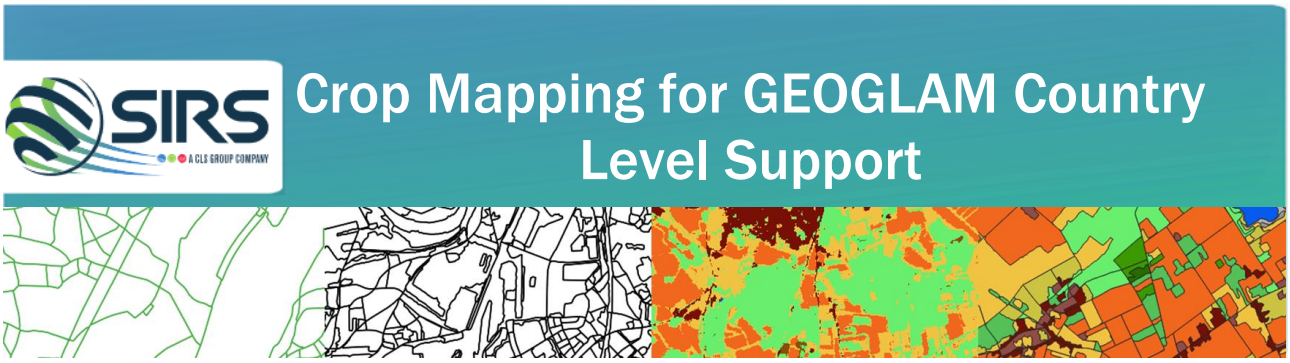
Service contract for the Copernicus Land monitoring services



Framework Contract N°939708-2020-IPR

First Specific Contract

D2.4 Field Campaign for Kenya – Short rains season – Methodology applied

Prepared by:

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COLLECTE LOCALISATION SATELLITES

TerraSphere

with support from:

Upande

Reference: COPERNICUS4GEOGLAM_ShortRains_Field_Campaign_Kenya

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AOI	Area of Interest
FAO	Food and Agriculture Organization
GeoODK	Geographical Open Data Kit
GPS	Global Positioning System
JRC	Joint Research Centre of the European Commission
OSM	Open Street Map
RGB	Red Green Blue
VHR	Very High spatial Resolution

1 Introduction

CLS (Collecte Localisation Satellites) and **TerraSphere** were selected in response to the Call for Tender for a Framework service contract in relation to Crop Mapping for Group on Earth Observations Global Agricultural Monitoring Initiative (**GEOGLAM**) Country Level Support as part of the Copernicus Global Land component.

The present document covers the D2.4 Deliverable focusing on summarizing the workflow and the changes between the actual field sampling and the planned one (as of the feasibility study) and the description of the impact of the changes in the following tasks.

Upande Ltd as a subcontractor to CLS was in charge of the field campaign in Kenya for the short rains season, taking full profit of past experience during the first field campaign and local knowledge regarding regulations, logistics and resources.

2 Objectives of the field campaign

The objective of the survey is to collect in the field harmonized training data (also called ground truth data) for 1) the classification of crop mask and crop types for the short rains season and 2) the provision of unbiased crop area estimates and the validation of the crop type maps and crop mask.

So, 75% of the data collected in the field will be used as a training dataset. The image classification will involve Sentinel-2 at 10-meters resolution (with support of Landsat-8), and Sentinel-1 time series. Sentinel-1 will only be used in case of prolonged cloudiness. The remaining 25% of the data collected in the field will be used to evaluate the accuracy of the results (distinction between crop types mainly) and to obtain information on unbiased crop area estimates.

3 Specification of the Area Of Interest (AOI)

Following a discussion with the Head of Agricultural Statistics Unit of the Ministry of Agriculture Tom Dienya, there were changes in the definition of the AOI as described in the feasibility study for Kenya (D1.1) with the addition of 3 districts (Narok, Laikipia and Tharaka Nithi).

The AOI was expanded and finally the field campaign took place over the counties in the western highlands counties; central and northern rift valley and central highlands (Busia, Kakamega, Bungoma, Vihiga, Siaya, Kisumu, Homabay, Migori, Kisii, Nyamira, Narok, Nakuru, Nandi, Elgeyo Marakwet, Trans Nzoia, Uasin Gishu, Kiambu, Nyandarua, Muranga, Kirinyaga, Embu, Meru, Laikipia, Tharaka Nithi, Nyeri, Bomet and Kericho). The total area occupied by the AOI is covering approximately 98,690 km² representing 17% of the country. The AOI as described in the feasibility study for Kenya (D1.1) previously covered around 75,000 km² resulting in an extension of approximatively 23,500 km².

The three regions usually act as swing regions for food security and availability of data from these areas will be an important step towards food security forecast in the country. Most of the AOI is located in the Highland areas (elevation ranging from 1000 m to 2500 m with mountainous areas having elevation ranges between 2500 to >3000 m). Fertile soils are prevalent constituting of loams and clay/sandy loams (i.e., Phaeozems, Nitosols, Cambisols). Soils are deep and well drained, and as such highly suitable for agriculture. Figure 1 shows the extent of the area.

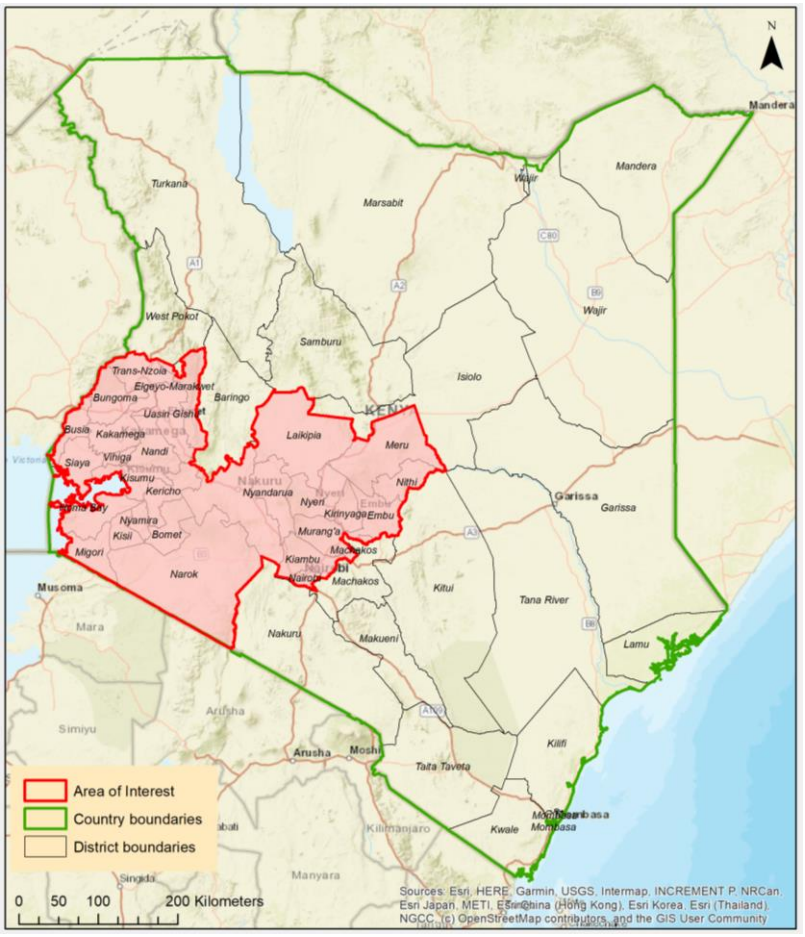


Figure 1: Area Of Interest (in red) in Kenya

Short rains season field campaign

There were no changes in the definition of the AOI for the short rains season compared to the long rains season.

4 Review of the Stratification and Sampling Design implemented in the feasibility study

4.1 Stratification

The stratification applied was unchanged from what was proposed in the feasibility study (D1.1) but was expanded to the new districts added into the AOI as described in section 3. The stratification is summarised as follows based on a series of 6 strata and defined as follows (see Figure 2):

1. Irrigated crops (including rice fields);
2. Rainfed Lowlands;
3. Rainfed Highlands Sub-Humid/Humid;
4. Rainfed Tropical Highlands Humid;
5. Rainfed Tropical Highlands Sub-Humid;
6. Other areas (including areas ≥ 3,000 m and land cover classes different from cropland areas).

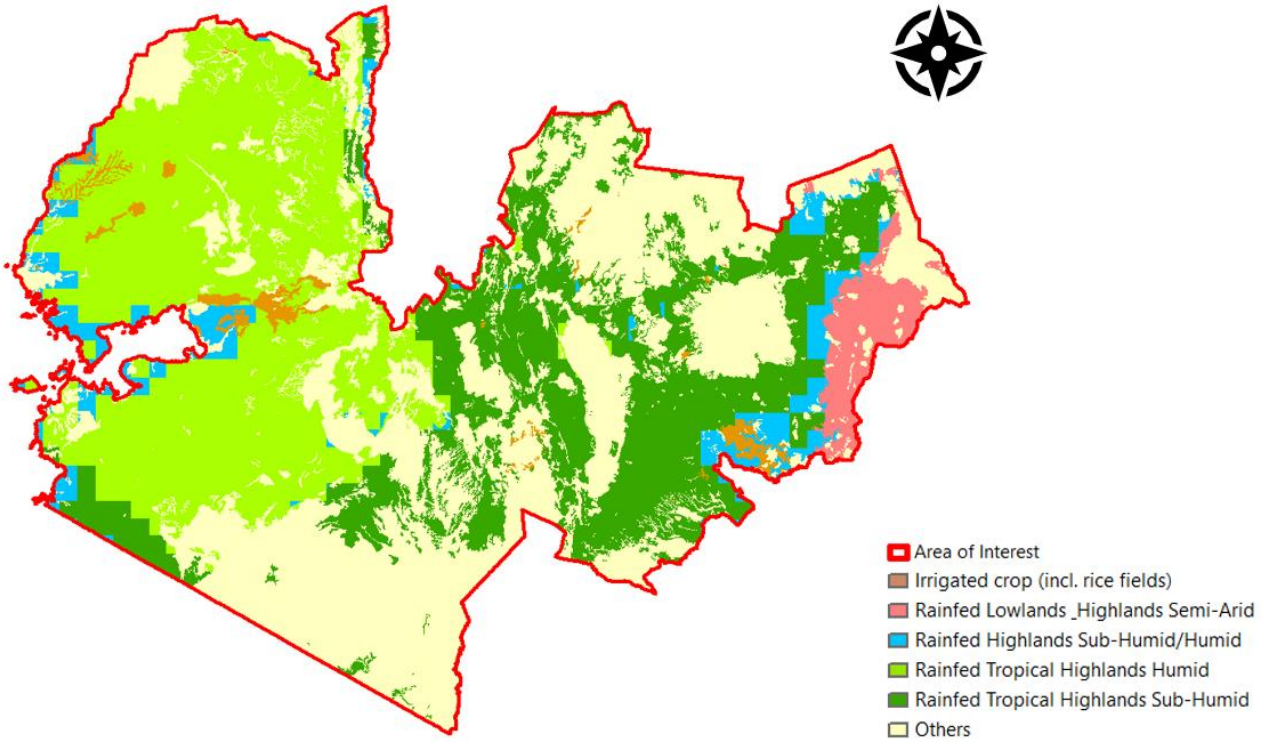


Figure 2: Derived AOI stratification

These strata are based on a combination of physical information (like the Copernicus Digital Elevation Model (DEM) at 30-meter spatial resolution[1] and the FAO's AFRICOVER dataset at 30 m for the Period 1995-2002) or the agro-climatic conditions (Agro-Ecological zones (AEZ) for Africa South of the Sahara at 10 km for the reference year 2015), so the resulting strata are homogeneous regarding both climate and agro-ecological conditions (relief, soil, etc.), and agricultural practices.

Short rains season field campaign

The stratification applied was unchanged from what was proposed in the feasibility study. No new stratification was applied for the second field campaign.

4.2 Sampling Design

Due to the modification of the AOI, the sample was modified from what was proposed in the feasibility study (D1.1) and delivered in D1.2 as a as a georeferenced vector file.

The approach is summarised as follows based on the new definition of the AOI.

The selection of sample units was still based on a stratified systematic and random sampling selection (two stage approach). The first stage was implemented by applying the same 20 x 20 km grid over the overall new area of the AOI. In a second stage, multiple sample units were still randomly selected in sequence for each grid cell based on the 500 x 500 m sub-grid as illustrated in Figure 3; but the protocol of the second stage was adapted.

1 https://spacedata.copernicus.eu/web/cscda/dataset-details?articleId=394198

Thus, the first replicate is in any case surveyed on the fields following the protocol described in the feasibility study (D1.1). But if the first replicate in the block is sampled in the cropland stratum, the second replicate is no longer included in the sample (whether it falls in the cropland or "other areas" strata). As described in D1.1, if the first replicate falls in the "other areas" stratum, the second replicate is still included only if it falls in a cropland stratum as there should only be one replicate in the "other areas" stratum per block.

The sample design finally resulted with 271 segments selected.

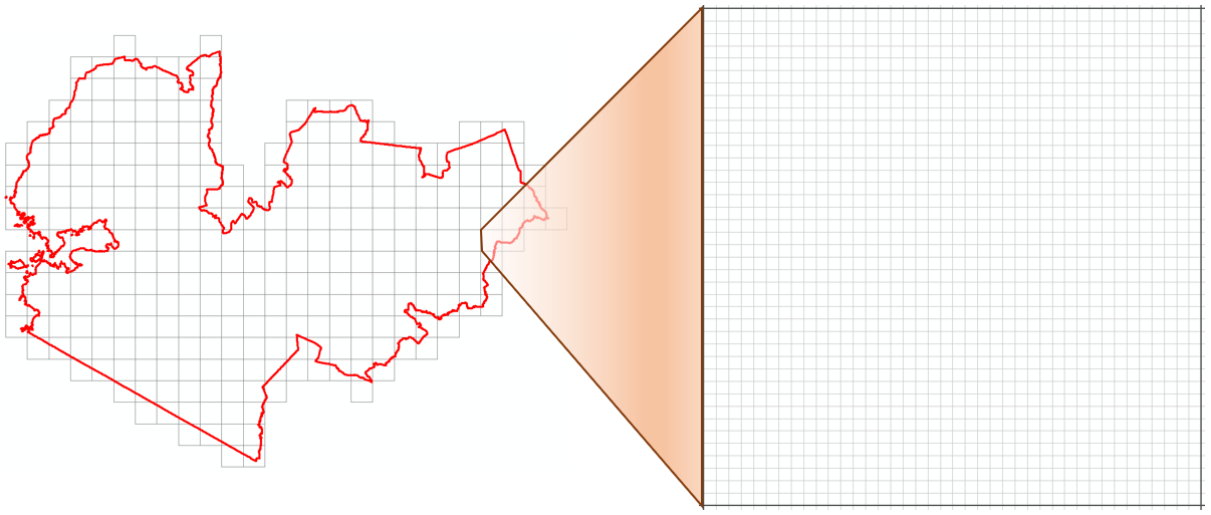


Figure 3: Two-stage stratified random sampling design: 1) 20 x 20 km grid applied on the AOI and 2) 500 x 500 m sub-grid used for the random selection of square segments as sample units

The spatial distribution of the sample units over the crop and non-crop strata are shown in Figure 4

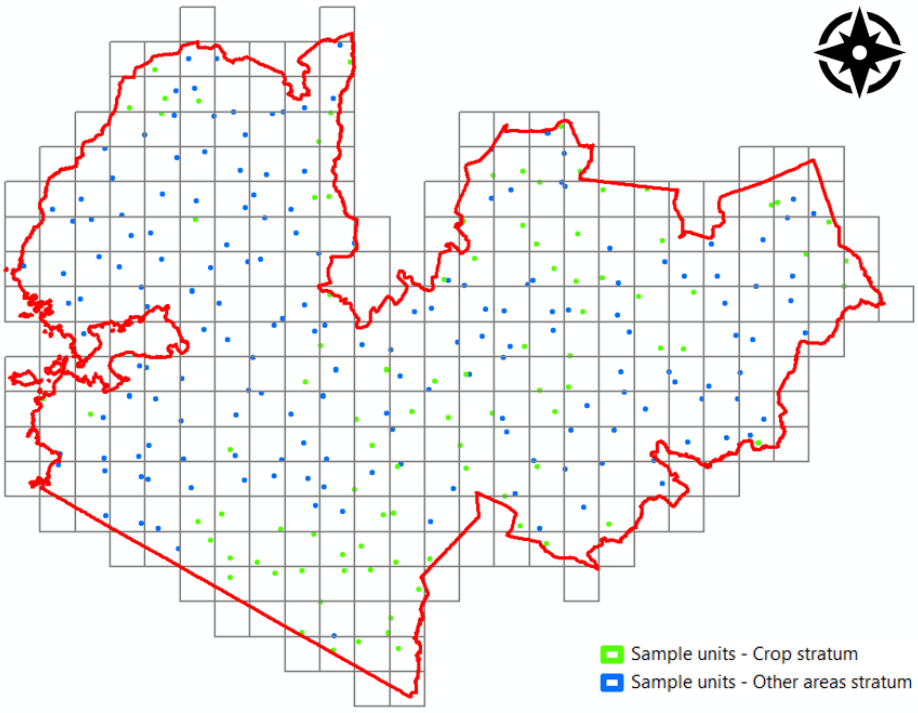


Figure 4: Spatial distribution of the sample units per aggregated stratum

However, a visual assessment of some of the selected segments was made during the feasibility study and showed that some crops were also sometimes present in the other areas stratum. Therefore, this assessment was conducted based on available imagery from Google Earth / Bing Maps over all segments to identify, from the overall samples, the segments without any crops present. This information was used to determine the number and location of the segment to be surveyed as an input to the contract for Upande Ltd. In total out of the overall sample of 271 segments, 201 segments were identified to contain field parcels and therefore were to be surveyed.

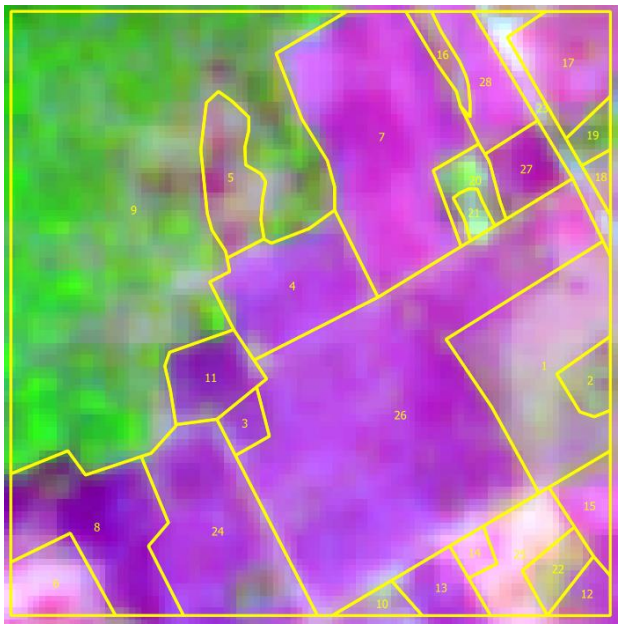
Short rains season field campaign

The sampling design applied was unchanged from what was proposed in the feasibility study. No new sampling design was implemented for the second field campaign; the same sample units/segments drawn were used

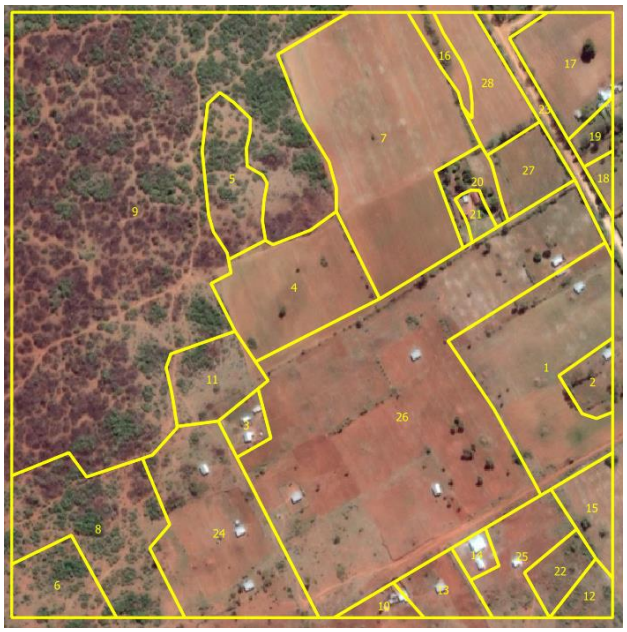
5 Field campaign

5.1 Segment survey protocol

Prior to the first long rains season field campaign, each segment has been visually interpreted by CLS using a combination of the most recent available Very High Resolution (VHR) imagery from Google Earth/Bing Maps, Yandex, Planet and Sentinel-2 imagery from the current season. All field boundaries (including cropland parcels) were digitalised, resulting in polygons that constitute the segment. Figure 5 shows an example of a square segment interpreted and digitalized overlaid on a Sentinel-2 image (16 April 2021) and a VHR Google satellite image (Actual date unknown). Both the square segments and the associated fields are numbered with unique identifiers. These identifiers correspond with the form to be filled by the enumerators. The hardware and software tools used by the enumerators to collect the information in each sample is described in the following section.



Sentinel-2 imagery from 16/04/2021 (False color composite B11/B8/B4)



VHR Google imagery (date unknow)

Figure 5: Example of samples digitalized prior to the fieldwork

After digitalising the fields, the land cover is determined. Based on the VHR and Sentinel-2 imagery a land cover is assigned following the “Main Land Cover” nomenclature presented in Table 1.

Table 1: Main Land Cover nomenclature

1	Forest
2	Grassland
3	Cropland
4	Bare soil
5	Urban
6	Shrubland
7	Water
8	Wetland

Standard definitions for Land Cover are applicable such as:

- Forest: areas covered by woody species capable of exceeding 5m height tree crown and area > 10%
- Grassland: areas where the vegetation is dominated by grasses with a maximum of 10% of tree cover
- Cropland: land devoted usually to agriculture (temporary or permanent) in case of doubt if there was not a clear distinction between e.g. grassland or cropland, the parcel was classified as cropland
- Bare soil: areas with a minimum of 50% bare ground
- Urban: human settlement with high population density and infrastructure of built environment
- Shrubland or bushes: where the vegetation is dominated by shrubs (small to medium sized perennial woody plant) >20% cover of woody plants < 5m high
- Water: areas covered with permanent water surfaces (canal, rivers, water bodies, etc.)
- Wetland: a distinct ecosystem that is flooded by water, either permanently or seasonally, may include vegetation.

Only segments for which cropland is detected were surveyed. In cases of doubt, the segment was included in the survey. As a result, based on the new AOI and the modification of the sampling design protocol, **201 cropland segments were identified (out of 271) from which cropland parcels have been detected and potentially to be surveyed,** as is shown in Figure 6.

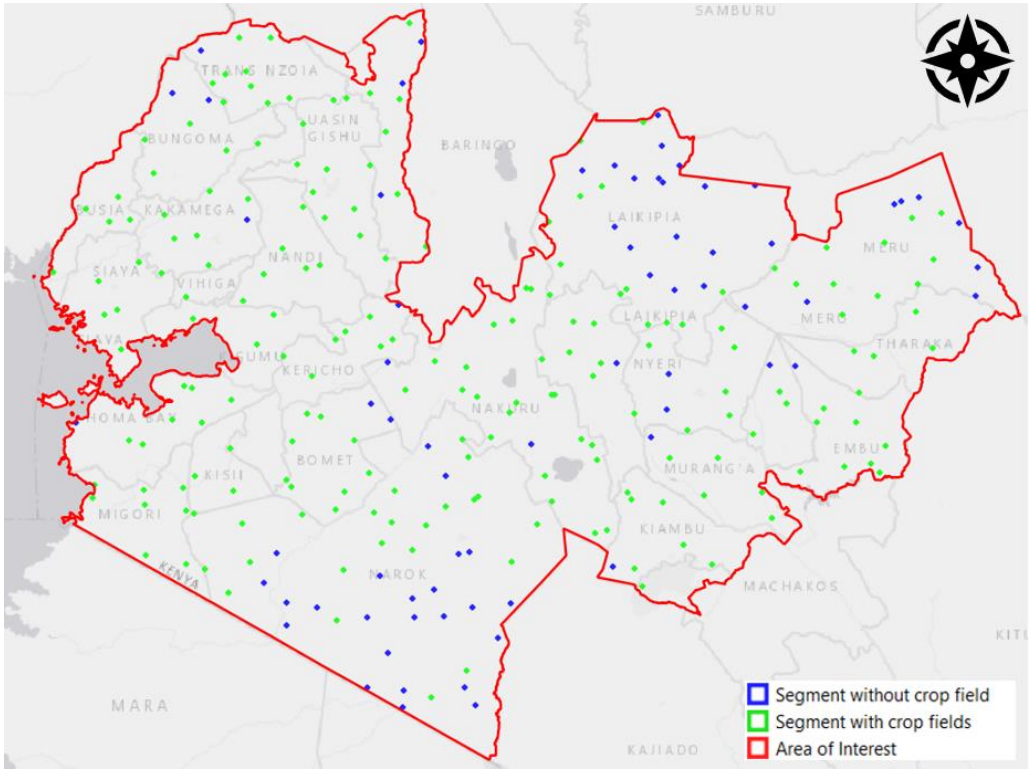


Figure 6: Spatial distribution of the 247 segments where crops have been identified

Short rains season field campaign

The sampling design applied was unchanged from what was proposed in the feasibility study. No new sampling design was implemented for the second field campaign; the same sample units/segments drawn were used and visited in the field.

5.2 Adaptation of the field protocol and description of the impact of the resulting changes

All the 201 segments where crops have been identified were not surveyed in the field. During the field campaign, the enumerators faced some difficulties accessing the segments due to multiple causes such as:

- Segments not accessible due to the heavy rains, the landscape or the wildlife (e.g. located in mountainous areas, without road/track network, presence of snakes)
- Local people/farmers denying the access to their private land, getting even sometimes violent. Some enumerators were sometimes held captive for several hours by local community before being released.
- Segments located in Government's properties (access denied despite the official support letters made available with enumerators holding in custody for several hours)
- Segments located in insecure counties such as Laikipia[23].

So, for the safety of the enumerators, it was decided not to survey those segments. Finally, only 167 cropland segments were visited as shown in Figure 7.

The 34 cropland segments that were not visited are mostly scattered over the entire AOI as shown in Figure 7 below even if two counties were particularly affected, Laikipia (northern part of the county) and Narok (southern part). Nevertheless, the two counties are not swing regions for agriculture with mainly non-crop areas (see Figure 2), so segments visited and located in the two counties should be sufficient. Therefore, the surveyed sample should be representative of the overall AOI and the resulting crop area estimates should not suffer from any substantial bias.

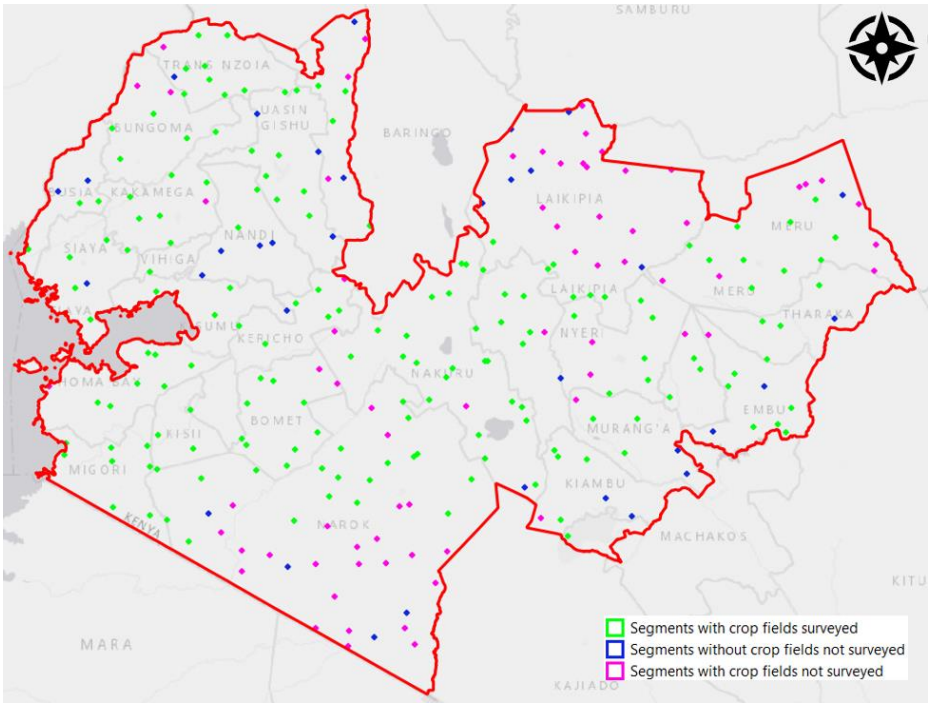


Figure 7: Final Spatial distribution of the surveyed segments

[2] https://www.bbc.com/news/av/world-africa-58677304

[3] https://www.standardmedia.co.ke/editorial/article/2001423264/tackle-root-causesof-laikipia-clashes-once-and-for-all

Moreover, all the parcels where crops were identified within a segment were not surveyed. This was due to the fact that it had been agreed that a maximum of 50 crop parcels within a segment were to be surveyed to avoid spending too much time on one segment. Indeed, as described in the feasibility study (D1.1), most of the farmers in the AOI are small holder farmers with land sizes ranging from 0.4 to 2 hectares often resulting in more than 50 crop fields per segment in some cases. In addition, to save time during the survey and considering the spectral heterogeneity of field parcel less than 1,000 m², it was also decided not to survey the crop parcels less than 1,000 m² with a maximum of 50 fields to be survey inside a segment.

5.3 Information collected in the field

The information collected was performed as planned in D1.1 with some minor adjustment as detailed below.

For each field id the enumerators have to collect data grouped in two categories:

1. First, the context of the sample with **field characteristics.** The geolocation of the position where the enumerators collect the data, and the time of visit were collected. The field characteristics to be collected in the field and to be reported in the form are shown in Table 2.
2. Secondly, the **crop characteristics** were be captured including especially the identification of the crop type for each field that is identified as cropland. The crop characteristics to be collected in the field are shown in Table 2.

Table 2: Information to be collected and documented in the application.

Additional information	Definition	Possibilities
Cropland presence	Presence of crop fields	Yes / No
Crop identifiable	Is a crop identifiable in the field?	Yes / No
Irrigation type	Identification of the irrigation type	Rainfed / Irrigated / Unidentified
Cropping pattern	Identification of the cropping pattern	Mono-culture / Mixed cropping / Agroforestry
Crop in monoculture	Identification of the name of the crop	Maize / Beans / Potatoes / see Figure 25
Crop field status	Identification of the crop field status	Bare soil / crops in ridges / ridges closed / field covered
Overview photo of the field	Photo indicating the field	
Detail photo of the field	Photo indicating details like crop stage or field preparation	Text

Especially, the enumerators identified the correct crop type for each field identified as cropland using a predetermined nomenclature shown in ANNEX I – Description of form used for segment survey.

Short rains season field campaign

To improve the crop areas estimates and the classification results, it has been asked to the surveyors to indicate during the second rainy season field campaign:

1. if a dominant crop was visible for crops in mixed cropping pattern.
2. if the whole field was fully harvested or not.

5.4 Survey logistic and implementation

The survey logistics was performed as anticipated in D1.1 with some minor adjustments as detailed in the following sections.

5.4.1 Equipment in the field

Before performing the fieldwork, the team installed all the equipment and software tools mentioned below.

5.4.1.1 Mobile devices and software tools

The fieldwork was carried out predominantly with **mobile devices** (e.g., an android smartphone or a tablet) using a dedicated **Open Data Kit (ODK) Collect** application customized by Upande to store the collected information in a uniform way using a smart form. ODK Collect is an open-source application which is usable offline but can communicate with a central database to retrieve forms and upload information. The information was stored in the form as numeric fields, text fields, photographs, and geolocation. Figure 8 presents an earlier example of a smart form which was used to test the fieldwork procedures in December 2020.

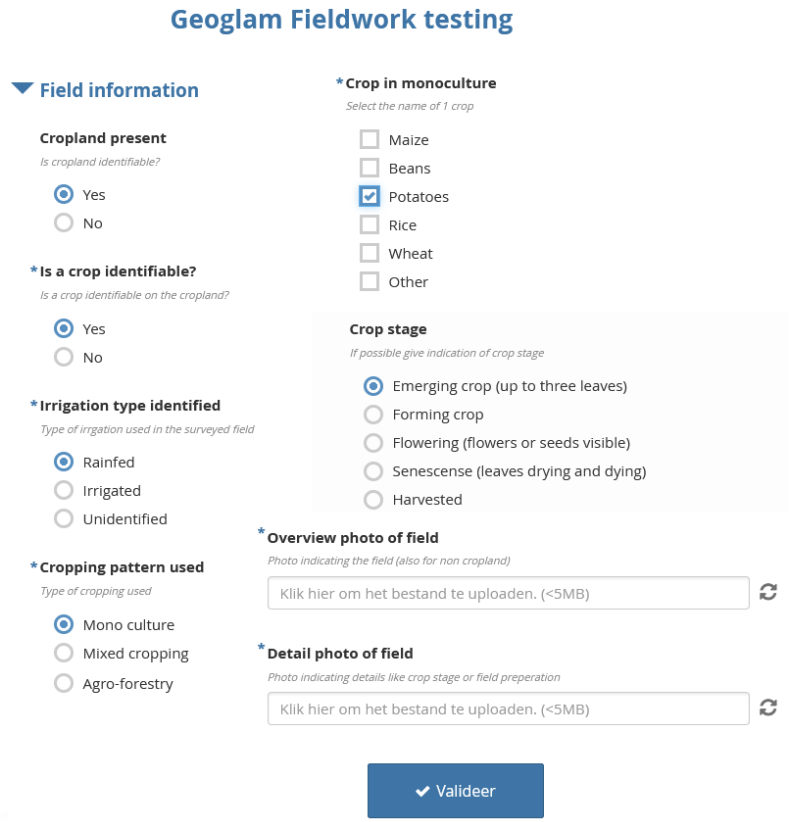


Figure 8: Screenshot of the GEOGLAM fieldwork data form for Kenya.

Data was captured locally and transmitted to secure cloud servers once internet connectivity became available.

Because the capture of geolocation is dependent on the Global Navigation Satellite System (GNSS) available on the mobile device like smartphone or tablet), it is important that the device is capable of getting an

accurate measurement and quick fix of available satellites during sampling. The most ideal situation is when the chip of the device is capable of receiving multiple constellations such as GPS and GLONASS.

Beside the application needed for data collection, the application **Avenza maps** were installed on mobile device and used for convenient navigation from one sample unit to the next one (see Figure 9). Avenza Maps allows the display of basemaps like Open Street Map (OSM). To facilitate navigation from one sample to the next one, custom maps were provided in MBtiles format. These maps combine Red Green Blue (RGB) or False Color mosaicked Sentinel-2 images with vector overlays of the square samples and a selection of OSM elements (roads and waterways). Each team of enumerators were provided with an indicative optimal route.

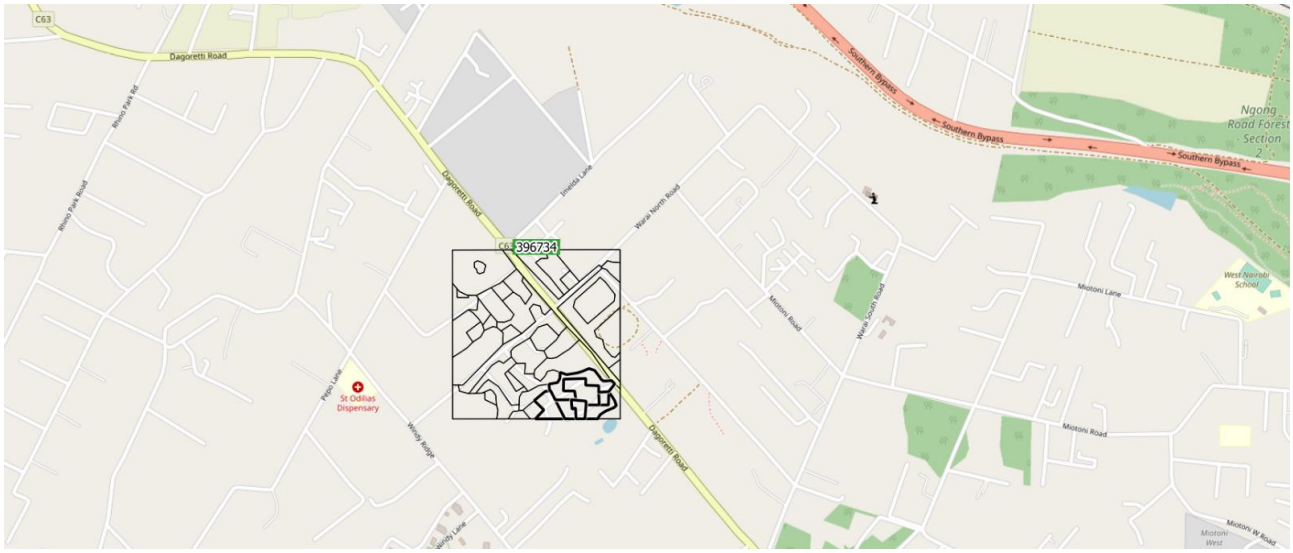


Figure 9: Situation map with segment squares and OSM network

Figure 10 shows a general example of visualization possibilities with Avenza Maps.

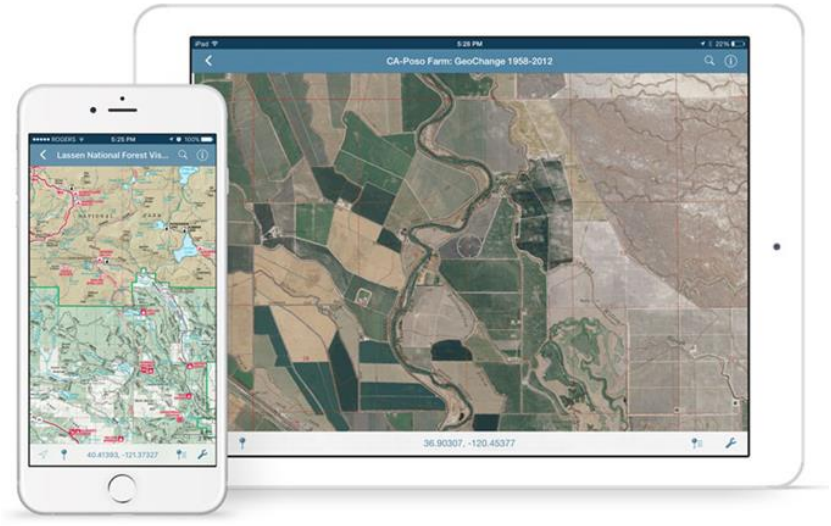


Figure 10: Avenza Map mobile app examples

Beside navigation the application was also be used to collect additional ground-truth data by the quality control team. See chapter ANNEX I – Description of form used for segment survey for a further description of the collection methodology for this additional data collection.

5.4.1.2 Additional instruments and equipment

Although fieldwork can be performed with the mobile devices and tools mentioned above, additional equipment can be used during fieldwork. Especially to mitigate failure of the mobile devices or provide a cross-check. Enumerators were advised to equip themselves with hardware to mitigate problems with the mobile devices like spare memory cards, sufficient cables, chargers and power banks.

To cross-check the accuracy and mitigate errors with capturing geolocations on the mobile device an additional navigational device like a GPS receiver can be used in the field. An additional photo camera can be used to mitigate failures of the camera in the mobile device. It also helps to collect additional pictures during sampling to provide more context for those processing the fieldwork data.

T-Shirts, Baseball caps or umbrellas with logos from the European Union (EU) made available by the EU Delegation in Kenya were worn by enumerators during the field campaign to facilitate contacts with local farmers. These were considered particularly useful and even essential.

5.4.2 Field work methodology and orientation in the field

5.4.2.1 Guidelines

Every evening, the team prepared the routing to reach samples that they plan to do the day after. Each team of enumerators prepared an indicative optimal route to reach the segments to visit.

The following guidelines were applied:

- Maximize the use of public rights of way;
- Visit the local community leader office to ask permission where possible to get permission of carrying out the field visit in those areas
- Do not damage;
- If challenged, explain mission (show the official support letter from the country contact), be polite, and apologise if necessary.

5.4.2.2 Orientation

As mentioned, the software Avenza maps were used for navigation from one sample to the next one. Within the application distinct types can be used to navigate and orientate. Both OSM basemaps (see Figure 11) and custom made RGB or false color satellite imagery (see Figure 12) were provided. Overlays were available of the digitalized samples and fields in combination with OSM vector networks like roads and waterways. This routing was advised to be planned at least one day before visiting the sample.

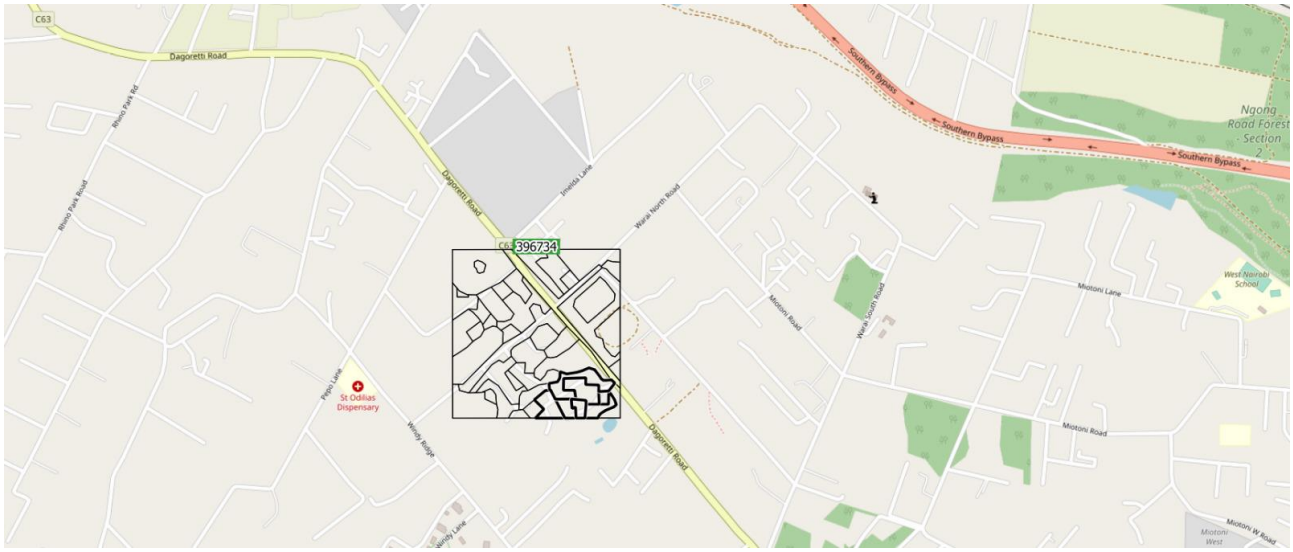


Figure 11 Orientation using OSM with overlayed sample unit 396734

Figure 12 Satellite imagery (S2) in natural colours with sample fields and routing overlays

Within the ODK Collect the same maps were made available through MBtiles. When taking a geolocation the enumerators could see a point on top of the selected basemaps with vector overlays. This helps 1) to visualize the geolocation is currently correctly measured and as such reduces the errors that might result of

a lower quality satellite fix and 2) to capture locations in the app from a distance. This is possible because the location can be selected by tapping a location on the map and confirm the pinpoint. This type of orientation in the ODK collect app will be used when the enumerators are in the field.

5.4.2.3 Field survey protocol and data collection

When the team reaches the segment, enumerators filled in the smart form stored on the mobile device with ODK Collect. This form ensures a quick, intuitive and uniform collection of field data. The enumerator is asked to identify field information on crop type and crop stage, as well as meta information on the country, the surveyed sample unit, and the field_id. A detailed description of the form is presented in ANNEX I – Description of form used for segment survey.

Figure 13. Illustration of the field data collection process

5.4.2.4 Photography

In order to cross-check the results, geolocated pictures of the crops (close-up for crop phenology and more distant for crop type and condition) were captured to assess the quality of the collected fieldwork. If needed it will help to augment the results with the help of a trained agronomist.

So, enumerators were requested to take 1) an overview picture of each field present in the segment from their selected vantage location and 2) a close-up picture of the present crop.

Overview pictures provide an overview of the fields with clear features of the visible landscape. These pictures will support spatial orientation at a later stage, using *e.g.,* Google Earth.

5.5 Specification of the local fieldwork partner and organization

The Kenyan company Upande Ltd has been selected as partner of the consortium to conduct the fieldwork for both growing seasons in 2021. Upande Limited is a private Kenyan social enterprise founded in 2009 in order to provide Internet, web mapping and Geographical Information Systems (GIS) services to a variety of clients including private sector, governments, multilateral and bilateral agencies. Customers are primarily based in Kenya, but they serve several other clients across Africa and beyond. During the last few years Upande has moved from a services provider to developing its own products. All products share that they facilitate data centric decision-making and have sensor data integration. The Upande team consists of a group of experts in GIS, Internet mapping, environmental and social academics, software developers and business practitioners.

5.6 Summary of the field campaign

- Starting date: 2021-11-16
- Ending date: 2021-11-29

A revisit was later conducted in January 2022 to cover fields and segments that were not covered during the first visit of the second campaign and those that had issues:

- Starting date: 2022-01-16
- Ending date: 2022-01-20

Upande Ltd were responsible for all practical local fieldwork and data acquisition. In total 12 enumerators were hired. A dedicated team took in charge the overall management of the campaign.

The project activities experienced challenges during the field campaign such as:

- Access denied to privately owned lands due to the fear of insecurity in certain areas or some local chiefs which were against the field campaign exercise even after being presented with the introductory letter supporting the exercise from the National government. Some enumerators were held hostage for a couple of hours before being released by the local community members/farmers such as in Thika Kiambu County, Elgeyo Marakwet.
- Segments inaccessible by means of vehicle or “bodaboda” (motorbikes) because roads were closed (not updated on map). Narrow, rocky, and hilly routes in some parts which could not be accessible by motorbike, forcing data collectors to walk long distances in order to cover crop parcels, whereas some areas could not be covered on foot.
- Severe rains affecting the survey on some regions.

6 Conclusion and recommendations

Overall, the field data collection in Kenya was performed as planned. The field campaign lasted for about nearly 2 weeks (with a short 4-day revisit later in January) so most crops were still in their vegetative state.

Interaction with local team was good and the quality of the work was also good once some minor adjustments were made.

Some recommendations based on feedback from the Upande can be made in case of a future campaign:

- Sensitization through radio/newspapers while engaging local community leaders a month before the start of the field campaign (chiefs, village elders, nyumba kumi leaders in areas to be visited).
- Providing small gifts to local authorities and farmers such as EU branded pens, baseball caps, shirts to allow smooth operations of our teams.
- Involving police officers in regions identified as risky areas.

- Using weather forecasting tools so that enumerators can be informed and decisions can be made for the organization of the field campaign.

7 ANNEX I – Description of form used for segment survey

7.1 Preamble

This annex describes the structure of the smart form, the protocol to be followed, what kind of information it retrieves in the field and how to deal with issues when surveying in the field.

Before starting to collect field information, each enumerator must make sure:

1. He is using the **new form** with the new URL in the ODK Server setting as shown in Figure 14:
   - URL: https://kc.kobotoolbox.org
   - Username: geoglamkenya
   - Password: see corresponding email
2. He is using the proper Reference Layer as shown in Figure 15. The enumerators have to use the **last MBTiles** from October/November 2021. The Figure 15 clearly shows that the MBTiles used are from October 2021 for all AOIs and each enumerator has the responsibility to check the proper use of the MBTile.

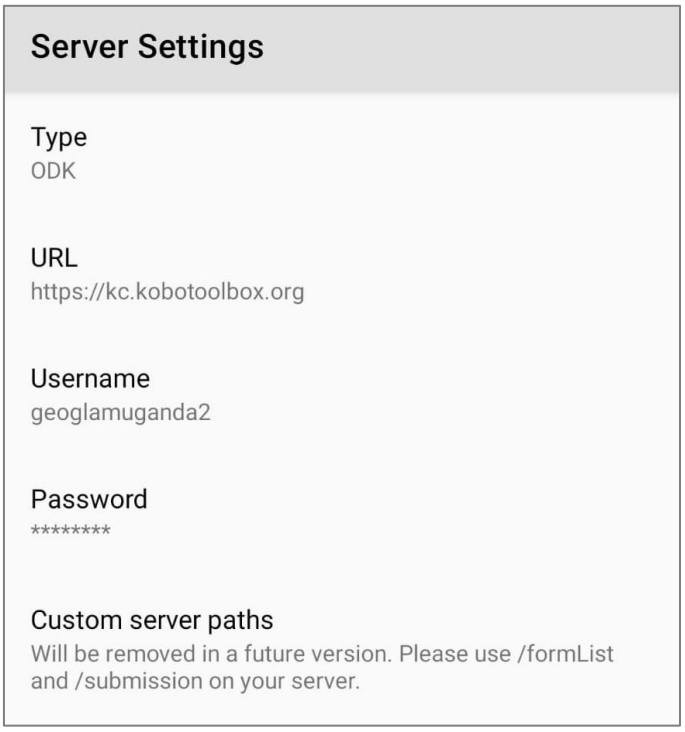


Figure 14: Server setting

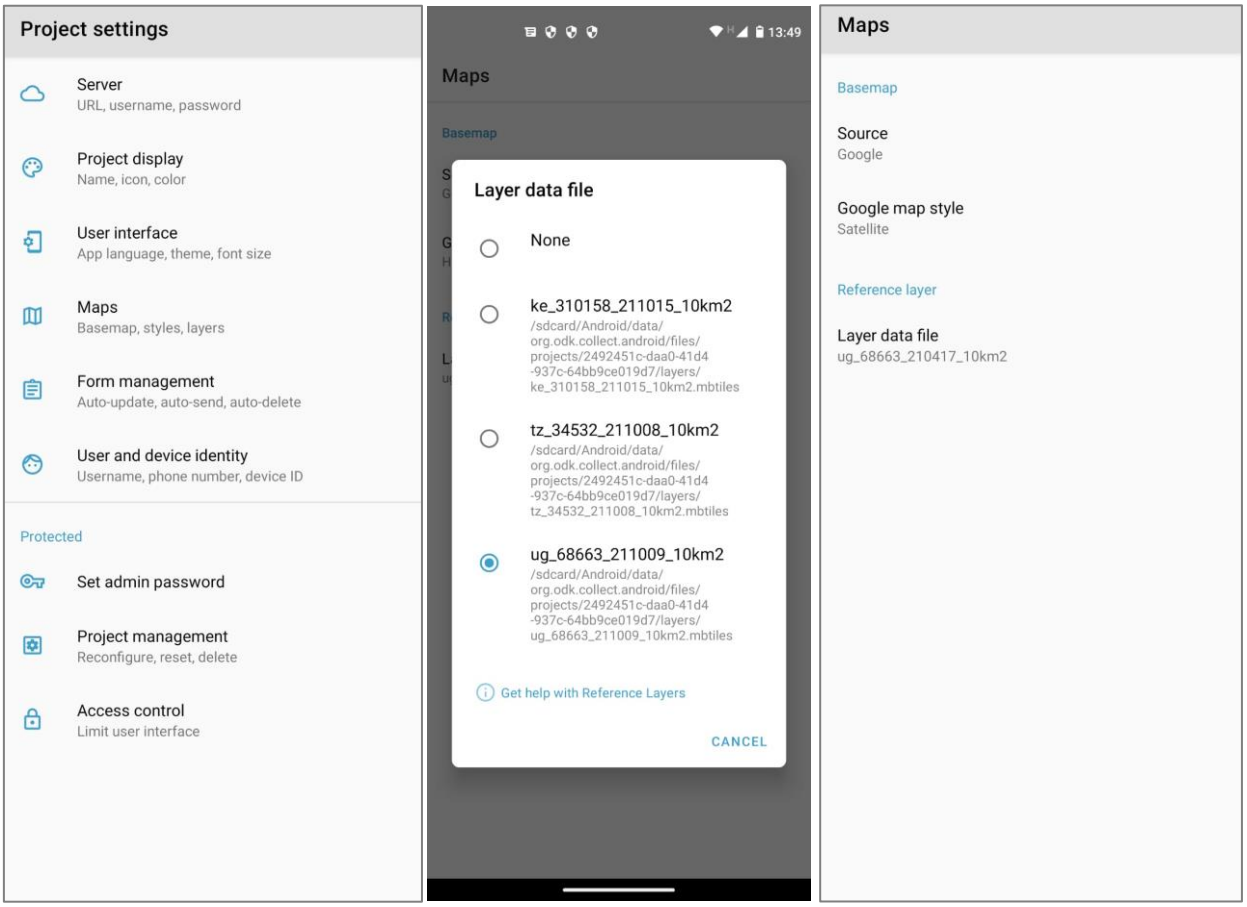


Figure 15: Map setting and MBTile selection

Hereafter, you will find the procedure to be followed for the configuration of the MBTiles, procedure based on a laptop where are stored the new MBTiles and the smartphone used in the field. This is a general procedure, and the configuration can vary from one device to another. Nevertheless, the steps to be followed:

1. Connect the smartphone with a USB cable to the laptop.
2. When connecting the USB to the laptop, the smartphone asks for the connection mode?
    a. If yes: choose the “File transfer” mode.
    b. If no: search for the general setting on the smartphone (with a “wheel” icon ⚙). Go to the “USB preferences” setting or in the search section, type “USB” and select the mode to be used for USB (File transfer) as shown in Figure 16.

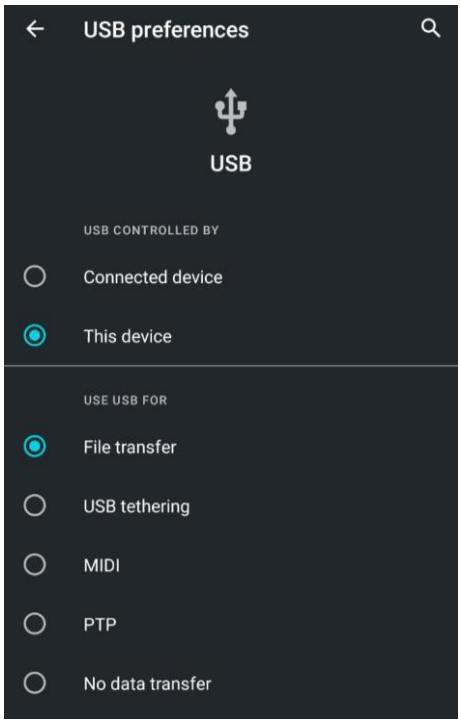


Figure 16: USB preferences

3. On the laptop, open an explorer window and navigate to the location where the MBTiles are stored (see example in Figure 17).
4. Delete all the old MBTiles.
5. Copy the new MBTiles.

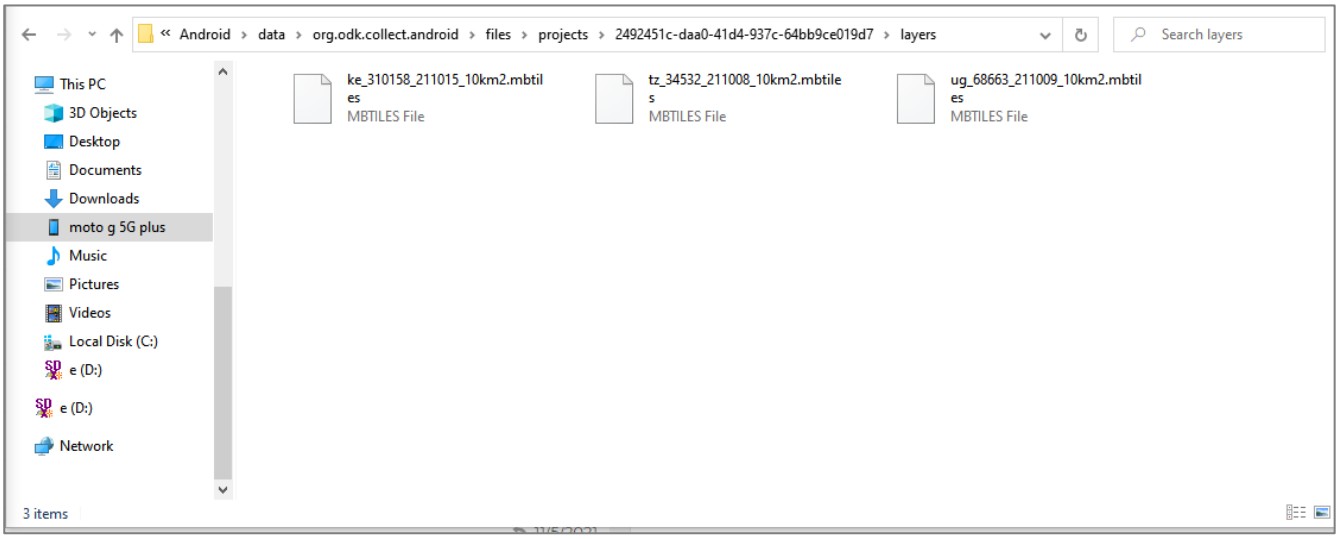


Figure 17: Configuration of the MBTiles in the smartphone used for the field campaign

Prior to the field campaign, each sample has been visually interpreted. All field boundaries (including cropland parcels) have been digitalised, resulting in polygons that constitute the sample. After digitalising the fields, the land cover of each field is determined. following the “Main Land Cover” nomenclature. Only cropland parcels should be surveyed during the field campaign.

7.2 Geolocation

When the surveyor is in the parcel, the first step is to pinpoint its current geographical position in the field as shown in Figure 18. The application will automatically use the coordinates given by the smart device.

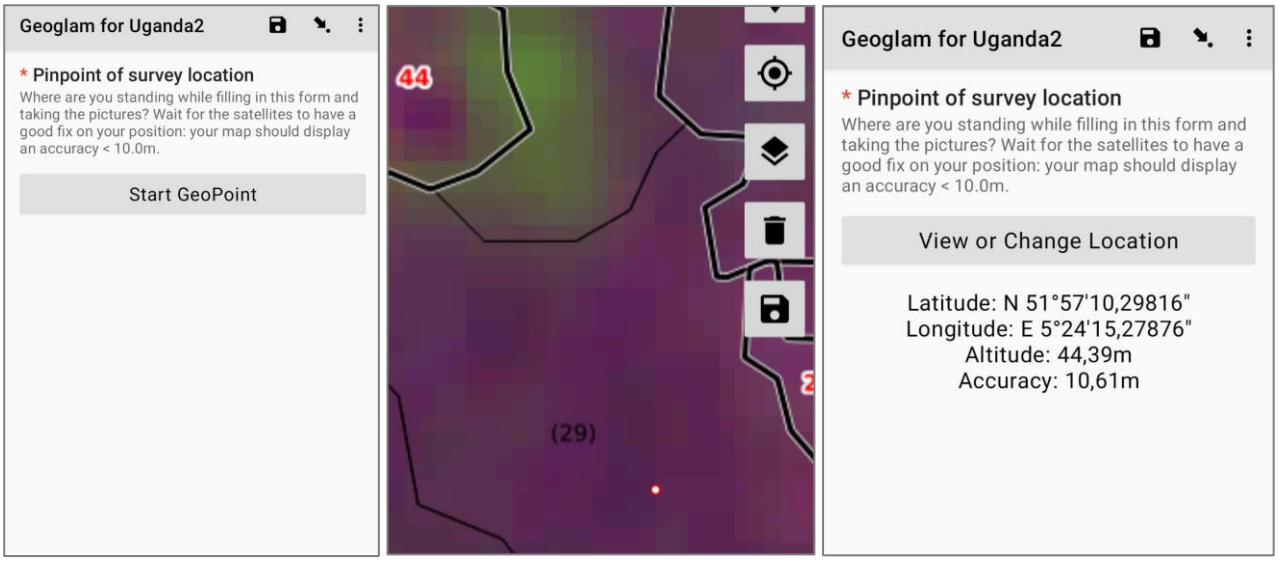


Figure 18: Pinpoint of survey location

The first geolocation concerns the position where the enumerator is standing when making its observation, filling in the form and taking the pictures.

The enumerators have to wait until the spatial accuracy is below **10 meters**.

The second step is to indicate/pinpoint the field actually surveyed as shown in Figure 19. In other words, the enumerator has to point the field surveyed on the screen (long press on the smartphone). It should be notice that no spatial accuracy is available for this second geolocation (field surveyed) because manually recorded by pressing the screen.

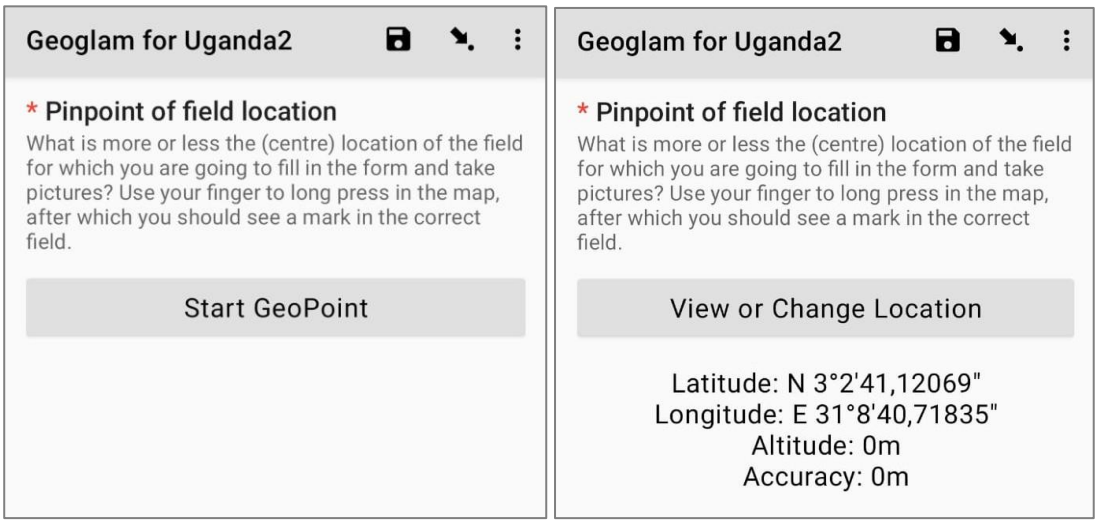


Figure 19: Pinpoint of field location

The enumerators have to access the field to collect the information (exceptions: any events like prohibition by owners or local governments or accessing issues due to heavy rain etc.). Indeed, the quality of the observation will be better when sitting in the field than observing from a long distance.

Special case: the field cannot be accessed

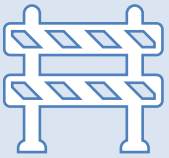
Case 1

If the field cannot be accessed BUT all the information concerning the cropland can be identified from a (small) distance the form can be filled in. In this case, during the second geolocation step, the pinpoint should be placed **within** the field observed and the collect make as usual.

Case 2

Many events like prohibition by owners or local governments or accessing issues due to heavy rain etc. can cause that a field can permanently not be accessed by the enumerator. If the field cannot be accessed permanently and no information can be retrieved, we still want to have the form filled-in, so that for the data-analysis it is clear that no data is to be expected in a later stage and that the field is not "forgotten".

In this case the enumerator can fill-in the form by: 1) **pinpoint** the field on the screen, 2) indicate "**No incorrect delineation"** to the question "Is the field correctly segmented with the desk digitization?" and put a note: "Field cannot be accessed due to [*with the reason*]", 3) indicate "cropland presence" with "No" and "Landuse" with "Other" and note that the field could not be accessed 4) make a mock-up picture and send the form.



Even if the **field cannot be accessed** permanently and **no information can be retrieved**, **enumerators have to fill in the form systematically**.

7.3 Meta-information

The next parts of the form are focusing on retrieving meta information concerning the fieldwork: “country_id”, “sample_id” and “field_id” (see Figure 20). For each segment of 500x500 meters a MBTile is created and the sample_id is given in the top middle of the MBTile (as seen in the third image in Figure 20).

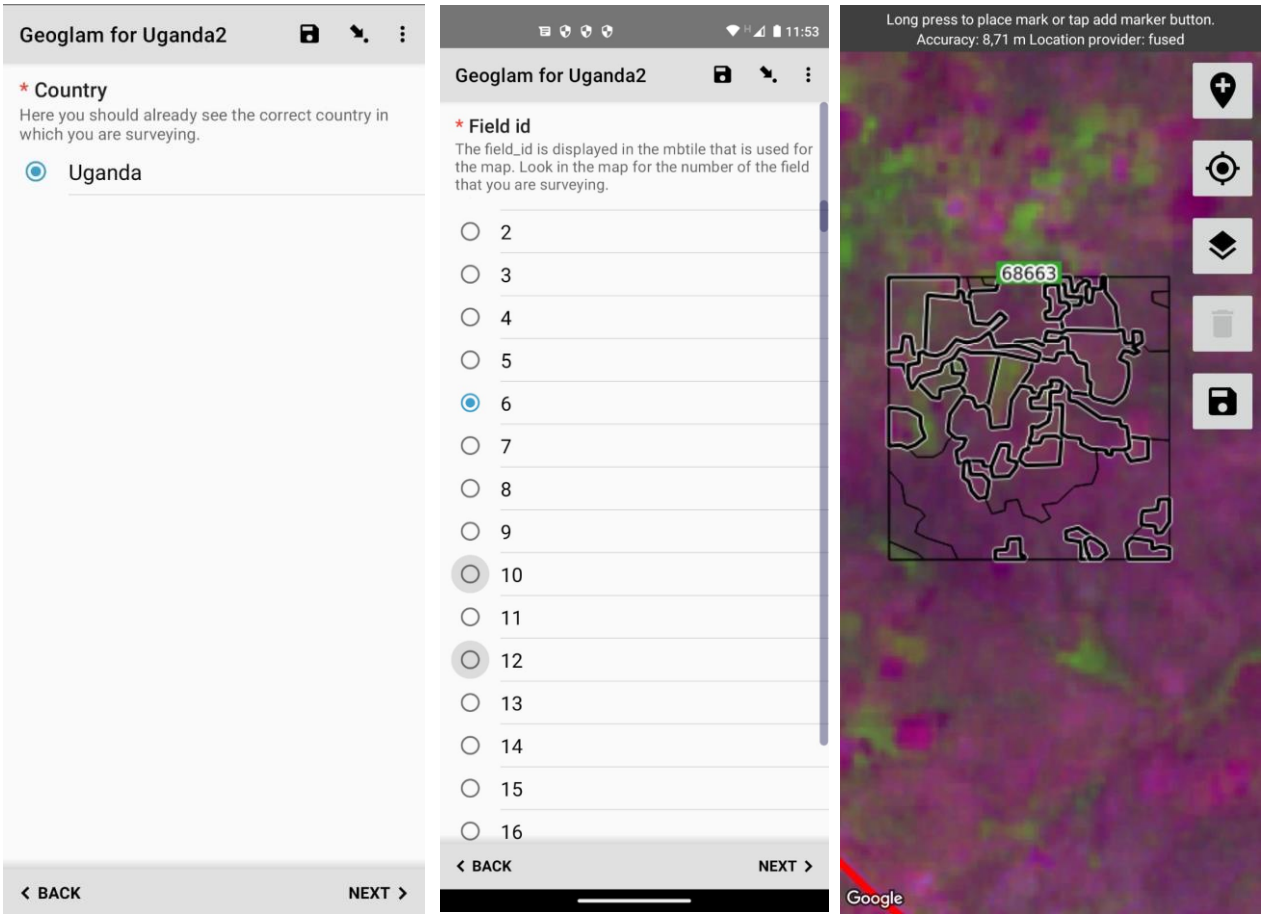


Figure 20 Collecting meta information

Each field has a unique id and ranges from 0 to the number of fields in the segment (see Figure 20). The combination of sample_id and field_id creates a unique combination for later data analysis. Each field_id which is indicated as potential **cropland should be surveyed** (unless the total amount exceeds the contractual amount agreed upon). **Other** digitalized fields with **landcovers** like homesteads, water and forest etc. **do not** have to be surveyed. The field_id number can be selected from a list in the form.

In the MBTile, **the crop fields to be surveyed are indicated with a red number** as shown in Figure 21**.** Other digitalized non-crop fields are indicated with black numbers and have parenthesis.

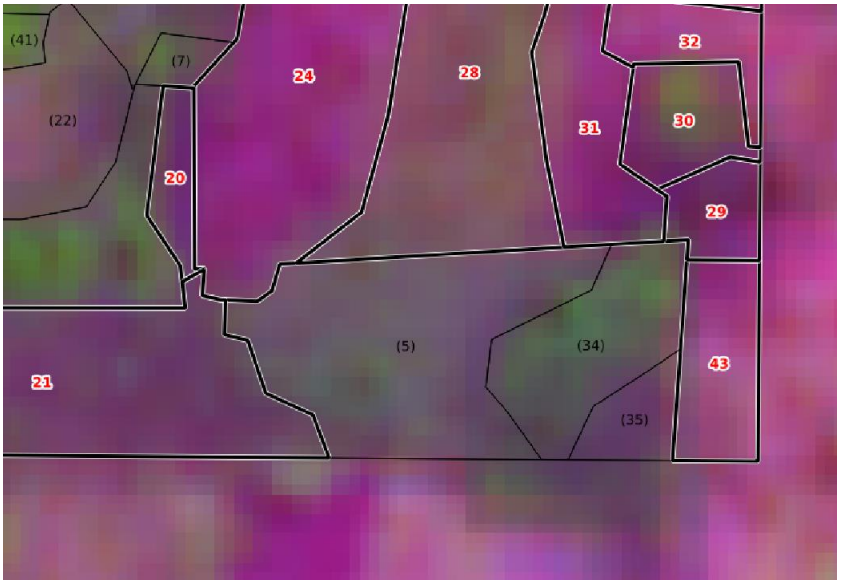


Figure 21 Digitalized sample with field IDs (crop fields with a red number and other landcovers in black)

Then, for each field id the enumerators have to collect data grouped in two categories and further detailed in the following sections:

3. First, the context of the sample with **field characteristics.** The time of visit will be automatically collected. Different field characteristics must be captured such as the correct delineation of the field.
4. Secondly, the **crop characteristics** have to be captured including especially the identification of the crop type for each field that is identified as cropland.

The field and crop characteristics to be collected in the field are shown in Table 3.

Table 3: Information to be collected and documented in the application

Additional information	Definition	Possibilities
Cropland presence	Presence of crop fields	Yes / No
Other landcover	If no presence of cropland, identification of the landcover	Bare soils / Forest / Natural grassland / Natural shrubland / Build-up / Water / Wetland
Cropping pattern	Identification of the cropping pattern	Monoculture / Mixed cropping / Agroforestry
Crop in monoculture	Identification of the name of the crop	See Figure 25
Dominant crop in mixed cropping	Identification of the name of the dominant crop (covering > 50% of the field)	
Crop in mixed cropping	Identification of the name of the crops	See Figure 26
Harvesting	Is the field fully harvested or not	Yes / No
Crop field status	Identification of the crop field status	Bare soil / Crops in ridges / ridges closed / field covered
Irrigation type	Identification of the irrigation type	Rainfed / Irrigated
Overview photo of the field	Photo indicating the field	
Detail photo of the field	Photo indicating details like crop stage or field preparation	

7.4 Field characteristics

The operators have to indicate if the field is correctly digitalized. Although the digitalization is done as precise as possible and using the most recent imagery the parcels in the field can be different. In this case discrepancies will be noted and described as a comment by the enumerator.

Case 1 – Field is aggregated with other fields
If the field surveyed should be aggregated to contiguous parcels and no distinction can be made concerning boundaries, crop type and crop stage, this has to be indicated in the form by selecting in the list the correct answer. In the note, the numbers of the other fields can be mentioned e.g. “field 6, 8 and 7 should be aggregated as one field”. For the other fields the forms should be filled in as well in similar fashion. This to avoid any possible doubt and to perform spatial joins during data analysis.

Case 2 – Field is split
If a field needs to be split, this can be indicated in the form as well. In the notes, enumerators have to put remarks concerning the split and the other crop(s) observed can be written.

Even if a field needs to be split because multiple crops can be observed, filling in additional forms for the different crops observed in the field is not needed and **completely forbidden**.

In other words, **enumerator have to collect one and only one observation per field surveyed.** Surveyors only have to indicate in the notes the different crops observed.

7.5 Crop(s) characteristics

First, the operators have to indicate if a crop is present in the field as shown in Figure 22.

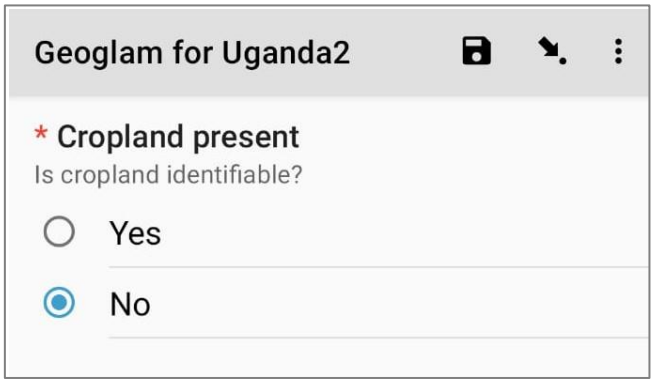


Figure 22: Cropland presence

Although the identification of possible cropland is done as precise as possible based on the recent imagery available, other landcover can be present in the field. In this case, enumerators just have to indicate that the field is not cropland, fill in the correct landcover observed from the list as shown in Figure 23 and take an overview photo of the landscape.

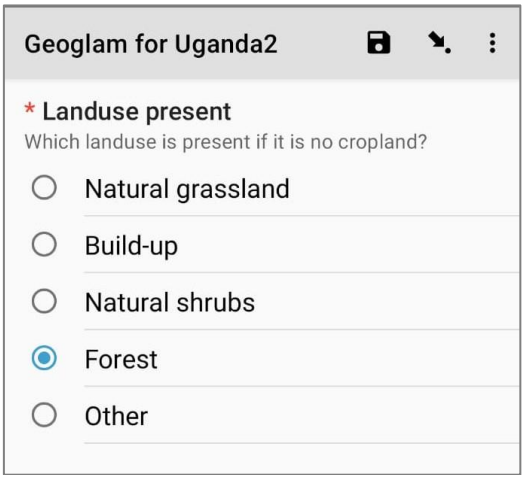


Figure 23: Other landcover identification

Even if no cropland can be observed in the field, the observation has to be made and a form sent to the server.

If a crop is present in the field, the enumerators have to identify the cropping pattern as shown in Figure 24.

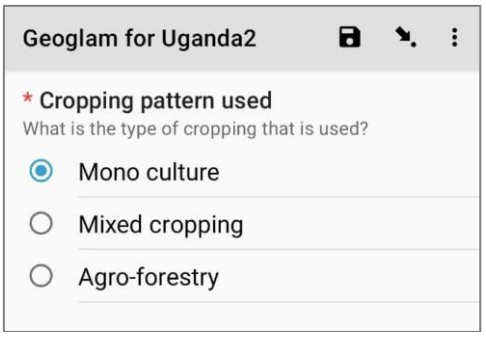


Figure 24: Cropping pattern

Then, from a list, surveyors have to indicate the name of the crop(s) observed in the field as shown in Figure 25 and Figure 26. The list of crops is derived from the first field campaign and should be exhaustive. Nevertheless, if the name of the crop surveyed is missing, the enumerator is allowed to indicate manually the name of the crop.

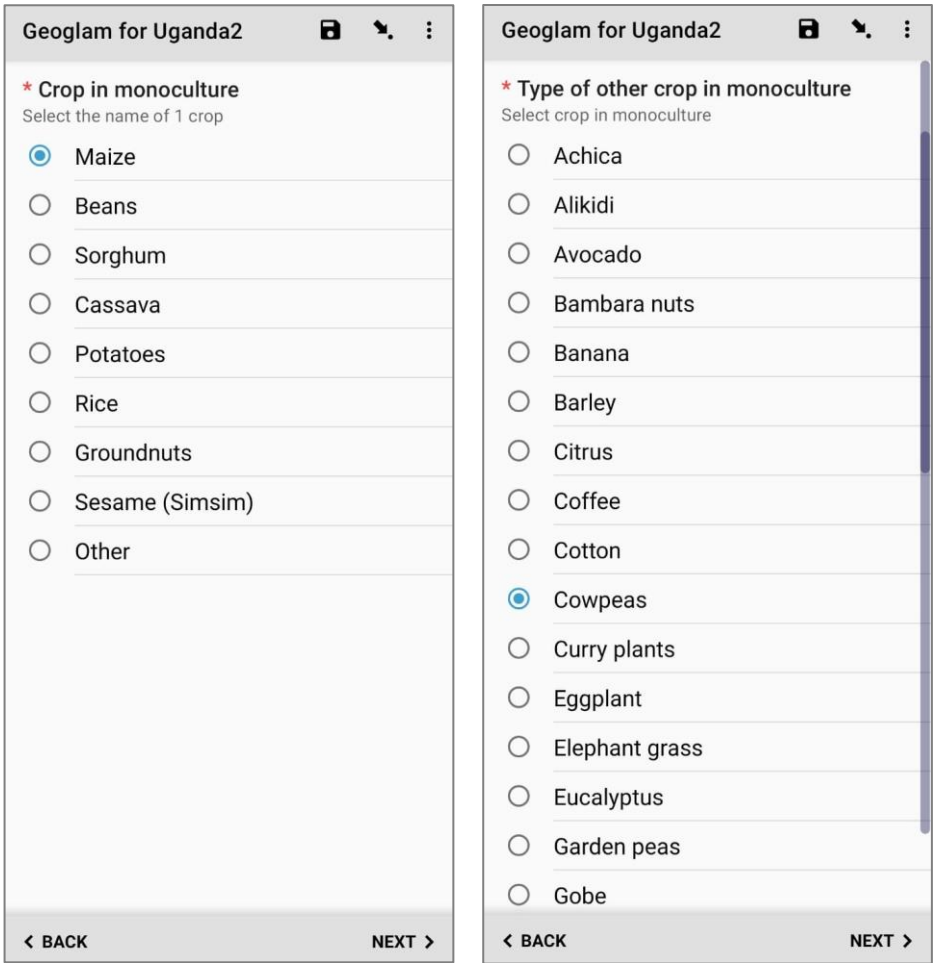


Figure 25: Identification of the crop in monoculture

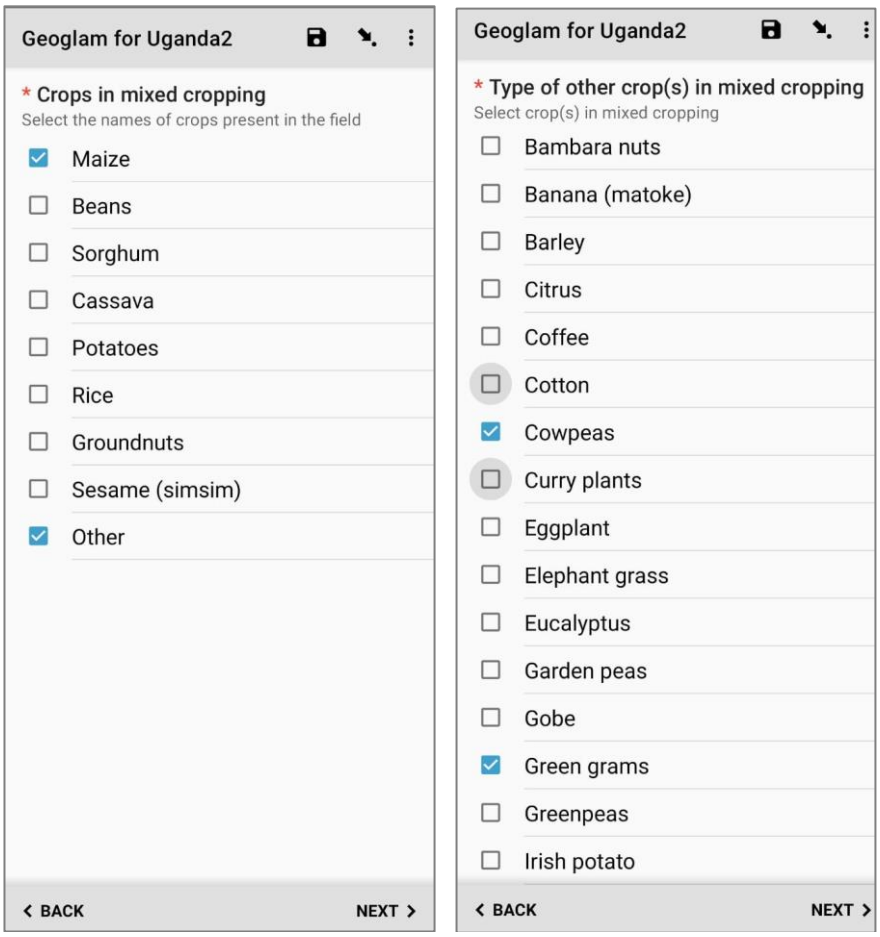


Figure 26: Identification of the crops in mixed cropping

Special cases

Agroforestry

For the agroforestry cropping pattern, the enumerators have to indicate the name of the crop present under the trees as shown in Figure 27. The name of the trees is not requested.

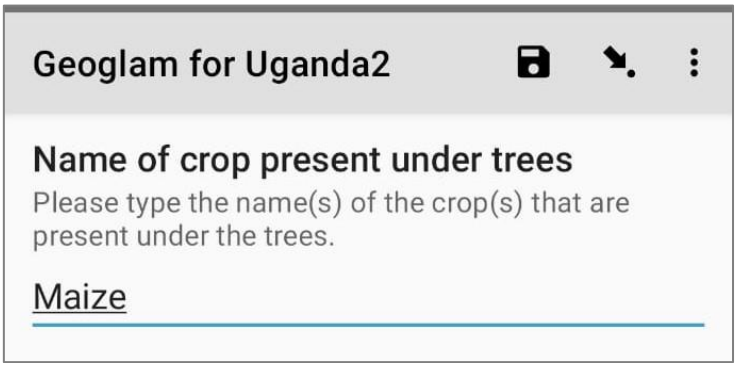


Figure 27: Identification of the crop in agroforestry

Mixed cropping

For the mixed cropping pattern, in order to improve the classification results, the surveyors have to indicate if a dominant crop is visible (from a pull-down list as shown in Figure 28).

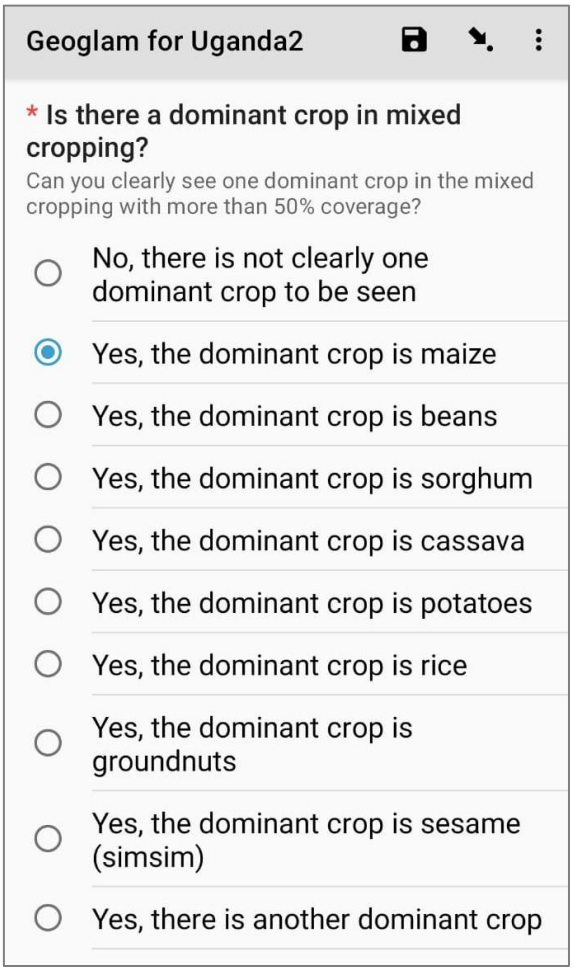


Figure 28: Identification of the dominant crop (if any)

A **dominant crop** covers **more than 50% of the area** (e.g. if it is a fifty/fifty situation, the answer is “No, there is not clearly one dominant crop to be seen”).

Then, the enumerators have to indicate different crop characteristics such as the crop field status (see Figure 30 and for examples), the irrigation system and the crop stage (harvesting status).

Crops in the field, in the ridges

Crops in the field, no ridges

Whole field covered by crops

Figure 29: Examples of crop field status

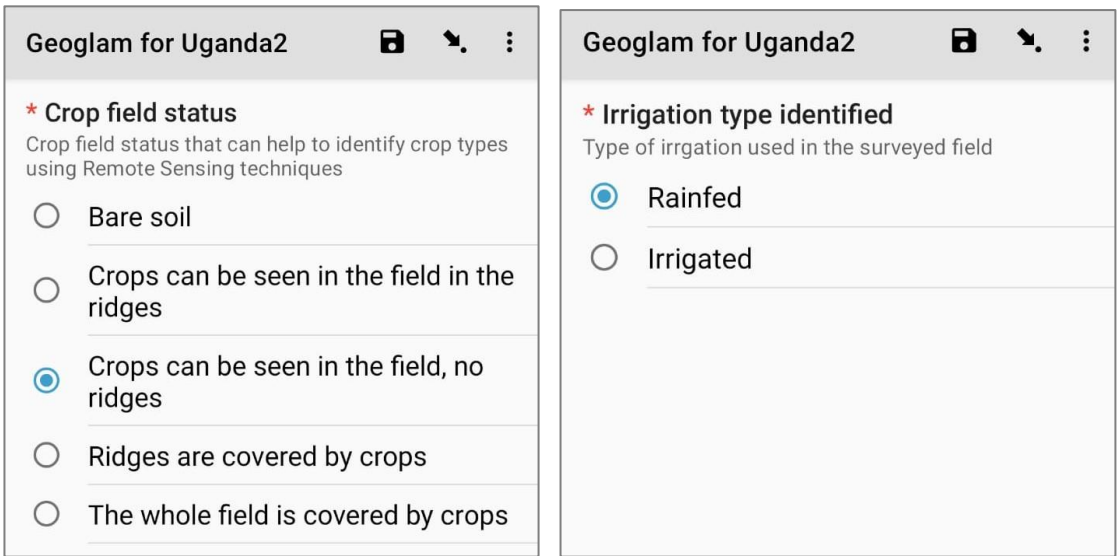


Figure 30: Crop field status and irrigation type identified

Special case: the crop stage harvested

In order to improve the classification results, the surveyors have to indicate if the whole field is fully harvested or not as shown in Figure 31.

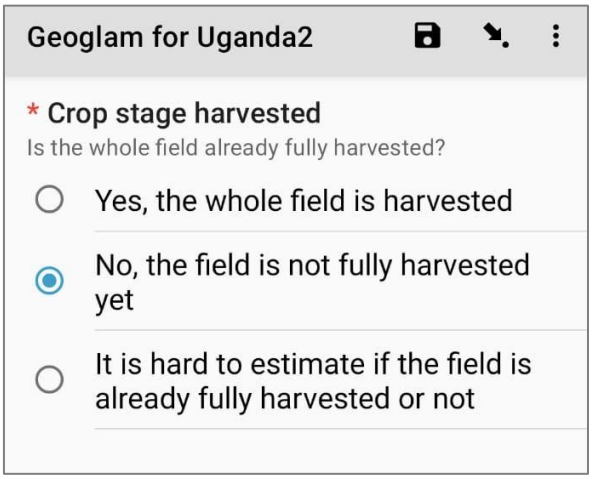


Figure 31: Crop stage harvested

If the field is **partially harvested**, with some parts of the fields still covered by crops, the answer to the question is "**No, the field is not fully harvested**"

Finally, the enumerators have to take two pictures of the field surveyed:

1. **An overview photo**: the operator takes an overview photo of the field zooming out at least 10-30m so the crop field or the landcover can be seen in relation with the surrounding as shown in Figure 32. The photo should be in landscape mode.
2. **A detailed photo**: the surveyor has to zoom out so crops are clearly visible, field characteristics can be inspected, and the crop phenology is clearly derivable from the close-up picture as shown in Figure 32.

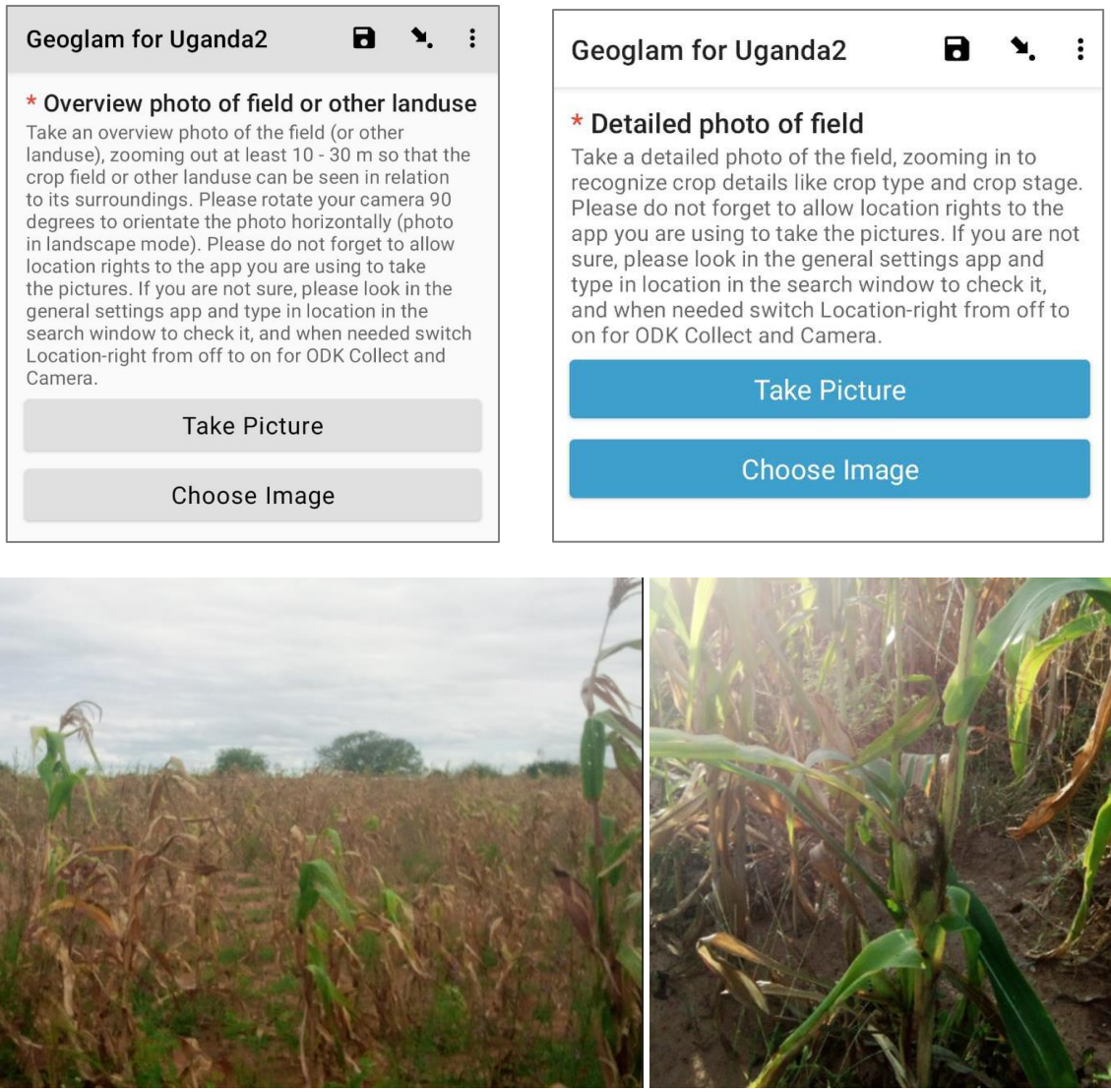


Figure 32: Overview and detailed photo and examples of good pictures (left: overview; right: detailed)

The enumerators have to **turn ON the GPS location on their camera** to enable geotag photos.

Depending on the used device used, this can vary, but in all cases one can use the search function with the general settings menu and search for "location" or "camera" or "app" as shown in Figure 33.

- Parameters of the smartphone / Privacy / Location;
- Parameters of the camera, enabling location.

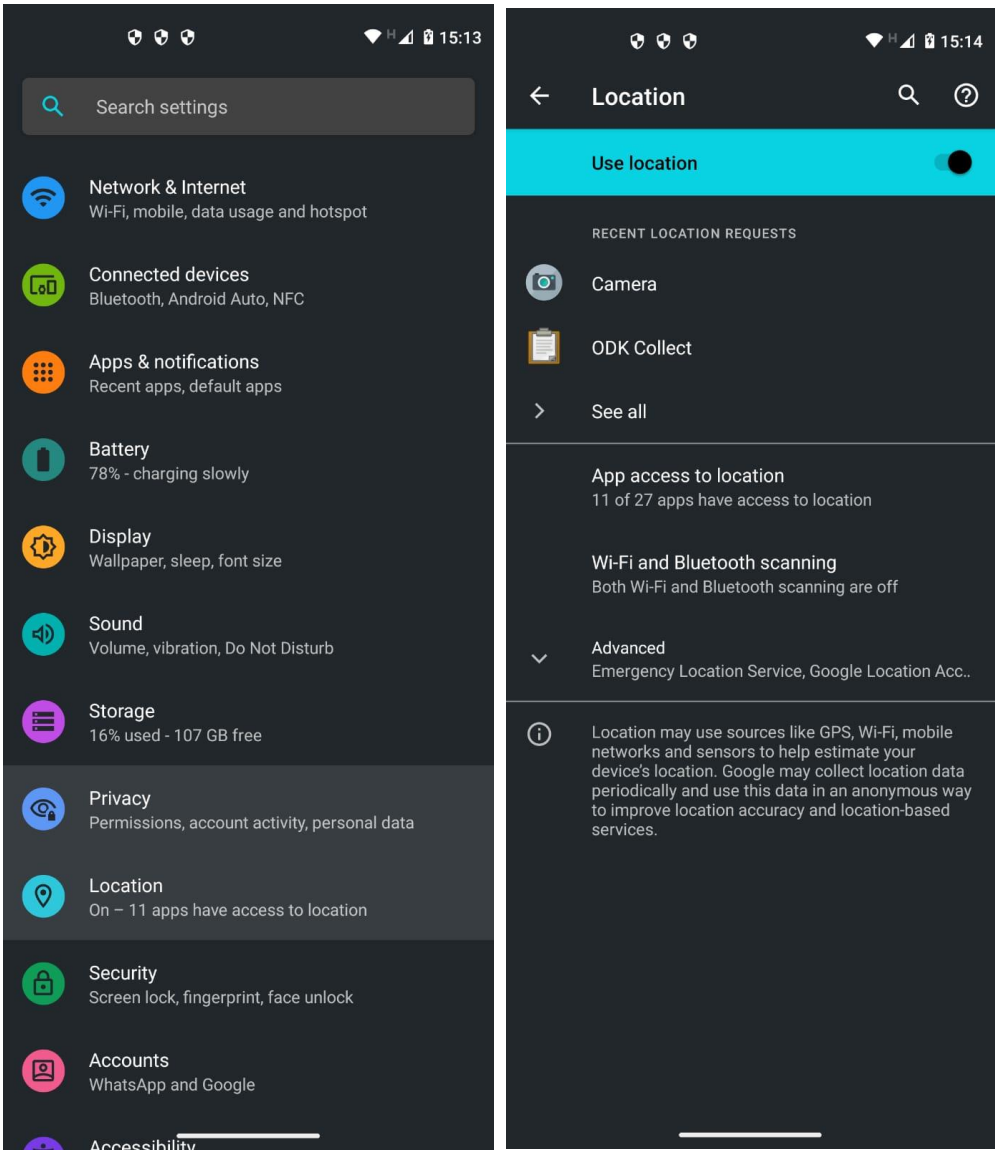


Figure 33: Turning ON the camera location

End result

The last step consists in saving the form (see Figure 34) and exit the data collection. After reviewing a complete segment, the data-analysis team expects to see a filled in form for all croplands (red numbers) in the segment.

Figure 34: Saving the form