Terms of reference (ToRs) for the procurement of services below the EU threshold

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Field Data Collection for Remote Sensing Based Large Scale Agricultural Investment Monitoring	**Project number/ cost centre:** **15.0124.6-008.00**

0. List of abbreviations

AVB	General Terms and Conditions of Contract (AVB) for supplying services and work 2018
ANRS	Amhara National Regional State
BGRS	Benishangul Gumuz Regional State
DLR	German Aerospace Center
GPNRS	Gambella Peoples' National Regional State
LSAI	Large Scale Agriculture Investment
RGIL	Responsible Governance of Investment in Land
S2RAI	Support to Responsible Agricultural Investments
ToRs	Terms of reference

1. Context

1.1 General background of the project

The global project "Responsible Land Policy" aims to improve access to land and to secure land tenure in rural areas with focus on specific population groups, thereby creating a central prerequisite for combating poverty and hunger. The Ethiopia country package S2RAI/RGIL project contributes to this by building capacities of national and regional authorities to fulfill their advisory and regulatory functions.

The country package is being implemented in the Benishangul-Gumuz, Gambella and Amhara regions and consists of three fields of action. The first field of action aims to improve the institutional framework and procedures for securing land use rights at national and regional level. In the second field of action, civil society is strengthened to become more involved in the formulation and implementation of responsible land policy. And the third field of action is dedicated to improving the framework conditions for responsible agricultural investment. The project duration is 4 years and 7 months (01/2019 - 07/2023).

This consultancy service is aiming to collect both spatial and associated non- spatial field data for the purpose of remote sensing based large scale agricultural (LSAI) monitoring. Capacitating the project regions with remote sensing based monitoring of the LSAI techniques fits to the third field of action. Thus, the S2RAI/RGIL project is hiring a qualified and experienced national consultant for in situ data collection in selected woredas in three project regions (Benishangul-Gumuz, Gambella and Amhara).

1.2 Remote Sensing Based Large Scale Agricultural Monitoring

Ethiopia has been promoting LSAI to transform the agricultural sector through technology transfer, expansion of local infrastructure, employment generation and securing food. But the progress by agricultural development has been limited. Most of the investors were not able to comply to the contract. In general, there is a lack of an overall consistent and transparent framework and severe human and institutional capacity constraints for managing LSAI. Such constraints affect all stages of the process of land management and implementing LSAI, from identification, demarcation and transfer of the land up to implementation and monitoring of the investments. Planning and monitoring of LSAI have

a very strong spatial dimension that must be examined and incorporated in the governance of LSAI.

Before the investment: The choice of location has to be based on an intensive investigation of prevailing land uses and the natural endowment. The replacement of existing agricultural or housing activities should be prevented and unused land without important ecology value, but with favourable agro-ecological conditions should be prioritized for the allocation of LSAI. Such information-based planning is crucial for a conflict-free and productive investment. During the investment: Spatial monitoring of the investment is needed to control the investment spatially and timely evolves as fixed in the contract. Such spatial monitoring enhances compliance of contracts and steering of investments. Regions lacks capacities to collect needed spatial data and to process this data to relevant information. This is especially true for in-situ data collection at the (potential) investment sites.

A promising solution to alleviate this lack of spatial information is utilizing earth observation (remote sensing, RS) for monitoring agricultural activities within LSAI areas. It provides repetitive, timely, relatively accurate and objective information about the surface of the earth from a distant platform, usually a satellite or airborne sensor, or unmanned aerial vehicle (UAV). This platform collects reflected electromagnetic radiation over large regions and processes the data into a digital image and finally into digital maps. RS data as the ones which are freely available with Sentinel-1 (S1) and Sentinel-2 (S2) from the Copernicus earth observation program constitute a major asset for this kind of application and provide an unprecedented opportunity to monitor LSAI.

To mitigate the above-mentioned problem, GIZ-S2RAI/RGIL project in collaboration with German Aerospace Center (DLR) will employ a remote sensing based LSAI monitoring technique in ANRS, BGRS and GPNRS project woredas. For this purpose, in situ data is required to train the input images during supervised classification and to validate the classified map. Hence, the project will commission this field data collection to an experienced and capable national consultant.

1.3 Objective of the Consultancy Service

The general objective of this consultancy service is to commission the spatial and non-spatial (attribute) field data collection activities in the selected woredas of the three project regions for remote sensing based LSAI monitoring.

2. Tasks to be performed by the contractor

The main task to be performed by the contractor is in-situ/field data collection as per the data collection manual attached under annex 2. The areas where data to be collected are Wenberma and Debre Elias woredas in ANRS, Assosa and Bambasi woredas in BGRS and Gambella Zuria, Abobo and Etang woredas in GPNRS. The field data collection will focus mainly on the existing LSAI areas in the aforementioned woredas.

The collected data will be used for monitoring LSAI based on remote sensing approach. The data to be collected will be used for training and validation purpose in the satellite image analysis and classification process. The field data to be collected will be a minimum of 100 points per land cover/ land use or crop type for each woreda. The contractor should use the protocol for data collection sheet (See annex 2). For each region in situ data need to be collected separately.

The contractor is responsible for providing the following services:

- Define the boundary of the LSAI in the project woredas of the three regions.
- Collect 100 GPS points per woreda for each the land cover/use or crop data within the boundary of each LSAI including the buffer area up to 3 km radius during the main growing season (August – October) of the year.
- Collect sufficient descriptive field data for each GPS points (with 100 sites for each land use class or crop type) as per the manual and protocol attached in annex 2.
- Convert the data into polygon and point data (shapefile format) with the corresponding attribute data.

Certain milestones, as laid out in the table below, are to be achieved by certain dates during the contract term, and at a particular location:

Milestone	**Deadline**
Inception report	August 31/2021
In situ data collected from ANRS, BGRS and GNRS	December 15/2021

Period of assignment: From August 15/2021 until February 28/2022.

3. Concept

In the bid, the bidder is required to show how the objectives defined in Chapter 2 are to be achieved, if applicable under consideration of further specific method-related requirements (technical-methodological concept). In addition, the bidder must describe the project management system for service provision.

Technical-methodological concept

Strategy: The bidder is required to consider the tasks to be performed with reference to the objectives of the services put out to tender (see Chapter 1). Following this, the bidder presents and justifies the strategy with which it intends to provide the services for which it is responsible.

The bidder is required to interpret the objectives and critically examine the tasks in the tender. The bidder is required to describe and justify the strategy for delivering the services put out to tender.

The bidder is required to describe the key **processes** for the services for which it is responsible and create a schedule that describes how the services according to Chapter 2 are to be provided. In particular, the bidder is required to describe the necessary work steps and, if applicable, take account of the milestones and contributions of other actors in accordance with Chapter 2.

The bidder is required to describe its contribution to knowledge management for the partner and GIZ and promote scaling-up effects (**learning and innovation**).

Other specific requirements

The bidder is required to explain its approach for coordination with the GIZ project. The contractor is responsible to collect a quality data in a timely manner.

In addition to the reports required by GIZ in accordance with AVB, the contractor submits the following reports:

- Inception report
- Contributions to reports to GIZ's commissioning party
- Brief quarterly reports on the implementation status of the project (5-7 pages)

The bidder is required to draw up a **personnel assignment plan** with explanatory notes that lists all the experts proposed in the bid; the plan includes information on assignment dates (duration and expert days) and locations of the individual members of the team complete with the allocation of work steps as set out in the schedule.

4. Personnel concept

The bidder is required to provide personnel who are suited to filling the positions described, based on their CVs), the range of tasks involved and the required qualifications.

The below specified qualifications represent the requirements to reach the maximum number of points.

Team leader (1)

Tasks of the team leader

- Overall responsibility for the whole packages of the contractor (quality and deadlines)
- Coordinating and ensuring communication with GIZ, regional partners, DLR if necessary and others involved in the project
- Regular reporting in accordance with deadlines

Qualifications of the team leader

- Education/training (2.1.1): University degree in remote sensing & GIS, Geoinformatics, Geoinformation management or other related disciplines.

- General professional experience (2.1.3): 7 years of professional experience in remote sensing & GIS;
- Specific professional experience (2.1.4): 3 years in spatial data collection and analysis, satellite imagery processing and analysis.
- Leadership/management experience (2.1.5): 2 years of management/leadership experience as project team leader or manager in spatial data collection and analysis.
- Regional experience (2.1.6): 2 years of experience in projects in the project regions.
- Development Cooperation (DC) experience (2.1.7): 2 projects working experience with GIZ or other development cooperation.
- Other (2.1.8): Experience in land cover land use mapping.

GIS Expert (1)

Tasks of GIS expert

- Supervise and ensure the quality of data as per the data collection manual.
- Provide training or orientation of the field data collection manual to the data collectors.
- Give technical guidance for the data collectors.
- Responsible to organize the spatial data and link with the attribute data.

Qualifications of GIS expert

- Education/training (2.2.1): A university degree in GIS, remote sensing, Geoinformatics, Geoinformation management or other related disciplines.
- General professional experience (2.2.3): 5 years of experience in the acquisition and analysis of spatial data.
- Specific professional experience (2.2.4): 2 years of experience in spatial data organization and analysis.
- Regional experience (2.2.6): 2 years of experience in the project regions.
- Development Cooperation (DC) experience (2.2.7): 2 projects working experience with GIZ or other development cooperation.
- Other (2.2.8): Experience in land cover land use mapping.

Data collectors and encoders (ANRS:1, BGRS:4, GPNRS:6)

Tasks of data collector

- Collect quality field data as per the manual.
- Encode the data and convert to shapefile format.

Qualifications of database expert

- Education/training (2.3.1): A university degree in surveying, GIS, remote sensing, land administration, geography and other related disciplines.
- General professional experience (2.3.2): at least one year of experience in field spatial data collection using handheld GPS receives or similar tools.
- Regional experience (2.3.6): 1 years of experience in the project regions.

Soft skills of team members

In addition to their specialist qualifications, the following qualifications are required of team members:

- Team skills
- Initiative
- Communication skills
- Sociocultural competence
- Efficient, partner- and client-focused working methods
- Interdisciplinary thinking

5. Costing requirements

Assignment of personnel

Team leader: Assignment for 20 expert days.

GIS Expert: Assignment for 30 expert days.

Data collectors: Assignment for 40 expert days.

Travel

The bidder is required to calculate the travel by the specified experts and the experts it has proposed based on the places of performance stipulated in Chapter 2 and list the expenses separately by daily allowance, accommodation expenses, flight costs and other travel expenses.

6. Inputs of GIZ or regional partners

The regional bureaus mandated to the large-scale agricultural investment will provide the following:

- Available spatial data such as Agricultural investment project boundaries in the project woredas of the respective regions. (BGRS: Assosa & Bambasi, ANRS: Wenberma & D/Elias, GPNRS: Abobo, Gambella Zuria & Etang)
- Land cover/land use data of the study areas (if available).

7. Requirements on the format of the bid

The structure of the bid must correspond to the structure of the ToRs. In particular, the detailed structure of the concept (Chapter 3) is to be organised in accordance with the positively weighted criteria in the assessment grid (not with zero). It must be legible (font size 11 or larger) and clearly formulated. The bid is drawn up in English (language).

The complete bid shall not exceed 10 pages (excluding CVs).

The CVs of the personnel proposed in accordance with Chapter 4 of the ToRs must be submitted using the format specified in the terms and conditions for application. The CVs shall not exceed 4 pages. The CVs must clearly show the position and job the proposed person held in the reference project and for how long. The CVs can also be submitted in English (language).

If one of the maximum page lengths is exceeded, the content appearing after the cut-off point will not be included in the assessment.

Please calculate your price bid based exactly on the aforementioned costing requirements. In the contract the contractor has no claim to fully exhaust the days/travel/workshops/ budgets. The number of days/travel/workshops and the budget amount shall be agreed in the contract as ‘up to’ amounts. The specifications for pricing are defined in the price schedule.

Annex 1

List of Project Woredas & No. of LSAI

Regions	Project Woredas	No. of LSAI in the woredas	Approximate area (Hectare)
Amhara	Wenberma	23	2902
	Debre Elias	14	605
Benishangul Gumuz	Assosa	87	22,404
	Bambasi	78	16,673
Gambella	Gambella Zuria	153	78918
	Abobo	74	38026
	Etang	97	63934

Annex 2

Manual for Field Data Collection

Acquisition of in-situ data for Ethiopian Land Use Mapping

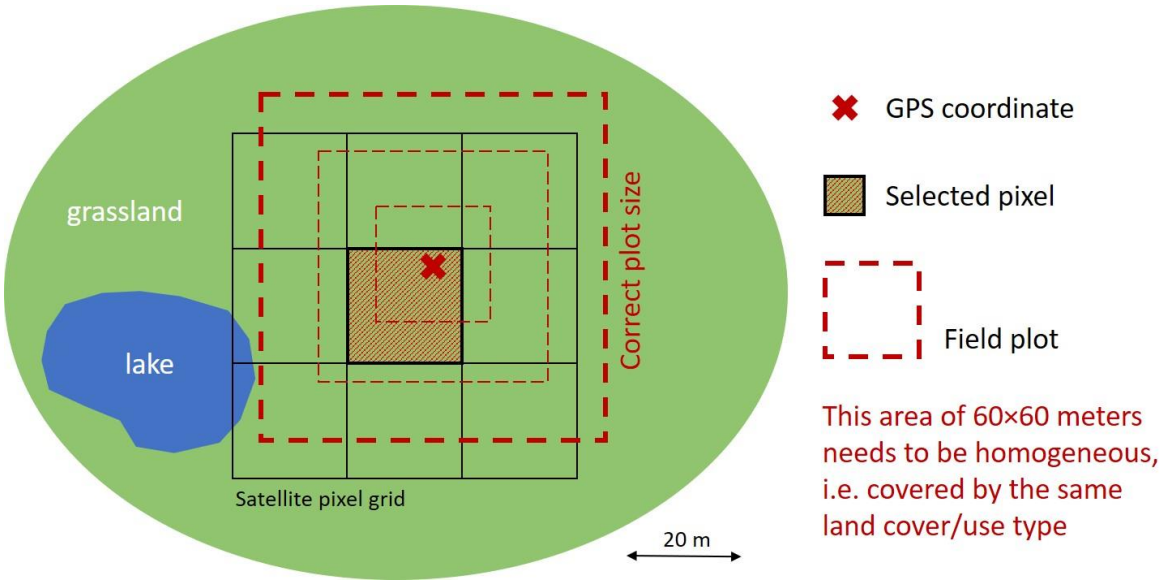
In-situ data (so called field data, field information, ground information, or ground truth) is required for the implementation of a land use classification with envisaged good to very good quality. This document aims at supporting the acquisition of suitable field information (in-situ data). Without field information, the creation and validation of land cover or land use maps is almost impossible.

1. Field measurements for classification based on satellite data

The use of satellite data with a certain spatial resolution causes special requirements for the in-situ data collection. The proposed dataset for classification will be Sentinel-2 satellite imagery with a spatial resolution of 20 meters per pixel (i.e. one pixel covers an area of 20 by 20 meters on the ground). **A field measurement** of a specific **land cover type** or **land use type** on the ground therefore **requires to be representative for an area of the size 60 × 60 meters**. This means that the entire area of 60 by 60 meters should be **homogeneous**.

Explanation: The challenge of collecting good quality field information is to choose locations that allow for a clear match of in situ information to information recorded by the satellite. In-situ information on the land cover/use is usually recorded in one location with a unique GPS coordinate, hence it is a **point information.** This information needs to be related to a pixel value, i.e. **area information**, for the classification. In the case of satellite imagery with a spatial resolution of 20 meters per pixel, this means that for a 20×20 meters area, only one information value is available in the satellite data. This value will be related to the in-situ information. Therefore, it is important, that the in-situ information is **representative** for the entire pixel area, i.e. that the area within the pixel square should be **homogeneous** and contain **only one land cover/use type**.

The rule of homogeneity, i.e. choosing larger plots that contain only one land cover type, is thereby fundamental due to the “mixed-pixel-problem”: the GPS coordinate will be used to select the corresponding pixel from the satellite imagery (see figure below). If this pixel was taken over an area covered by more than one land cover type, the signal is “mixed” and not typical for a specific land cover type. It can thus NOT be matched to the field measurement. This would introduce a large error in classical classification methods, reducing the reliability of the resulting map.
The homogeneous area on the ground centered on the GPS coordinate is called “**plot**” (see dashed red line in figure). Such a homogenous plot should be larger than the size of the pixel (at least twice the size), because it cannot be known where in the pixel the plot center will be located during the satellite acquisition, and it is unlikely that the plot center will be exactly at the pixel center. In addition, the geolocation of a pixel can only be guaranteed with an unsteady uncertainty, which depends e.g. on the topography. Therefore, reference point information from the ground needs to account also for that and hence plots for classification with the envisaged satellite data with 20 meters spatial resolution should be homogeneous over an area of **60 × 60 meters**.



2. Common land cover and land use classes

In a land cover map many classes such as tree cover, grassland, built-up area, bare area, together with a class "cropland" will be shown. The class “cropland” can further be differentiated into individual crop classes (i.e. crop types, land use types) that can be distinguished by remote sensing and for which in-situ data are available.

In-situ data are required for **every land cover and land use class** that is to be mapped. For the separation between cropland (cultivated land) and other land cover types (uncultivated land), those land cover classes that are similar to cropland are most important to be recorded in the field. Among these are bare areas, grassland/pasture, and (natural) sparsely vegetated areas - depending on the characteristics of the study site and its land cover/use.

Land cover and land use in-situ data are important for areas of specific interest such as bare areas. We need to know what you consider “bare area” in Ethiopia. Please also make sure to correctly distinguish between “bare area” (to our understanding: natural area that is bare and not covered by vegetation) and bare cropland / fallow land (cropland, which is not cultivated during this year).

Especially for the classification of different crop types, it is essential that reliable field data on crop types are collected. Without such in-situ data the identification of different types of crop is NOT possible. **For each individual crop type that shall be mapped, in-situ data need to be collected**.

For a good classification, a **minimum of 100 field plots** should be collected **for each individual land cover and crop type** (except water) that is to be mapped. **For each study site** (i.e. for each of the planned study regions / project areas) **in-situ data need to be collected separately**.

List of potential land cover and land use types

The **legend for land cover classification**, which is suggested for the envisaged land cover mapping in Ethiopia is the following:

Class number Level-1	**Land cover Level-1**	**Class number Level-2**	**Land cover**
100	Water body	**110**	Wetland
		120	Water body
200	Cropland	**–**	Cropland
300	Vegetation	**310**	Forest
		320	Woodland
		330	Afro-alpine Vegetation
400	Grassland	**410**	Grassland
		420	Scrubland
500	Built-up area	**–**	Built-up area
600	Bare land	**–**	Bare land

Please take **more than 100 in-situ points for every land cover type in the legend** (last column), except water bodies (Class number: 120).

Crop land differentiation for land use map

For every crop type that shall be differentiated in the classification, in-situ data have to be collected. All **relevant crop types that are commonly grown** in the study area should be included. The maximum number of crop types that can be distinguished is limited, depending on how similar the crops are with respect to spectral characteristics and timely development. A separation of more than five to seven crops at maximum is unlikely to be feasible.

Please **differentiate the cropland** into the **sub-classes of individual land use types / crop types.** These classes should be clearly distinguishable and measured as in-situ points in the field. The class “fallow land” is included for cropland areas that are commonly cultivated but are fallow in the year of observation, e.g. due to crop rotation. → Please **make a consistent legend** to be used for the field data collection.

The **legend for crop type classification**, which is suggested for the envisaged crop type mapping in Ethiopia is the following:

Class number	Land use / Crop type
201	Maize
202	Sorghum
203	Sunflower
204	Sesame
205	Mung bean (Masho)
206	Soya bean
207	Groundnut
208	Haricot bean
209	Cotton
210	Pepper
211	Horse bean
212	Chickpea
213	Field pea
214	Fallow cropland

Please take **more than 100 in-situ points for every crop type** in the legend.

3. Suggested step-by-step procedure for field data collection

Equipment to take with you:

- Several print outs of the **field form** (use the form we provide and which is shown below), pens and writing pad
- This **manual** and **list of classification numbers**
- **Mobile device** (you need **GPS and camera** – e.g. mobile device or mobile phone, e.g. you could use Gaia GPS (https://www.gaiagps.com/) or different mobile app that you prefer) for taking
  - GPS location
  - Pictures
- Compass (for distance measures)

Find and go to a **suitable location** for field data collection:

- Find suitable field plot
  - location with target land cover / land use
  - extent of minimum 60 × 60 meters
- Go to its center
- Check whether all coverage around you within 60 meters is exactly the same land use – only one type that you will later read in your legend (e.g. field of maize)

Fill out **field form**

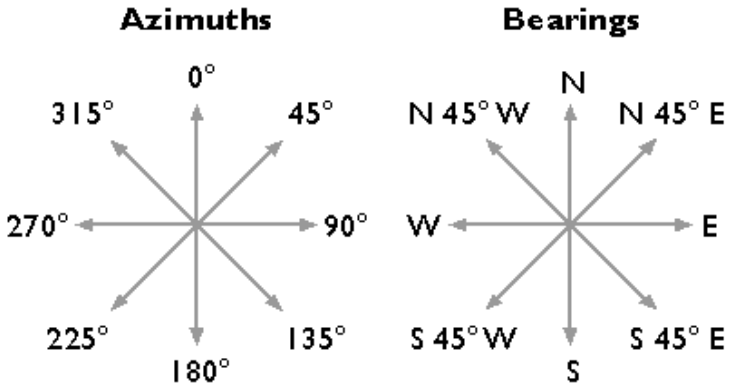
- Write down a name of the surveyor person, a date and time, and a geographic location (community, village, etc.) – (**1**)
- **Direct measures**: Take a measurement with a GPS device and give the GPS measurement a number, i.e. "Point ID" that contains an incrementing number (+ the date + name of the person). Write down the "Point ID" (**2**) and write down the location in latitude (**3**) and longitude (**4**) – ***Example*:** Addis Ababa city municipality office is located at 9,035°N 38,751°E. ***Use for Ethiopia*:** Latitude North of Equator is *N* and Longitude East of Greenwich line is *E*.

  Distance measures: If you cannot go within an area (e.g. because it is an agricultural field), take following measures:
  - GPS measurement: Point ID, latitude, longitude (**2, 3, 4**)
  - Distance to the middle of the target area (**5**)
  - and azimuth (see figure below), i.e. the angle between the direction you look at and the compass direction to North (**6**) – ***Explanation***: Imagine you stand in the field outside of a land use type you target (e.g. outside a maize field): look to the North direction and then to the point you target and estimate the Azimuth angle in Degree (°) between North and the direction of your point of target)

  → make a sketch of the situation (**7**), for better understanding of the location of the point and the target area

  → if this is too difficult, please only take points within a land use type (direct measures), and not from a distance

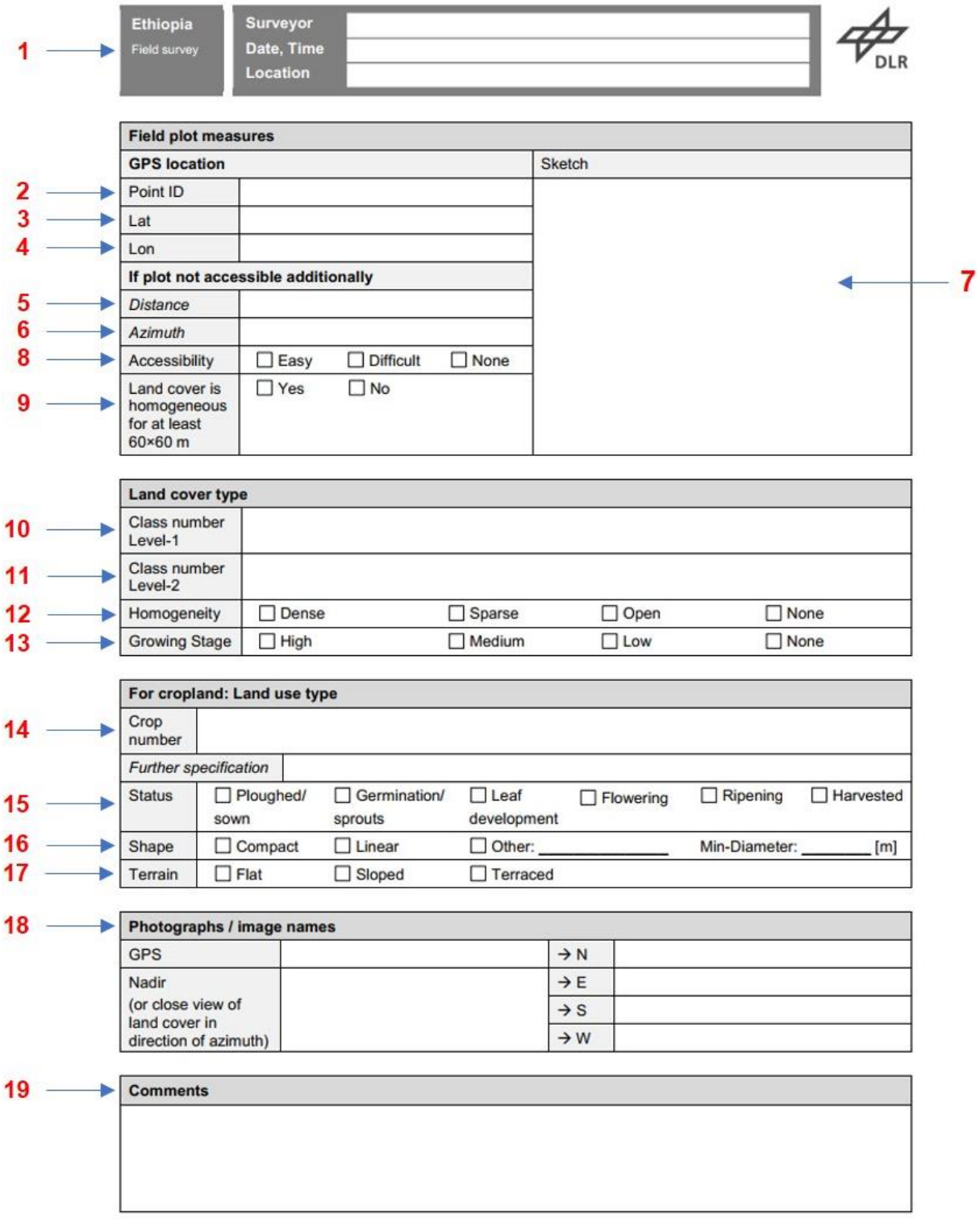
- Give information on accessibility (**8**)
- Check that the target area is homogeneous for at least 60 × 60 meters around the point of measurement (**9**).



- Look at the **list of land cover classification numbers**. Write down the class number for level-1 (**10**) and the class number for level-2 (**11**) for the measured land cover type. Use the numbers from the list, e.g. if you measure a field of maize – you would write "2000" for cropland. If a further specification has been agreed on with your contact person of the project, you can write down this additionally. – ***Explanation***: with just writing down the number (e.g. 2000) the surveyor can save a lot of time and prevent from misunderstandings, when **all surveyors use the same list**.
- Give additional information on the location that you observe on: homogeneity (**12**) and growing stage (**13**).
- If you are at a cropland site: Look at the **list of land use / crop type classification numbers**. Write down a land use / crop type (**14**). Use the numbers from the list, e.g. if you measure a field of maize, you would write "2001" for Maize. If a further specification has been agreed on with your contact person of the project, you can write down this additionally. **All surveyors use the same list.**
- Give additional information on the location that you observe on: status of the crops (**15**), shape of the field and minimum diameter (**16**), and the terrain (**17**).
- Take pictures (**18**) and write down the names/numbers of the pictures from the device you take pictures with (camera or mobile phone) – start taking a picture of the GPS (you as the person in the field holding the GPS in hand; the GPS coordinates should be visible in the picture). For each and every sample point take the pictures of the plot as follows:
    - a picture of the **GPS** you hold in hand
    - for **direct measures:** Picture of the ground at your location (Nadir view) – to get an impression of the ground coverage
    - for **distant measures:** Picture towards the target plot that shows the land cover/ land use type you are recording
    - **PLUS 4 pictures** towards the four directions: North, East, South, West (always in this order)
- Give any comments that you consider of importance (**19**).

After finishing this procedure from (**1**) - (**18**), start with a new plot … and so on.

4. Field protocol (with numbers from procedure described in manual)



1	Ethiopia Field survey	Surveyor Date, Time Location	DLR

Field plot measures						
GPS location						Sketch
2 Point ID						
3 Lat						
4 Lon						
If plot not accessible additionally						7
5 *Distance*						
6 *Azimuth*						
8 Accessibility	☐ Easy	☐ Difficult	☐ None			
9 Land cover is homogeneous for at least 60×60 m	☐ Yes	☐ No				

Land cover type				
10 Class number Level-1				
11 Class number Level-2				
12 Homogeneity	☐ Dense	☐ Sparse	☐ Open	☐ None
13 Growing Stage	☐ High	☐ Medium	☐ Low	☐ None

For cropland: Land use type						
14 Crop number						
Further specification						
15 Status	☐ Ploughed/ sown	☐ Germination/ sprouts	☐ Leaf development	☐ Flowering	☐ Ripening	☐ Harvested
16 Shape	☐ Compact	☐ Linear	☐ Other: _____	Min-Diameter: _____ [m]		
17 Terrain	☐ Flat	☐ Sloped	☐ Terraced			

18 Photographs / image names			
GPS		→ N	
Nadir (or close view of land cover in direction of azimuth)		→ E	
		→ S	
		→ W	

19 Comments