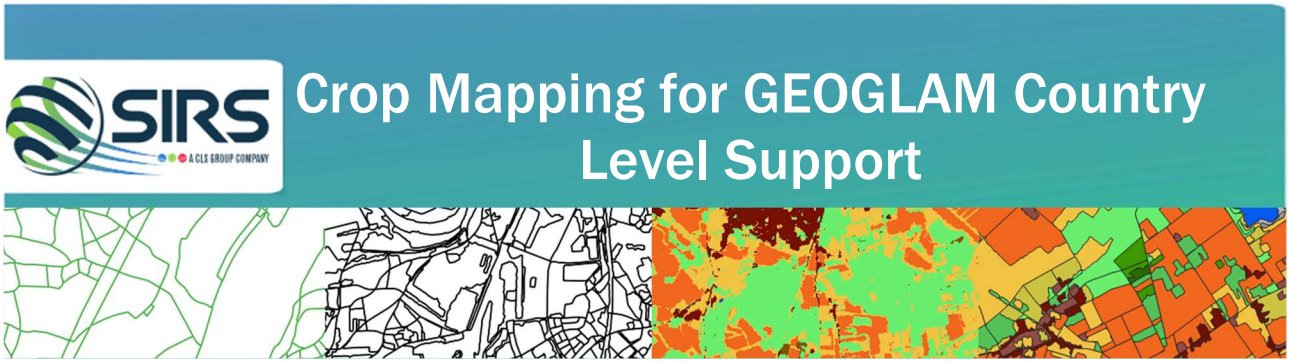
Service contract for the Copernicus Land monitoring services



Framework Contract N°939708-2020-IPR

First Specific Contract

D2.4 Field Campaign for Uganda – Methodology applied

Prepared by:

CLS
COLLECTE LOCALISATION SATELLITES

TerraSphere

with support from:

Upande

Reference: COPERNICUS4GEOGLAM_Field_Campaign_Uganda

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61 rue de la Cimaise - Bâtiment C 59650 Villeneuve d'Ascq, France

Tel +33 (0)3 20 72 53 64 Fax +33(0)3 20 98 05 78

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AEZ	Agro-Ecological zones
AOI	Area of Interest
DRDPM	Department of Relief, Disaster Preparedness and Management
FAO	Food and Agriculture Organization
GeoODK	Geographical Open Data Kit
GPS	Global Positioning System
JRC	Joint Research Centre of the European Commission
NGO	Non-Governmental Organization
OSM	Open Street Map
RGB	Red Green Blue
VHR	Very High spatial Resolution

1 Introduction

SIRS/CLS (Systèmes d'Information à Référence Spatiale/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 campaigns in Uganda. They subcontracted the field data collection to **OpenStreetMap Uganda** a local Non-Governmental Organization (NGO) taking full profit of 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 types 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)

There were no changes in the definition of the AOI as described in the feasibility study for Uganda (D1.1).

The field campaign took place over the regions of West Nile, Acholi, Teso and Karamoja, located in the Northern and North-Eastern parts of Uganda as shown in Figure 1. The total area occupied by the AOI is covering approximately 86,300 km² representing 36% of the country.

The Teso and Karamoja regions lie in the Eastern part of the country, the latter receives rainfall once a year, while Teso region lies along the cattle corridor making the two regions highly prone to drought. West Nile and Acholi regions are some of the regions that host a high number of refugees in the country, yet refugee influx keeps fluctuating with porous borders.

The four 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.

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

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) and is summarised as follows based on a series of 6 strata and defined as follows (see Figure 2):

1. Cropland Lowlands Humid;
2. Cropland Lowlands Sub-Humid;
3. Cropland Tropical Lands;
4. Cropland Highlands Humid;
5. Cropland Highlands Sub-Humid;
6. Other areas (including areas ≥ 1,800m and land cover classes different from cropland areas).

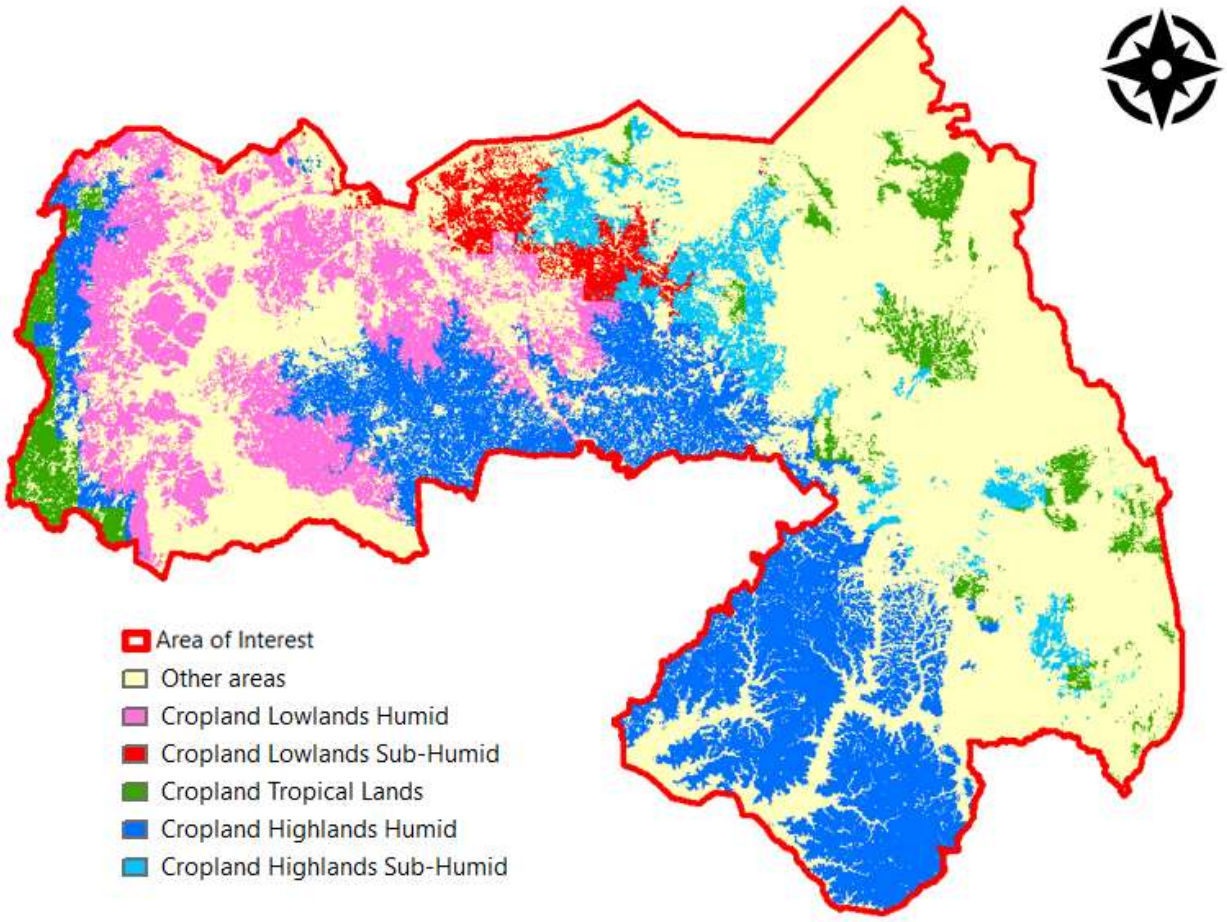


Figure 2: Derived AOI stratification

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 national land cover dataset provided by the Department of Relief, Disaster Preparedness and Management (DRDPM) from Uganda 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.

4.2 Sampling Design

The sample design applied was unchanged 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.

The selection of sample units was based on a stratified systematic and random sampling selection (two stage approach). The first stage was implemented by applying a 20 x 20 km grid over the overall area of the AOI. In a second stage, multiple sample units were randomly selected in sequence for each grid cell based on the 500 x 500 m sub-grid as illustrated in Figure 3; resulting with 338 segments selected.

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

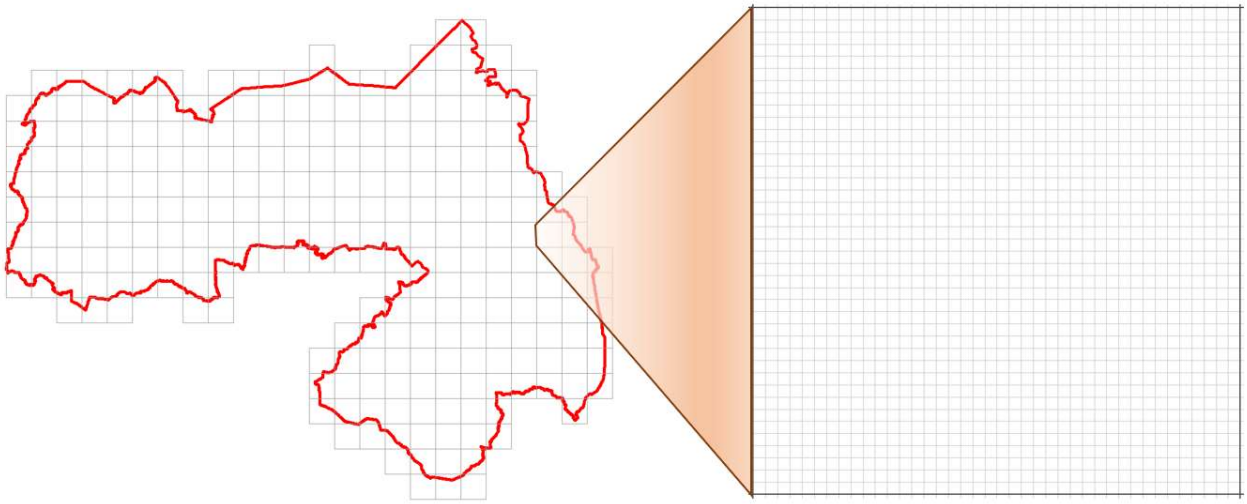


Figure 3: Two-stage stratified random sampling design: 1) 20 x 20 km grid applied on the AOI and 2) 500 x 500 m sub-grid used for the random selection of square segments as sample units

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

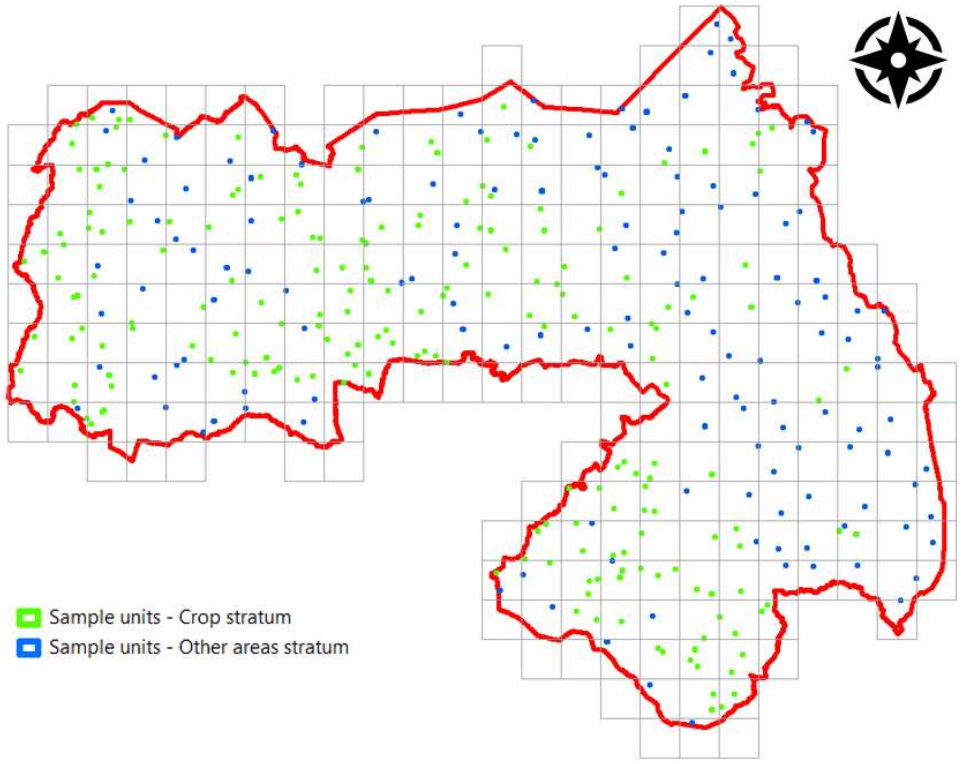


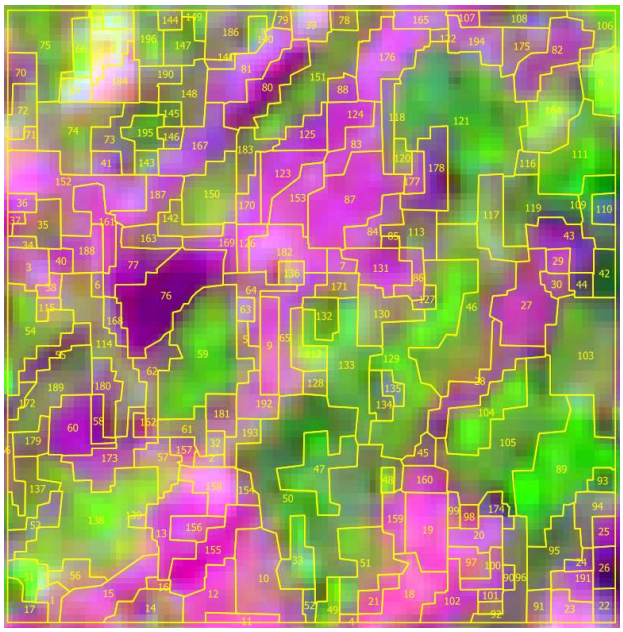
Figure 4: Spatial distribution of the sample units per aggregated stratum

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 338 segments, 259 segments were identified to contain field parcels and therefore were to be surveyed.

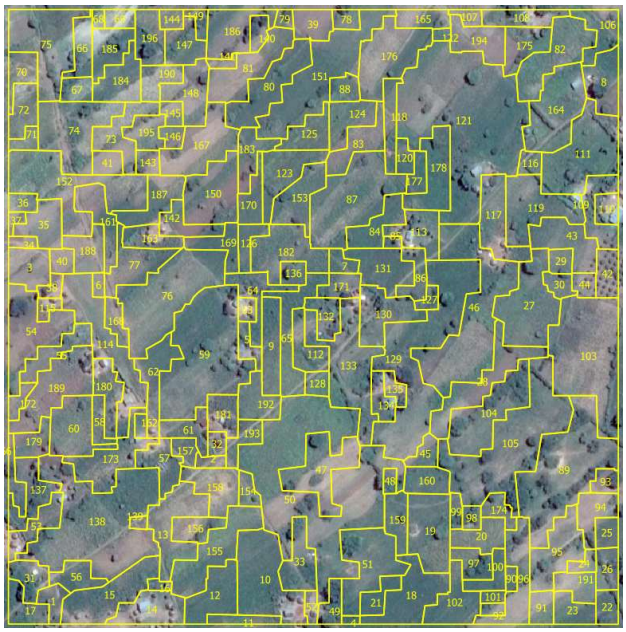
5 Field campaign

5.1 Segment survey protocol

Prior to the 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 (9 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 09/04/2021 (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, **259 cropland segments were identified (out of 338) from which cropland parcels have been detected and potentially to be surveyed,** as is shown in Figure 6.

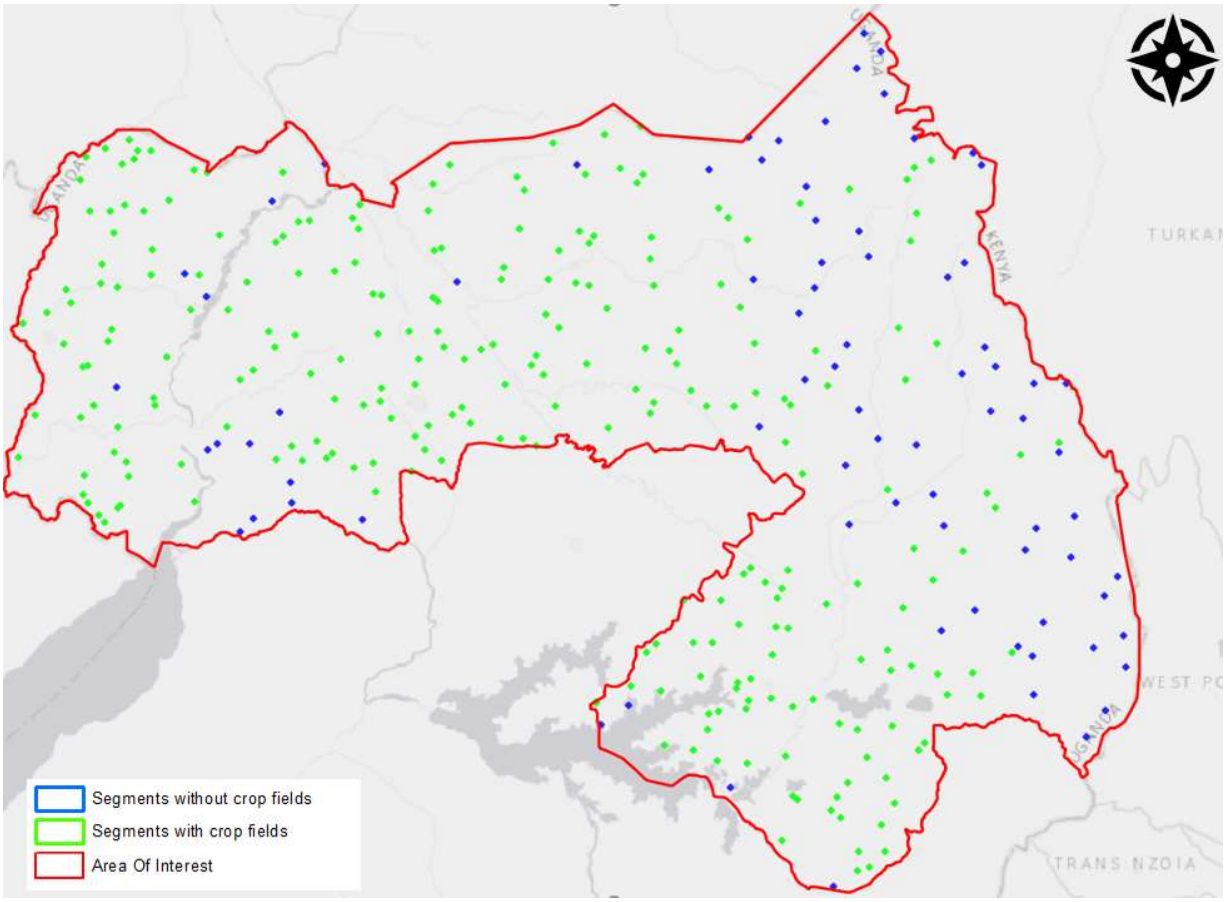


Figure 6: Spatial distribution of the 259 segments where crops have been identified

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

5.2.1 Surveyed segments

Not all the 259 segments where crops have been identified were surveyed in the field. During the field campaign, the enumerators faced some difficulties accessing the segments due to multiple causes such as:

- Local people/farmers denying the access to their private land, getting even sometimes violent and despite the supporting letter from the government.
- Segments located in districts where the government authorities didn't allow activities due to Covid-19 lockdown restrictions implementation.
- Segments located in regions affected by conflicts (cattle rustling in the Karamoja region, rebel activities at the border Uganda/South Sudan).
- Segments not accessible due to the landscape (e.g. located in national reserve, swamp areas without road/track network)

So, for the safety of the enumerators, it was decided not to survey those segments. Finally, only 155 cropland segments were visited as shown in Figure 7.

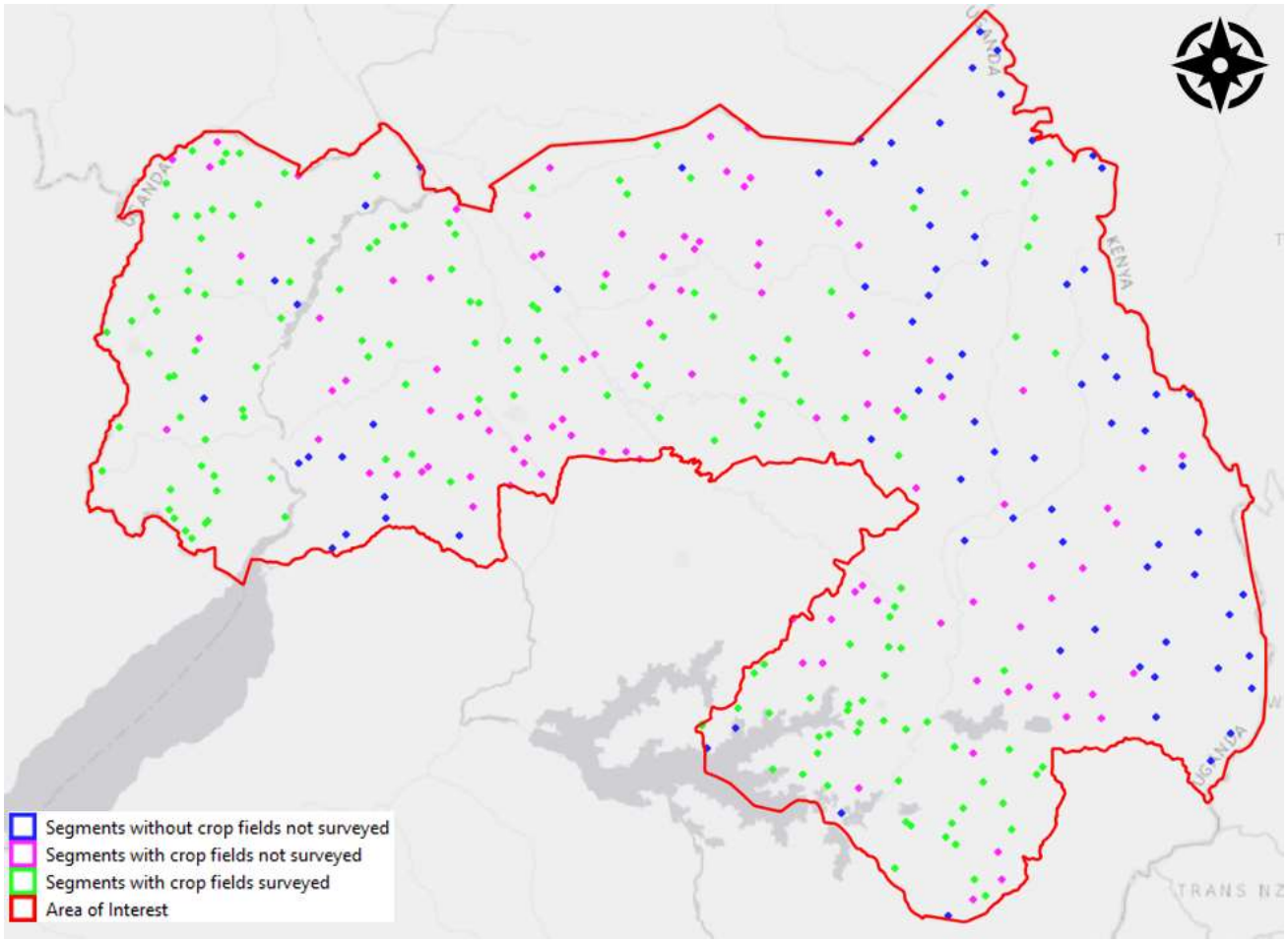


Figure 7: Final Spatial distribution of the surveyed segments

The 104 cropland segments that were not visited are mostly located to the Karamoja and Acholi regions as shown in Figure 8.

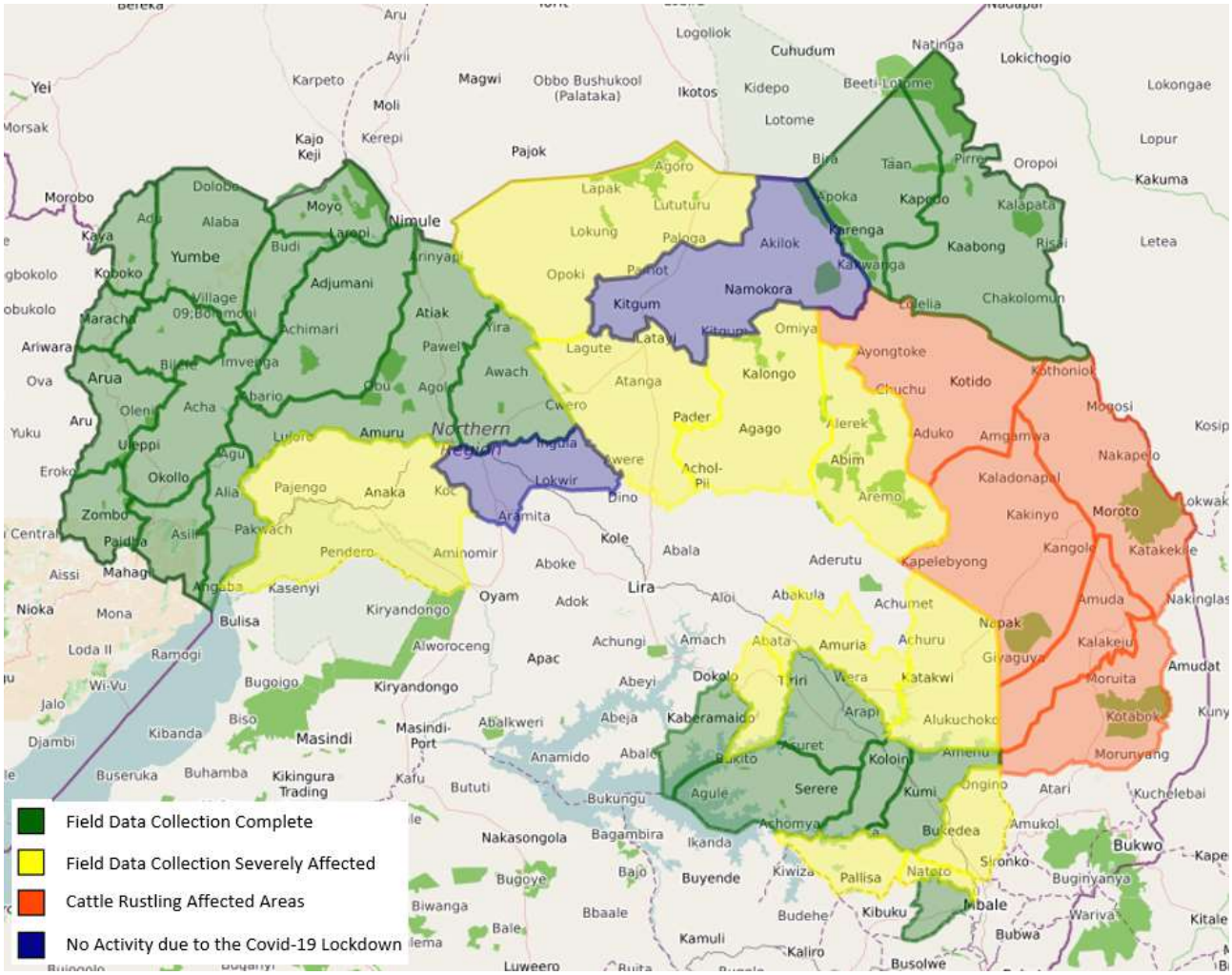


Figure 8: Field data collection overview

Nevertheless,

Table 2 shows that the field campaign permits to have sufficient data for the image classification for the West Nile (86% covered) and Teso (73% covered) regions. Acholi is more problematic (49% covered), but the segments for which data are available are well scattered over the area). Therefore, the surveyed samples should be representative of the overall AOI for those 3 regions and the resulting crop area estimates should not suffer from any substantial bias. Karamoja is more critical despite good coverage (79%), but there is a limited amount of cropped segments and those for which data are available is concentrated in the northern part of the region.

Table 2: Final distribution of the surveyed segments per region

Region	Segments surveyed	Segments not surveyed	Segments not to be surveyed	Total
Acholi	43	58	12	113
Karamoja	11	18	58	87
Teso	45	18	4	67
West Nile	56	10	5	71
Total	155	104	79	338

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 1 to 2.5 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.

5.2.2 Use of Drones

As stated in the D1.1 document for the feasibility study, the use of drones was envisaged to survey agricultural parcels that could not be reached on foot by the enumerators. However, in practice, during the field campaign, the fieldwork team faced major difficulties to obtain the authorization from the local government institutions which came late in the field campaign process. Moreover, overall access to the segment was more problematic than reaching individual parcels as described in section 5.2.1. Therefore, drones were not used for that purpose in Uganda.

Instead, the use of drones was implemented more as a test to investigate whether they could be used for:

- Quality control purposes to ensure that the field data collected was accurate.
- As a potential alternative method for the field data collection

Taking into account the time available and the situation in the country, only one segment was covered by drone imagery in the region of West Nile in Terego District. The equipment used was a quadcopter drone as anticipated in the D1.1 and promising result is shown in Figure 9.

Figure 9: Example of a drone picture and equipment used for the test

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 3.
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 3.

Table 3: 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 Table 4
Crop stage	Crop stage	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 Table 4.

Table 4: Crop Type Nomenclature

301	Maize
302	Millet
303	Sorghum
304	Bambara nut
305	Cassava
306	Peas
307	Sunflower
308	Sweet Potatoes
309	Sugar cane
310	Rice
311	Groundnuts
312	Cotton
313	Beans
999	Other

This list has been derived from the crop typology to be covered by the mapping services listed in the "Information sheet" document provided by the Joint Research Center (JRC) of the European Commission. Other significant crops can also be expected in the field, so the other types of crops are derived from the list of main significant crop types in Uganda listed by the Food and Agriculture Organization (FAO, Country profile – United Republic of Uganda[2]).

If the observed cropland is not listed, the code 999 "Other" selected in the smart form. The enumerator identified the observed crop type in the "comment" section.

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 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 10 presents an earlier example of a smart form which was used to test the fieldwork procedures in December 2020.

[2] http://www.fao.org/countryprofiles/index/en/?iso3=UGA

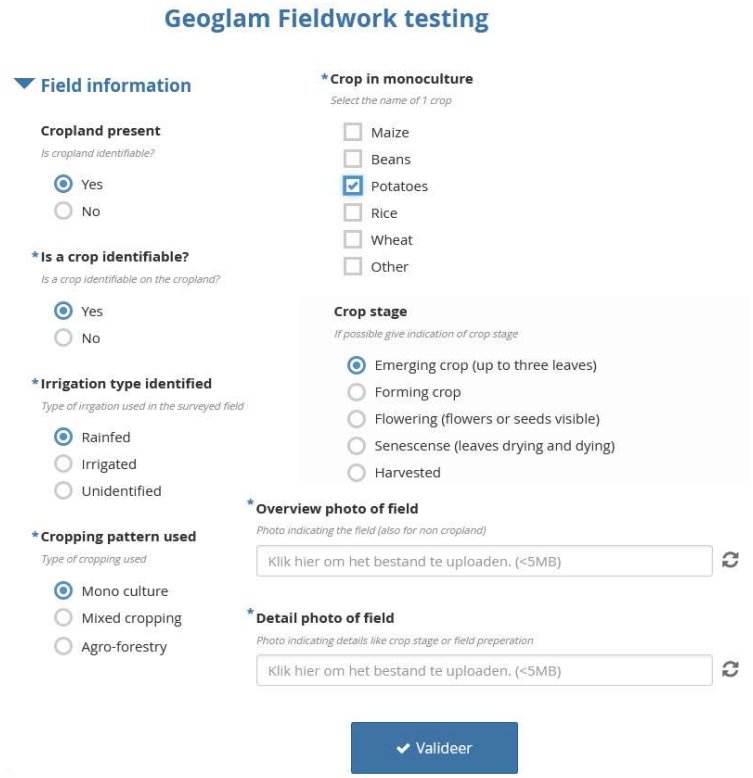


Figure 10: Screenshot of the GEOGLAM fieldwork data form for Uganda.

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. 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 as shown in Figure 11. 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.

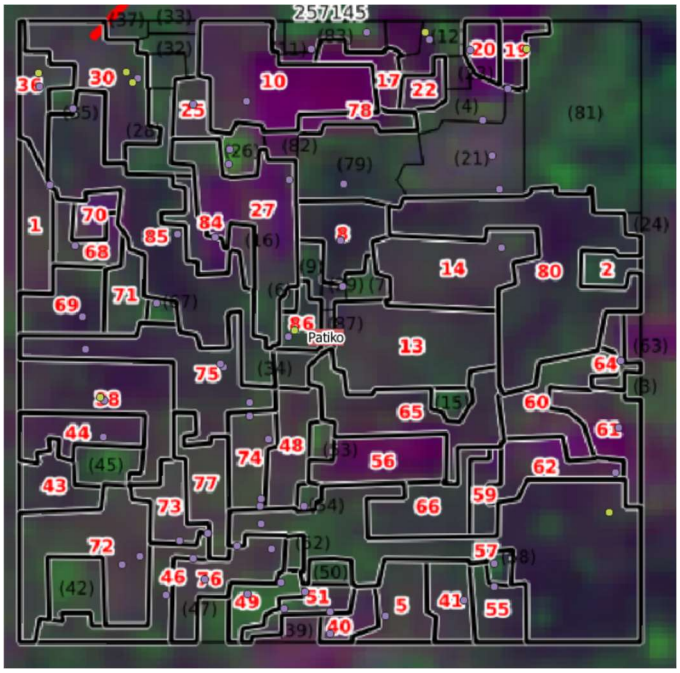


Figure 11: MBTiles and Satellite imagery used to guide the enumerator in the field

Figure 12 shows a general example of visualization possibilities with Avenza Maps.

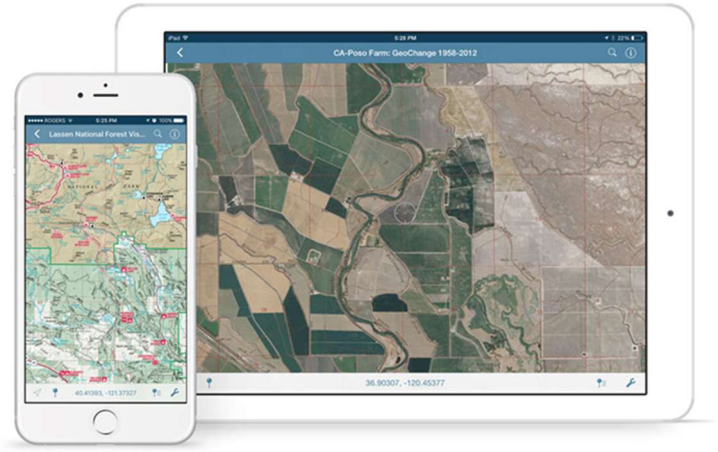


Figure 12: Avenza Map mobile app examples

Beside navigation the application was also be used to collect additional ground-truth data by the quality control team. See chapter 5.4.3 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.

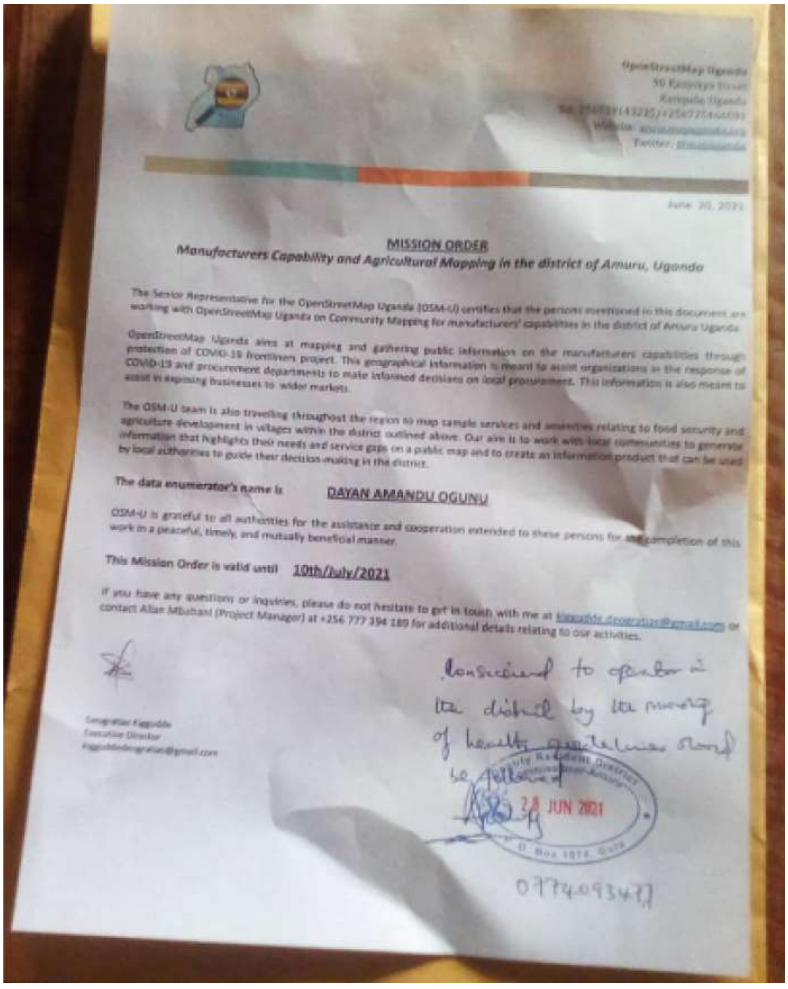
5.4.2 Field work methodology and orientation in the field

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 – see Figure 13), be polite, and apologise if necessary.



MISSION ORDER

Manufacturers Capability and Agricultural Mapping in the district of Amuru, Ugando

The data enumerator's name is DAYAN AMANDU OGUNU

This Mission Order is valid until 10th/July/2021

28 JUN 2021

Figure 13: Government supporting letter

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 and custom made RGB or false color satellite imagery (see Figure 14) 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.

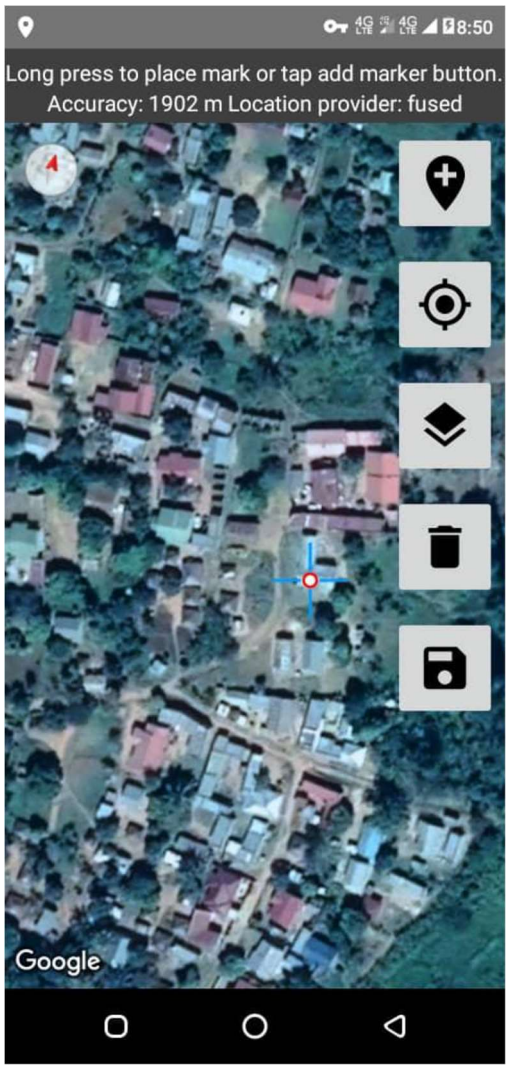


Figure 14: Recent satellite imagery in natural colours to guide the enumerators in the field

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 15: Illustration of the field data collection process (top from left to right: Boda Bodas (Motorcycle) used for the transport, Training session of the enumerators, Inception meeting with the district officials of Omoro – bottom: field data collection)

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.

5.4.3 Collection of extra ground-truth data

To collect potential additional ground-truth data but also control the field data collection, the quality control team was asked to collect extra ground truth data along the route and inside the segments.

In addition, as detailed above some drone imageries were also envisaged and tested with promising results.

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.

Upande Ltd subcontracted the field data collection to the local OpenStreetMap Uganda team a local NGO specialised in field data collection across Uganda and the promotion of the community mapping to generate map awareness. OpenStreetMap Uganda was founded in 2012 and was registered as an NGO and registered as a company in April 2017. They provide cartographic training, web mapping and Geographical Information Systems (GIS) services to a variety of clients including private sector, universities, government agencies and NGOs.

5.6 Summary of the field campaign

Starting date: 2021-05-31

Ending date: 2021-08-01

OpenStreetMap Uganda was responsible for all practical local fieldwork and data acquisition. In total 84 enumerators were hired including the QC activities. A dedicated team took in charge the overall management of the campaign.

Initially set up to be completed in a 21-day period, the project activities were delayed due to the impact of covid-19 and other challenges experienced during the field campaign such as:

- Access denied to privately owned lands even after being presented with the introductory letter supporting the exercise from the National government. The region is known to be subject to land wrangles and land grabbing. Some enumerators were held hostage for two days before being released by the local community members/local police such as in Lamwo and Pader districts.
- Segments inaccessible by means of vehicle or boda boda (motorbikes) because roads were closed (not updated on map).
- Segments not accessible due to the landscape (e.g. located in national reserve, swamp areas, without road/track network)
- Segments located in districts where the government authorities didn't allow activities due to covid-19 lockdown restrictions implementation (especially the Teso and Karamoja region and the districts of Kitgum and Omoro) following the President’s guidelines (no inter-district movement allowed).
- Segments located in regions affected by conflicts:
    - Rebel activities occurred at the border areas with South Sudan where Uganda Army personnel was killed. The government authorities advised the teams to hold on until the government resolves the conflicts in the affected areas.
    - Cattle rustling and tribal conflicts in the south of the Karamoja region hindered the project activities in this area.

6 Conclusion and recommendations

Overall, the field data collection in Uganda was performed as planned regarding the implementation and methodology but the field campaign was severely impacted by the current situation in the country primarily due to the impact of covid-19 pandemic, the hostile reception of the local community chiefs and members and conflicts affecting the region.

Thus, all the segments where crops had been identified were not surveyed in the field (104 cropland segments not visited out of 259). However, as presented in 5.2.1, the surveyed samples should be representative of the overall AOI for at least 3 regions (West Nile, Teso and Acholi) and the resulting crop area estimates should not suffer from any substantial bias. Karamoja could be more critical since there is a limited number of cropped segments and those for which data are available is concentrated in the northern part of the region.

Moreover, due to all the reasons previously described, there was a delay 4-5 week and the field campaign lasted for about nearly 2 months which could have an impact since most of the crops were not in their vegetative state as shown in the field campaign preliminary results (D2.1) with half of the cropland characterized with bare soil.

The preparation of the field campaign took considerably more effort than initially anticipated. In particular, the digitising of the segment was far more complex than envisaged and it appears that the agriculture in the area is very dynamic and requires the use of the latest imagery available.

Interaction with local team was good and the quality of the work was also good despite the current situation in the country, once some minor adjustments were made.

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

- Sharing the reports of the in-season field campaign results and crop mask/type mapping to the communities visited to support further activities and clearing some misconceptions of the project being sometimes associated with the land grabbing in the country.
- Involvement of all implementing parties early from the start of the project.
- Community engagement and involvement in the data collection.
- Materials such as T-Shirts, Baseball caps or umbrellas with logos from the European Union (EU) worn by enumerators during the field campaign to facilitate contacts with local farmers would be useful and essential.

8 ANNEX I – Description of form used for segment survey

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

Within each segment each field/landuse is digitalized and all croplands should be surveyed. When the surveyor is in the field the first step is to pinpoint the current geographical position **in** the field. The application will automatically use the coordinates given by the smart device. If the device is giving a wrong location or enumerator is not in the field, the point should be moved to make sure the point is clearly in the field. (See also section dealing with issues below).

The first part of the form is focused on retrieving meta information concerning the fieldwork; country,id of sample id and field id (see Figure 16). For each segment of 500x500 meters a MBTile is created and the sample_id is given in the top middle of the MBTile.

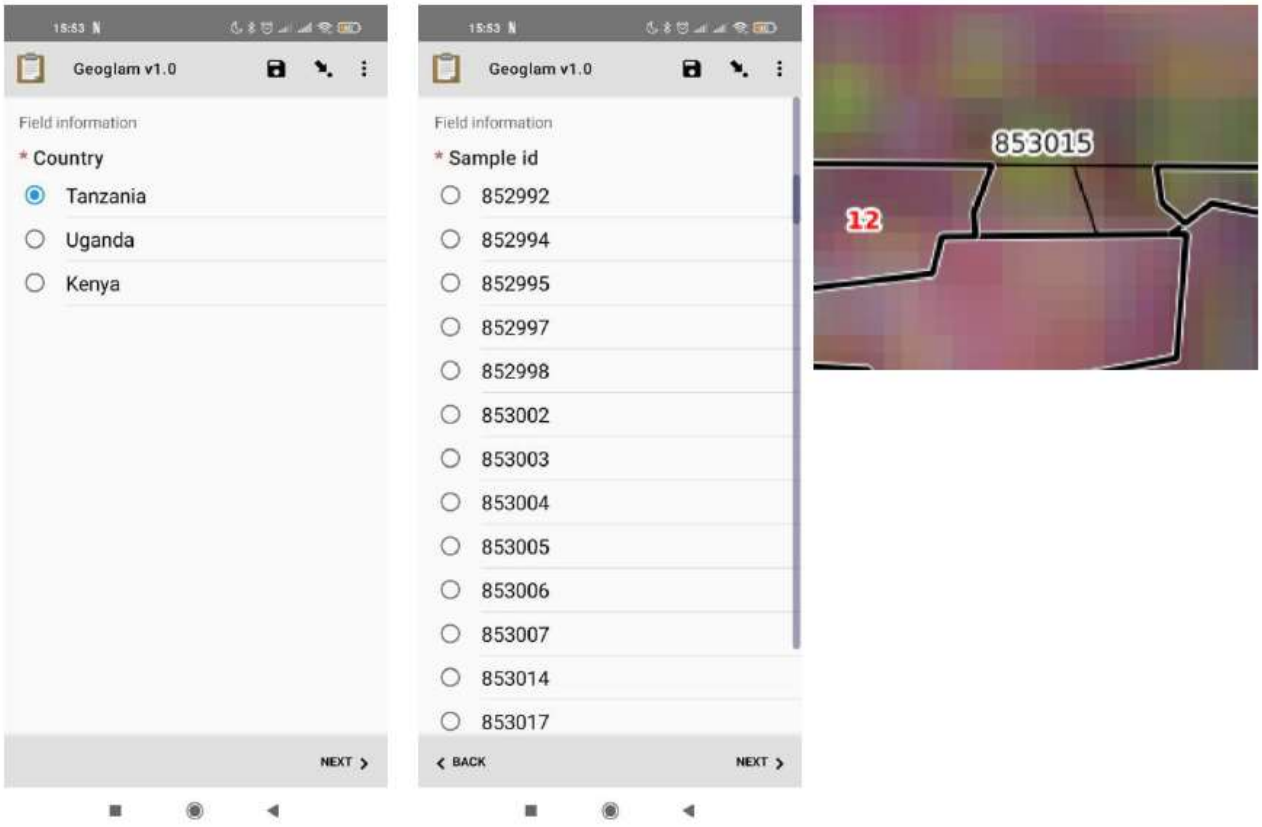


Figure 16: Collecting meta information

Each field has a unique id and ranges from 0 to the number of fields in the segment (see Figure 17). The combination of segment_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). In the MBTile these fields are indicated with a **red number**. Other digitalized fields with landuse like homesteads, water and forest etc. **do not** have to be surveyed and are indicated with black numbers and have parenthesis. The field_id number can be selected from a pull_down list in the form.

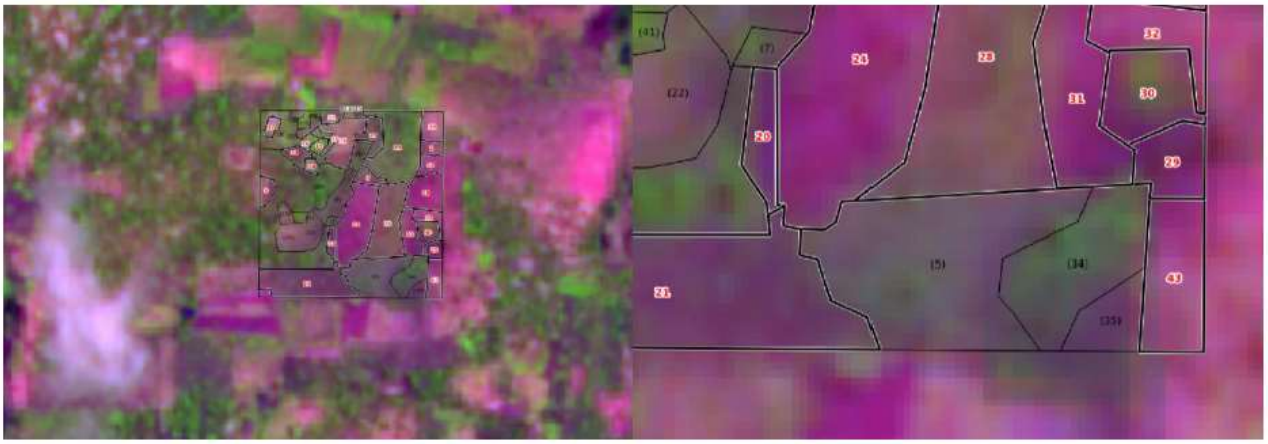


Figure 17 Digitalized sample with field IDs

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 will be automatically collected. Different field characteristics must be captured such as irrigation/rainfed type. The field characteristics to be collected in the field and to be reported in the form are shown in Table 5 and Figure 18.
2. 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 crop characteristics to be collected in the field are shown in Table 5 and a small excerpt is shown in Figure 18.

Table 5: 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 Table 4
Crop stage	Crop stage	bare soil / crops in ridges / ridges closed / field covered, d
Overview photo of the field	Photo indicating the field	
Detail photo of the field	Photo indicating details like crop stage or field preparation	Text

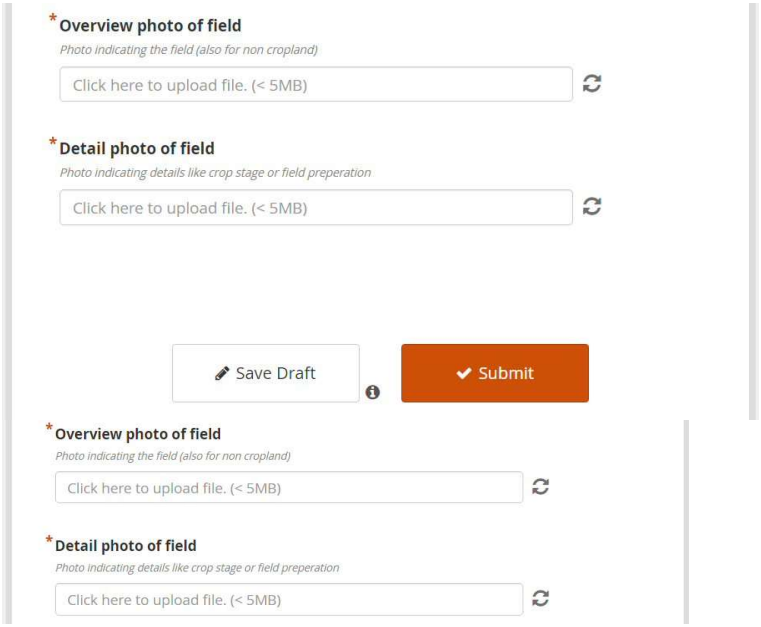


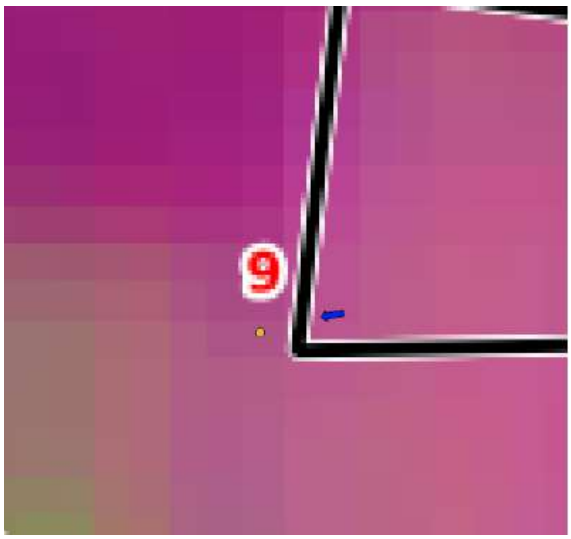
Figure 18: Example of characteristics captured with the form

Dealing with issues

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 the pinpoint should be dragged **within** the field. (See mock-up below with location and view of the enumerator as a blue error and the dragged point to survey field 9).



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 like to have a filled in form, 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) **dragging the pin-point** and 2) indicate **OTHER** with the question Is the field correctly segmented with the desk digitization? and note 'Field cannot be accesed due to ' with the reason. 3) Indicate cropland present with No > Landuse Other and note that the field could not be accessed 4) make a mock-up picture and send the form.

Field is not a cropland

Although the identification of possible cropland is done as precise as possible other landuse can be present in the field. In this case just indicate that the field is not cropland and fill in the correct landuse. The field should be surveyed and a form send to the server.

Field is not correctly digitalized

Although the digitalization is done as precise as possible and using the most recent imagery the parcels in the samples 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 a field is aggregated and no distinction can be made concerning boundaries, croptype and cropstage this can be simply indicated in the form. In the note the numbers of the other fields can be mentioned e.g. '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 is split this can be indicated in the form as well. In the notes remarks concerning the split and the other crop(s) can be given. Filling in additional forms for the additional fields is **not** needed

Example of good overview pictures
Crops are clearly visible, field characteristics can be inspected and the crop phenology is clearly derivable from the close-up picture.

End result

After reviewing a complete segment, the data-analysis team expects to see a filled in form for all croplands (red numbers) in the segment. The pin-points should match as much as possible the location of the enumerator, but sould be completely in the the field_id polygon and match the field-id given in the form.

Below in Figure 19 some examples of incorrect placement of pin-points are given. In the left image field 21 and 12 have two forms filled in, whereby one form is meant for other fields. In the right image a pin-point is given outside the segment below and two fields below do not seemed to be surveyed.

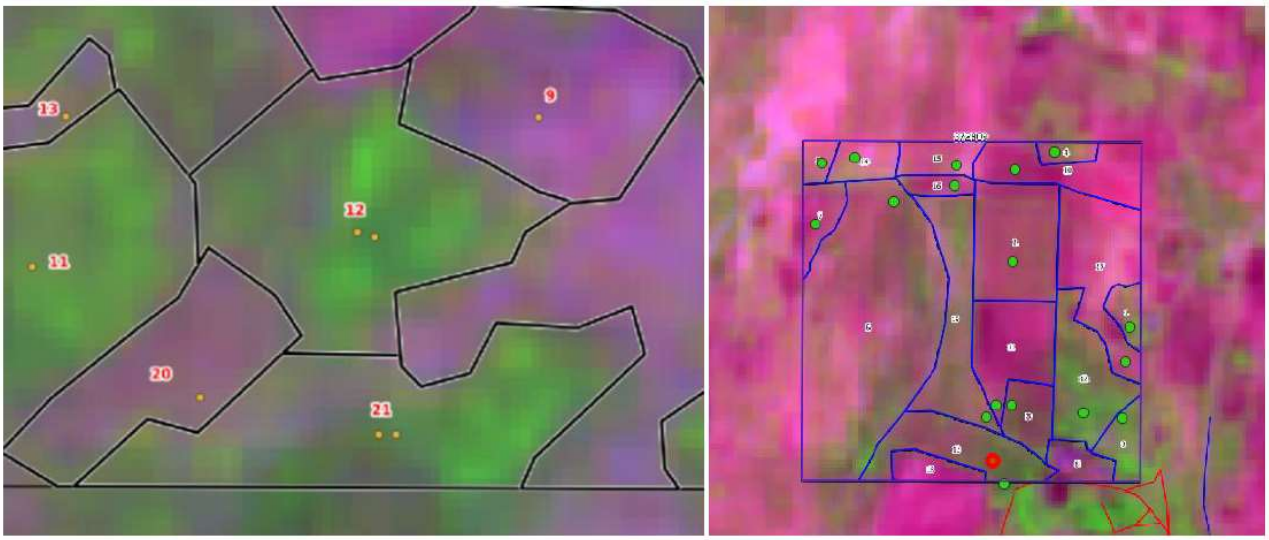


Figure 19: examples of incorrect placement of pin-points