point from where at the radius of 50 meters (at least) you see homogeneous canopy cover. Hold your camera about 1 meter above the ground, face up and take a photograph of the canopy cover and face down to take a photograph of ground cover. Next, record the location from your GPS receiver and mark your site ID. Take another photograph of a profile parallel to the greatest slope in the surrounding area. If the area is flat, then take any. Label your photographs in a separate sheet according to your site ID using the picture number shown by the camera. i.e., site ID\_out, site ID\_up, site ID\_down, site ID\_side.

## ***Recording information for each individual point of location***

For each individual point, fill in the form in the Appendix. If the list does not apply to your particular sites, please modify accordingly and provide the modification.

### **General Information**

**Area ID:** name of villages or area within the landscape

**Site ID:** the numeric code assigned sequentially from the GPS receiver

**Training Sample #:** numbers are consecutively assigned by the surveyor for each separate Area ID and Land Cover Class, e.g., Primary Forest#1, Rubber#2, etc. One of the purposes is to keep track of the number of replicates for each land cover class.

**Today's Date/Surveyor's Name:** records the date the data is collected, as well as the full name of the surveyor

**Status/Owner's Name:** record the status of ownership and the property owner (if known) of the site

**Geographic Coordinates:** record the geographic coordinates in UTM from the GPS receiver

### **Diagram of General Observations:**

**Aerial View:** Make a rough sketch of boundaries, permanent landmarks, general land cover characteristics, and location within the site. Please provide the north arrow.

### **Land Use/Cover Types:**

The two major categories are forest and non-forest (first column). If the vegetation type of your site is forest or shrubs, grasslands, then fill in the upper part of column two and

move to the next section. If your vegetation type is farmland then go to column three and move to the next section. If your land cover is of barren land then fill in the lower part of column two and move to the next section.

## Existing vegetation type

Copy the list from the focus group discussion into this section and fill in the description of vegetation types. Please modify the questionnaire according to the list. Some examples:

- Sal - Predominantly *sakhu* (*Shorea robusta*) bearing forests
- Teak - Predominantly *sagaun* (*Tectona grandis*) bearing forests
- Bamboo - Predominantly *baans* (*Dendrocalamus strictus*) bearing forests
- Mixed - Multi-species forests without any particular species domination
- Riparian - Vegetation along the river or streams
- Shrubs - Small multi-stemmed perennial vegetation
- Grassland - Predominantly grass bearing areas with or without scattered trees
- Farmland - Agricultural fields used to grow domesticated crops such as wheat, rice etc.
- Barren land - Land without vegetation cover

## Vegetation Disturbances

- Initial Succession – areas at the initial stages of regrowth or fallow, e.g., recently abandoned field, pastures or logged areas. Mostly a dense mixture of grasses, shrubs, seedlings, and saplings. No mature tree present
- Intermediate Succession – forests that were previously logged or farmed and now have returned to a forested state, will include young trees of various life stages
- Advanced succession – mature forest that has not recently been disturbed. Include old growth and mature forests
- Disturbed forest (human-induced) – area that has recently experienced human-induced disturbance. eg., clear-cutting, human-induced fire.
- Disturbed forest (natural) – region that has recently experienced a natural disturbance (for example, floods).
- Quarry – large, open pits, such as gravel pits and limestone quarries
- Forest with cleared understory – contain large canopy trees with little or no regeneration, herbaceous, shrubby species, or sub-canopy species present

## Non-vegetative Cover

- Concrete – areas paved with cement/concrete
- Gravel – areas covered with loose stones or rocks; describe whether natural (beach) or human-made
- Blacktop – areas covered with blacktop, such as parking lots

## Activity

- Broadleaf Crop – crops commonly found in the area include leafy vegetables
- Annual Grass Crop – crops commonly found in the area include Paddy, Wheat, maize, Pigeon pea, Mung bean, Groundnut, Green gram etc
- Wood Perennial Fruit Crop – orchard crops
- Plantation – tree plantations, such as numerous tree species depending upon the area
- Agroforestry/Crops – mixed of annual with perennial tree crops
- Agroforestry/Pasture – managed grassland or planted pasture for grazing animals combined with Agroforestry
- Pasture – open field composed of grasses and wildflowers with very little to no tree cover. Actively managed for grazing
- Degraded Pasture with Shrubs – same as a pasture, but also supports shrubs and small tree species that are considered unpalatable to grazing species
- Bare soil – area with no vegetation cover, includes fallow land or recently cleared areas
- Stubble Field – harvested fields that have not been plowed
- Plowed Field Agricultural Field – field plowed and maintained in preparation for planting

## Presence of Managed Species

- Number of Managed Species: record the number of tree species managed within the site
- Scientific Name: record scientific name if known
- Common Name: record common local name for managed species
- Density: percent of one managed species in relationship to other managed species
- Other Observations: describe the type of management and how individual plant species are impacted and used. Include any important information not included on other sections of this sheet

**Land Use History**: list any information regarding land cover change and human activity on the area

**General Observation**: mention any sources of water within the site, drainage characteristics and all evidence of human activity such as stumps and old property boundary fences, cattle.

## **Managing the data into a database**

Three different, but interrelated datasets will be produced:

1. GPS point download;
2. Set of photos, including photo of sketch of general observation from the questionnaire;
3. A spreadsheet of the questionnaires

The first two is straight forward; for number 3, a suggested excel file is attached. The three datasets have to have common IDs for the same locations. We suggest people to retain the hardcopy of the questionnaire at least until the project ends.

## Appendix

AREA ID: \_\_\_\_\_ SITE ID: \_\_\_\_\_ TRAINING SAMPLE#: \_\_\_\_\_  
 TODAY DATE: \_\_\_/\_\_\_/\_\_\_ LOCAL TIME: \_\_\_\_\_ SURVEYOR'S  
 NAME: \_\_\_\_\_ STATUS/OWNER NAME: \_\_\_\_\_

**DIAGRAM OF GENERAL OBSERVATIONS:** Show location of GPS points & site in relation to major features  
 Aerial View

(include land marks, north arrow and scale bar)

**GEOGRAPHIC COORDINATES:**

UTM Northing (X): \_\_\_\_\_ [m] UTM Easting (Y): \_\_\_\_\_ [m]  
 UTM Zone: \_\_\_\_\_ Datum

**LOCATION OF PLOT TOPOGRAPHICALLY:** Ridge \_\_\_ Slope \_\_\_ Flat \_\_\_  
 Steepness of Slope: \_\_\_° (0-90°) Azimuth (downhill direction of maximum slope in which water would naturally run) \_\_\_\_\_ (0-360°)

**LANDCOVER TYPE** (put a check mark next to land cover type or write in others):

EXISTING VEGETATION TYPE	DISTURBED	AGRICULTURE/PLANTATION
Forest	Initial succession	Broadleaf crop
Bamboo	Intermediate succession	Annual grass crop
Riparian	Advanced succession	Wood perennial fruit crop
Shrubs	Disturbed forest (logging)	Plantation (eg. Eucalyptus)
Grassland	Burned field	Agroforestry/crops
	Forest with cleared understory	Agroforestry/pasture
	Undisturbed forest	Pasture
	(Others-use space below)	Pasture with shrubs/woody regrowth
Farmland		Bare soil
Barren land	<b>INFRASTRUCTURE</b>	Stubble field
	Lawn	Plowed field
Others:	Concrete	(Other-use space below)
	Blacktop	
	Gravel	

If existing vegetation is secondary, give original vegetation if known: \_\_\_\_\_

**PRESENCE OF MANAGED SPECIES** (agriculture, agroforestry, plantation): Number of managed species (inc. planted): \_\_\_\_\_

Sci. Name (Family/Genus/Species): \_\_\_\_\_

Common name: \_\_\_\_\_

Density: Absent \_\_\_\_\_ Few \_\_\_\_\_ Moderate \_\_\_\_\_ Abundant \_\_\_\_\_

Uses: \_\_\_\_\_

Sci. Name (Family/Genus/Species): \_\_\_\_\_

Common name: \_\_\_\_\_

Density: Absent \_\_\_\_\_ Few \_\_\_\_\_ Moderate \_\_\_\_\_ Abundant \_\_\_\_\_

Uses: \_\_\_\_\_

Other Observations: \_\_\_\_\_

**LANDUSE HISTORY** (Fill out as far back in time as possible, recording dates of change to forest, pasture, crop, plantation, etc):

Time period (mm/yr) Land Cover / Land Use

\_\_\_\_/\_\_\_\_ - present \_\_\_\_\_

\_\_\_\_/\_\_\_\_ - \_\_\_\_/\_\_\_\_ \_\_\_\_\_

\_\_\_\_/\_\_\_\_ - \_\_\_\_/\_\_\_\_ \_\_\_\_\_

**GENERAL OBSERVATION:** Elevation (Altimeter reading in meters above sea level):

\_\_\_\_\_

Seasonal change affects land use or land cover: No \_\_\_\_\_ Yes \_\_\_\_\_

If yes, explain: \_\_\_\_\_