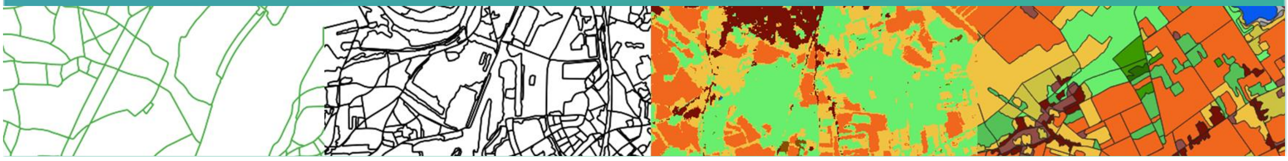
Service contract for the Copernicus Land monitoring services

Crop Mapping for GEOGLAM Country Level Support



Framework Contract N°939708-2020-IPR

First Specific Contract

D2.4 Field Campaign for Tanzania – Methodology applied

Prepared by:

CLS

COLLECTE LOCALISATION SATELLITES

TerraSphere

with support from:

UHURULABS

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LIST OF ABBREVIATIONS

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

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;

Uhurulabs as a subcontractor to CLS was in charge of the field campaigns in Tanzania, 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 not changes in the definition of the AOI as described in the feasibility study for Tanzania (D1.1).

The field campaign took place over the three administrative regions of Dodoma, Manyara and Tanga. The areas are located in the Central extending to the north-eastern part of the country. The total area occupied by the three regions is covering approximately 115,000 km² (representing 12% of the country). 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. Majority of the regions lie in the semi-arid characterized by bi-modal rainfall regime receiving from 500 mm to 800 mm annual rainfall for Dodoma, 450 mm and 1,200 mm annual rainfall for Manyara, and 750 mm to 1400 mm for Tanga. Figure 1 shows the extent of the area.

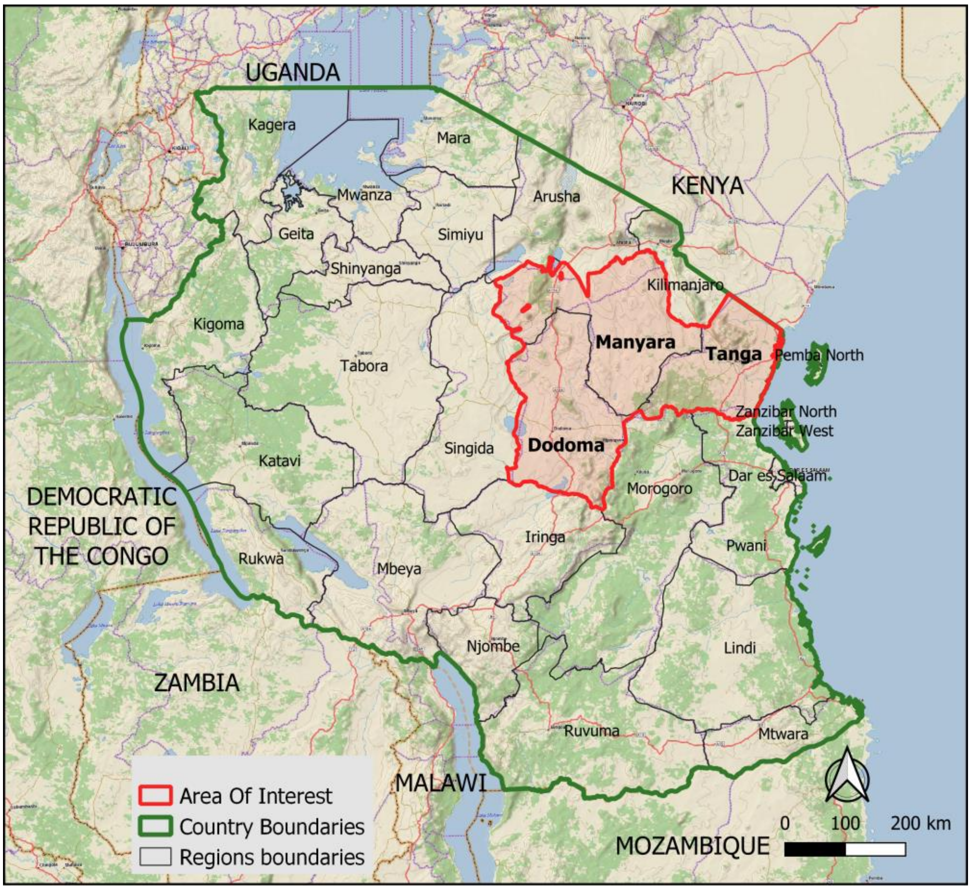


Figure 1: Area Of Interest (in red) in Tanzania

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/Sub-Humid
2. Cropland Lowlands Semi-Arid
3. Cropland Tropical Highlands
4. Cropland Highlands Humid/Sub-Humid
5. Cropland Highlands Semi-Arid
6. Other areas (including areas ≥ 3,000m and land cover classes different from cropland areas).

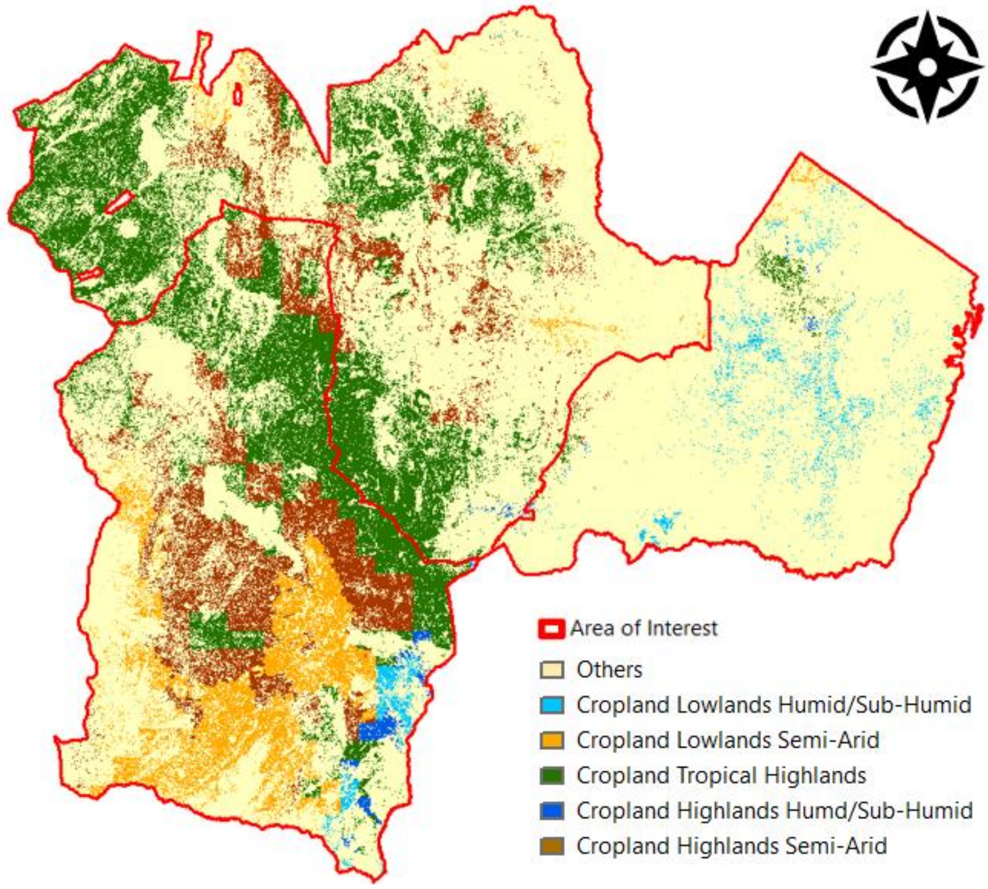


Figure 2: Derived AOI stratification

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 Copernicus Global Land Cover dataset at 100 m for the reference year 2019) 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 400 segments selected.

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

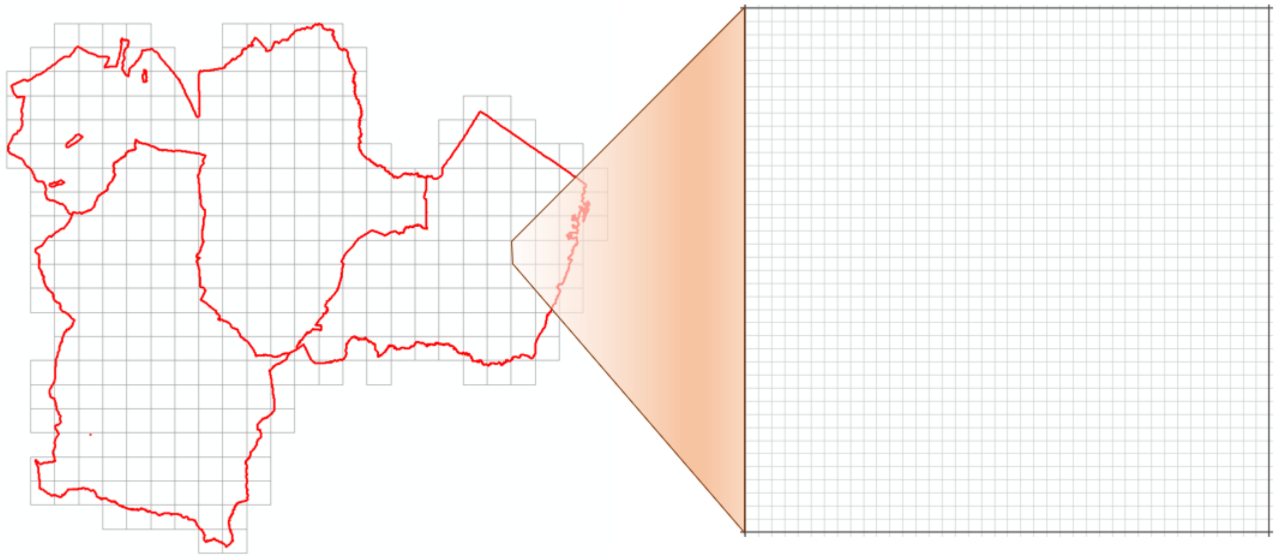


Figure 3: Two-stage stratified random sampling design: 1) 20 x 20 km grid applied on the AOI and 2) 500 x 500 m sub-grid used for the random selection of square segments as sample units

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

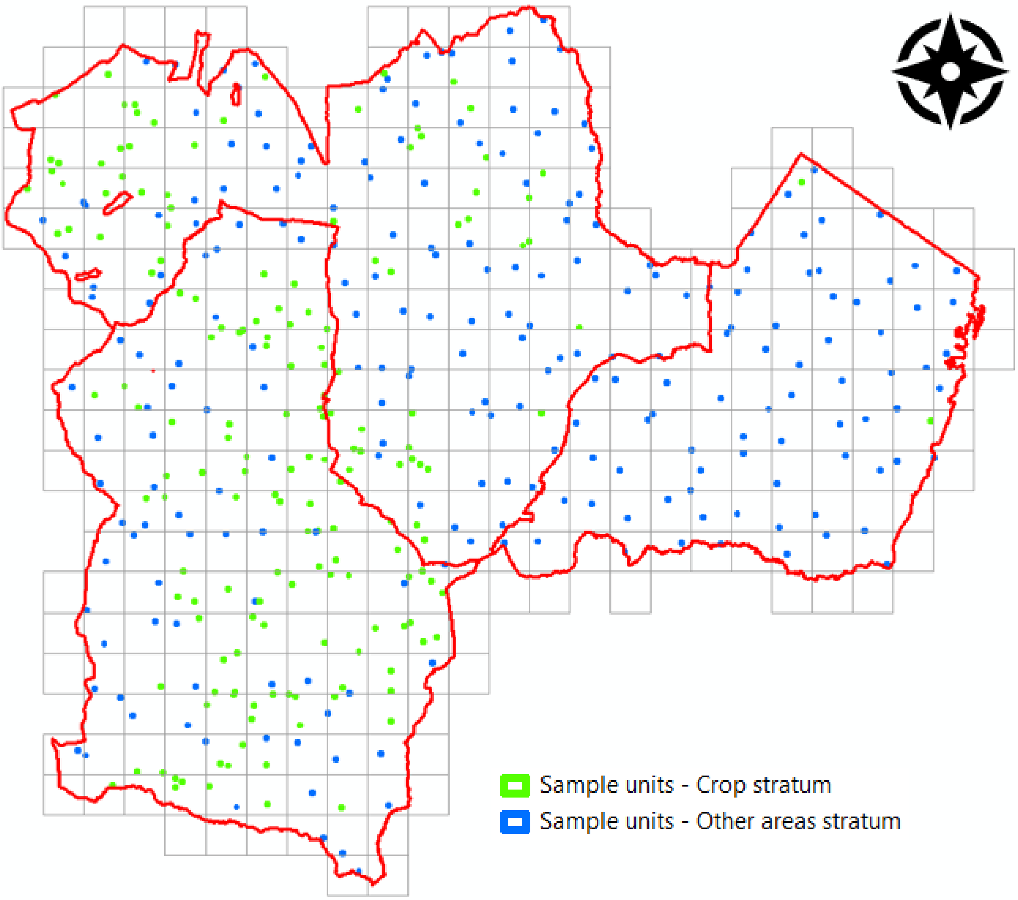


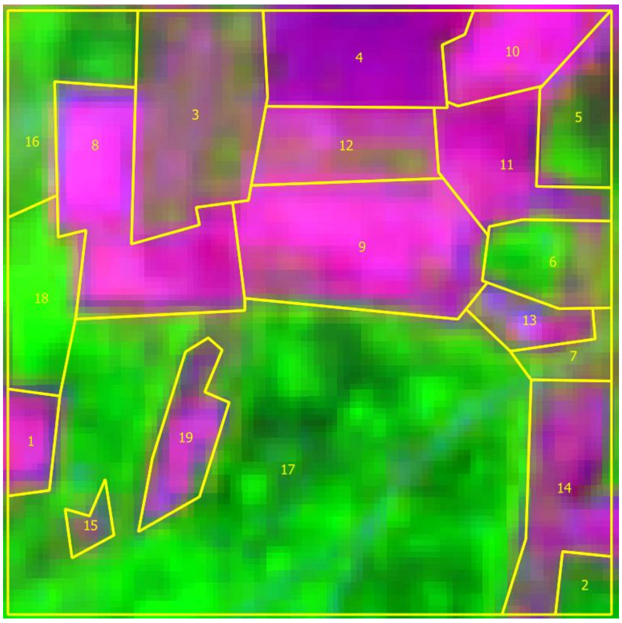
Figure 4: Spatial distribution of the sample units per aggregated stratum

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 Uhuru Labs. In total out of the overall sample of 400 segments, 200 segments were identified to contain field parcels and therefore were to be surveyed as indicated in D1.1.

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 (2 February 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 02/02/2021 (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. Based on this analysis, it turned out that some of the originally segments identified as non-cropland had changed and some crops appeared to be present. As a result, **an additional of 47 segments on top of the original 200 cropland segments were identified (out of 400) from which cropland parcels have been detected and potentially to be surveyed,** as is shown in Figure 6. However, as the contract with Uhuru Labs was limited to 200 segments, a priority was applied to each segment based on the identified crop cover for High (majority of cropland detected), medium (cropland in minority) and low priority (no cropland detected). In case some of the high priority segments could not be surveyed, a neighbouring medium or as a last resort low priority segment was surveyed.

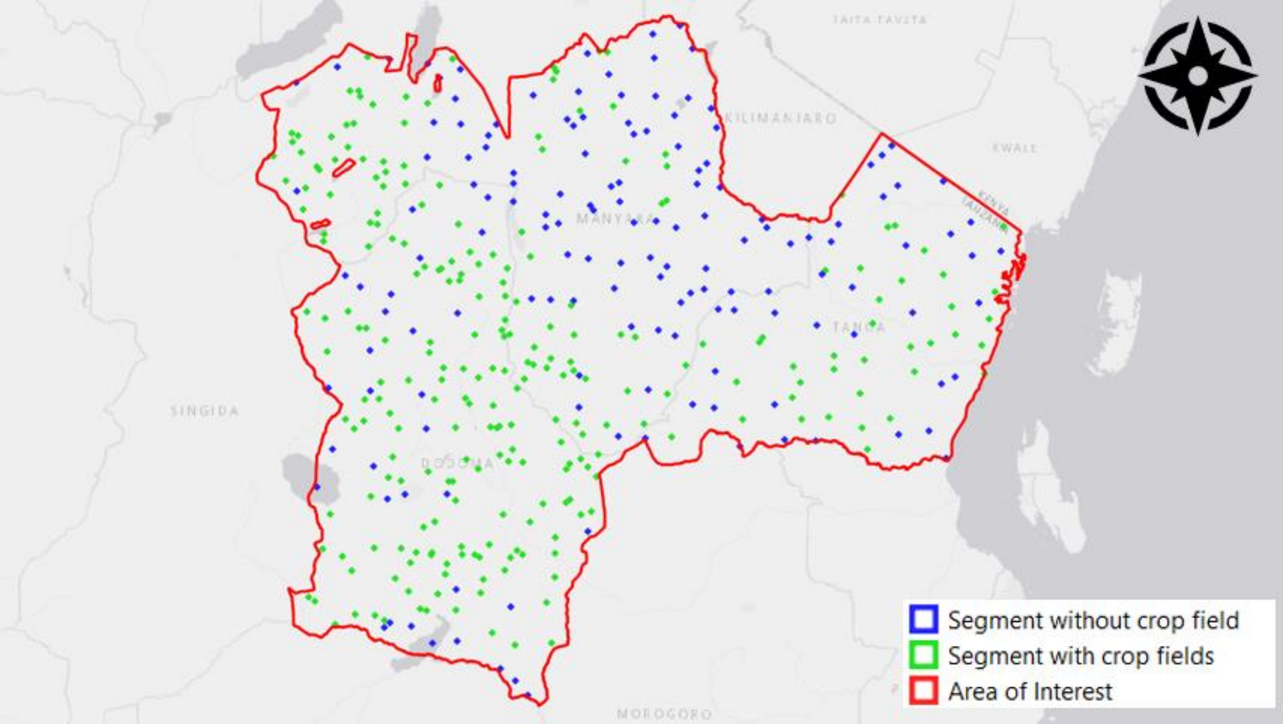


Figure 6: Spatial distribution of the 247 segments where crops have been identified

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

5.2.1 Surveyed segments

All the 247 segments where crops have been identified were not surveyed in the field. This was due to the fact that it had been agreed contractually that initially 200 segments were to be surveyed. In addition, during the field campaign, the enumerators faced some difficulties accessing the segments due to multiple causes such as:

- Segments not accessible due to the landscape (e.g. located in mountainous areas, without road/track network)
- Heavy rains episodes
- Local people/farmers denying the access to their private land, getting even sometimes violent.

So, for contractual reasons and the safety of the enumerators, it was decided not to survey those segments. Finally, only 198 cropland and 1 non cropland segments were visited as shown in Figure 7.

The 48 cropland segments that were not visited are scattered over the entire AOI as shown in Figure 7 below and therefore the surveyed sample should be representative of the overall AOI and the resulting crop area estimates should not suffer from any substantial bias.

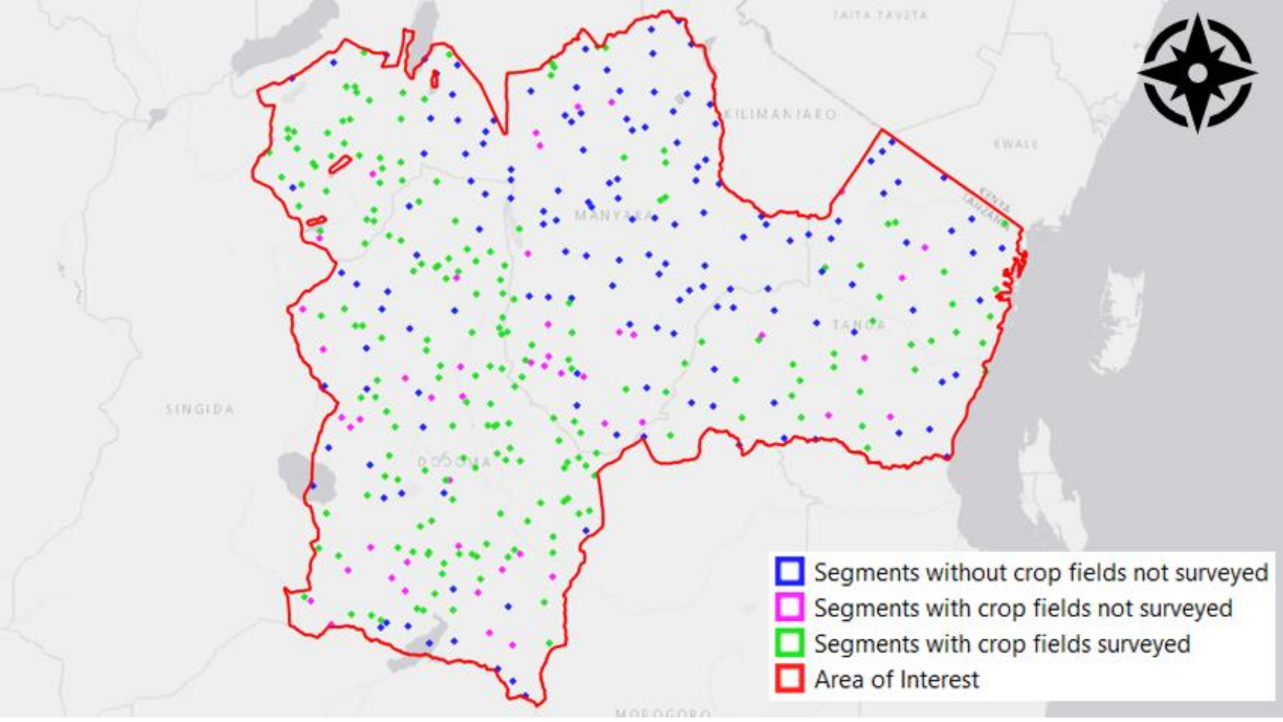


Figure 7: Final Spatial distribution of the surveyed segments

5.2.1 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 overall access to the segment was more problematic than reaching individual parcels. Therefore, drones were not used for that purpose in Tanzania.

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

In total 10 of the surveyed segments were covered by drone imagery thus representing 5% of the surveyed segments. Seven additional areas over which crops were present were covered. The equipment used was a quadcopter drone as anticipated in the D1.1.

Figure 8: Exemple of a drone picture

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. Finally, the field characteristic irrigation/rainfed type was captured as intended. Nevertheless, based on the feedback and knowledge of the local fieldworker partner, almost the entire AOI was rainfed.
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 4.

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 Table 3
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

Especially, the enumerators identified the correct crop type for each field identified as cropland using a predetermined nomenclature shown in Table 3.

Table 3: 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
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 were derived from the list of main significant crop types in Tanzania listed by the Food and Agriculture Organization (FAO, Country profile –United Republic of Tanzania[2]).

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

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

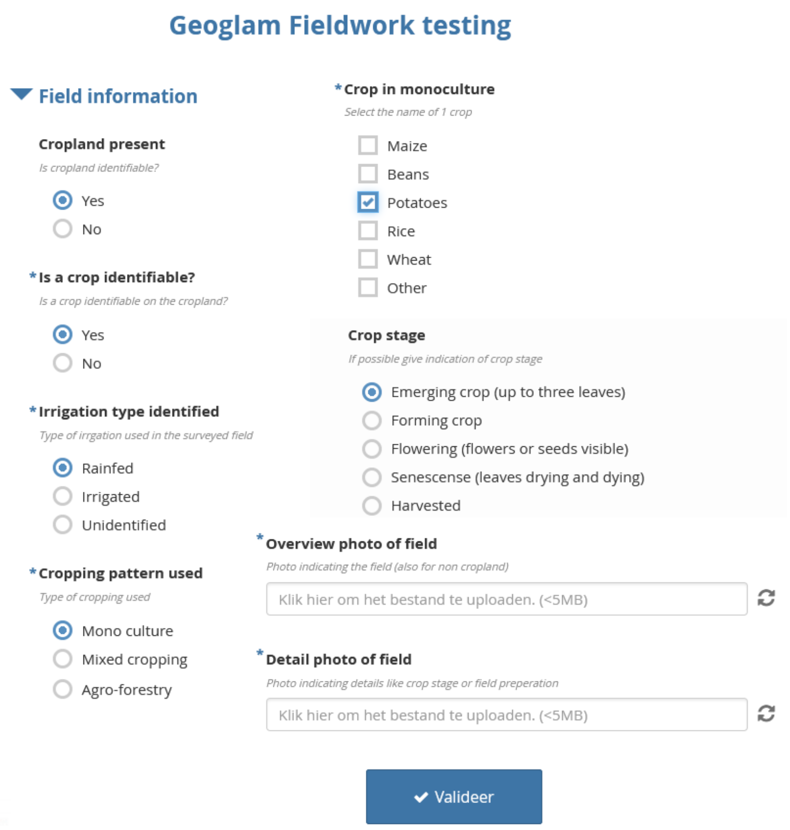


Figure 9: Screenshot of the GEOGLAM fieldwork data form for Kenya.

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 10). 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.

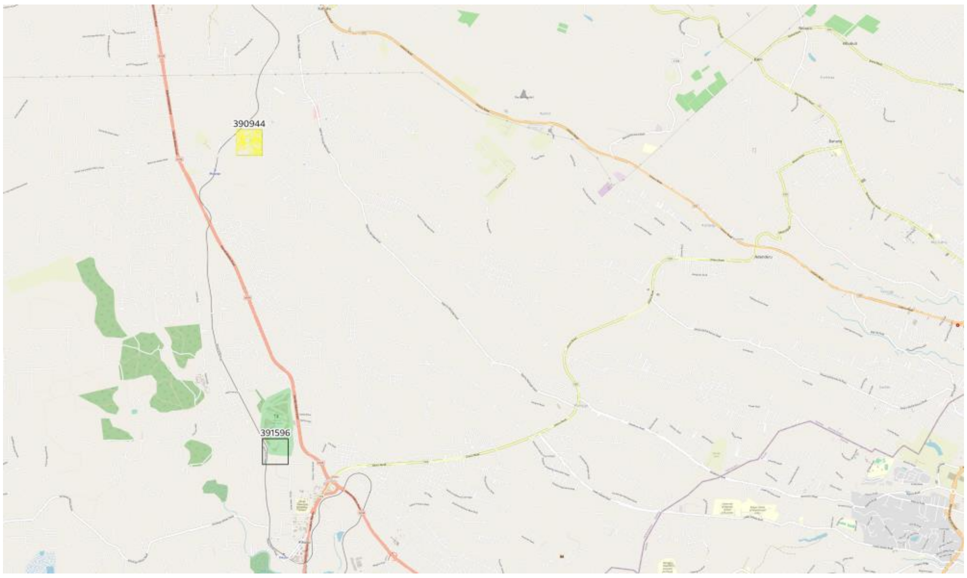


Figure 10: Situation map with segment squares and OSM network

Figure 11 shows a general example of visualization possibilities with Avenza Maps.

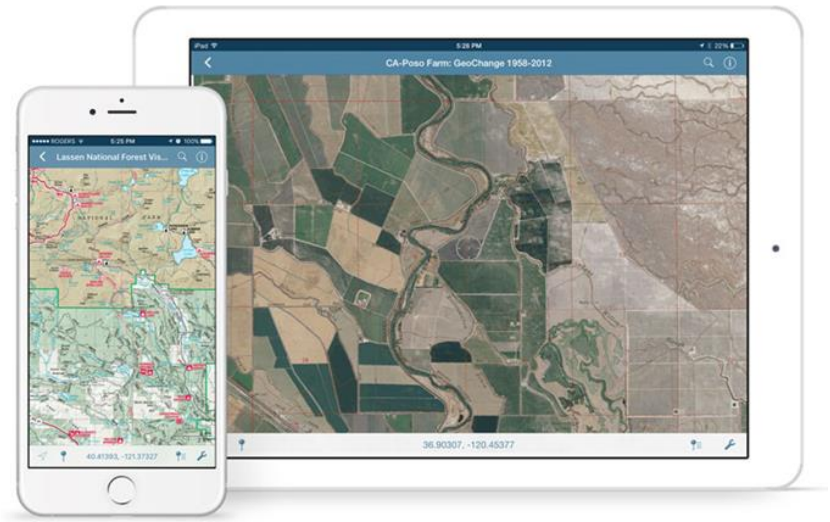


Figure 11: Avenza Map mobile app examples

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.

T-Shirts and Baseball caps with logos from the European Union (EU) made available by the EU Delegation in Dar Es Salam were worn by enumerators during the field campaign to facilitate contacts with local farmers. These were considered particularly useful and even essential. The Ministry of Agriculture (Kilomo) committed to be of help with the field campaign and even offered labour support.

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;
- Ask permission where possible, enter with discretion if not possible;
- Do not damage;
- If challenged, explain mission (show the official 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 12) and custom made RGB or false color satellite imagery (see Figure 13) 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.

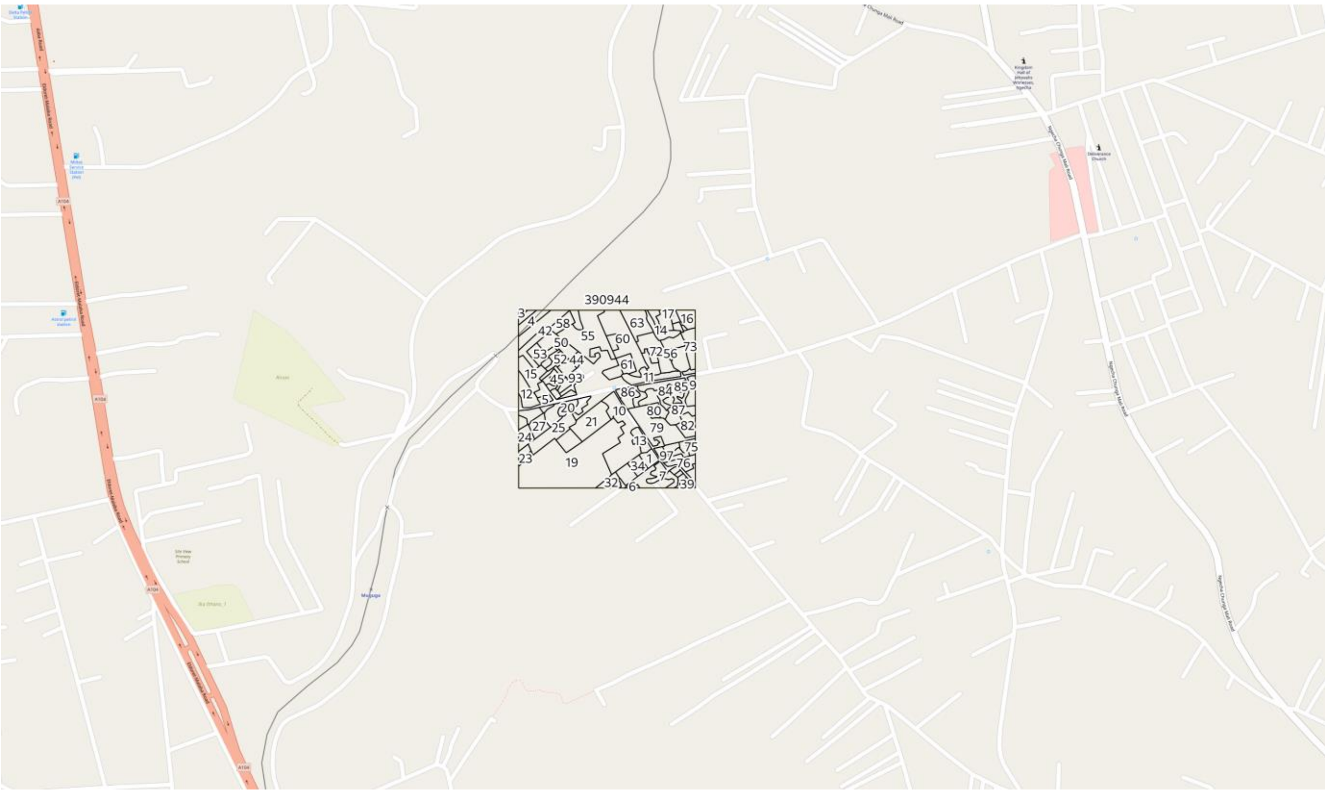


Figure 12 Orientation using OSM with overlayed sample unit 390944 and fields 1 to 97s

Figure 13 Recent 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 as illustrated in Figure 14. A detailed description of the form is presented in ANNEX I – Description of form used for segment survey.

Figure 14. 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.

5.4.3 Collection of extra ground-truth data

To collect additional ground-truth data besides the samples from the square samples the quality control team was asked to collect extra ground truth data along the route. This was done while travelling between the segments and stopping next to the road once a clear view of the crop land could be obtained. This type of data collection once stopped was executed using 1) two cameras to obtain more detailed pictures looking either to the left or to the right of the road for crop type / crop phenology validation and 2) an application for navigation and pinpointing the geolocations of the detailed pictures in the fields, and add crop stage information as an attribute to the point measurements. The proposed application for these two actions was Avenza Maps. Avenza maps allows for 1) navigation using a GNSS on a smartphone or tablet and 2) catching geolocation with attribute information on top of custom-made maps. Previous efforts showed that this is an effective way of rapidly collecting the most relevant information for crop type mapping (crop type and crop stage). In one day more than 200 stops can be performed for detailed sampling (taking 1 overview and 2 detailed pictures).

In addition, as detailed above some drone imageries and video were also acquired.

5.5 Specification of the local fieldwork partner and organization

The Tanzanian company Uhurulabs has been selected as partner of the consortium to conduct the fieldwork for both growing seasons in 2021. Uhurulabs is a service company focussing on mapping, IoT, drones and Big data. They are specialists in mapping and surveying projects using multi-rotor drones for agricultural, mining and engineering applications. They've been involved in various mapping projects in Tanzania and beyond on the topics of agricultural monitoring, often using multi-spectral drone image acquisition and processing. The Uhurulabs 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: 2021-04-20

Ending date: 2021-05-31

Uhurulabs were responsible for all practical local fieldwork and data acquisition. The subcontracted the field data collection to the local HotOSM team a local NGO specialised in field data collection. In total 12 enumerators were hired accompanied by a Team leader supported by another enumerator focusing on QC activities and overall management of the campaign. The field campaign started first in the Dodoma region to follow the crop calendar and went relatively smoothly with the exception for a road accident in which one of the enumerators suffered from minor injuries. In addition, severe rains affected the survey on some locations, but overall, the campaign could be completed within the allocated timeframe.

6 Conclusion and recommendations

Overall, the field data collection in Tanzania was performed as planned even though there was a 3-4 week delay primarily due to getting the necessary authorisation from the Tanzanian authorities. The field campaign lasted for about 4 weeks as anticipated as part of the feasibility study. The delay was not really problematic as most crops were sill in their vegetative state.

However, 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. This meant that the number of segments was initially underestimated because the initial assessment made during the feasibility study was performed on historical imagery.

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

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 15). For each segment of 500x500 meters a MBTile is created and the sample_id is given in the top middle of the MBTile.

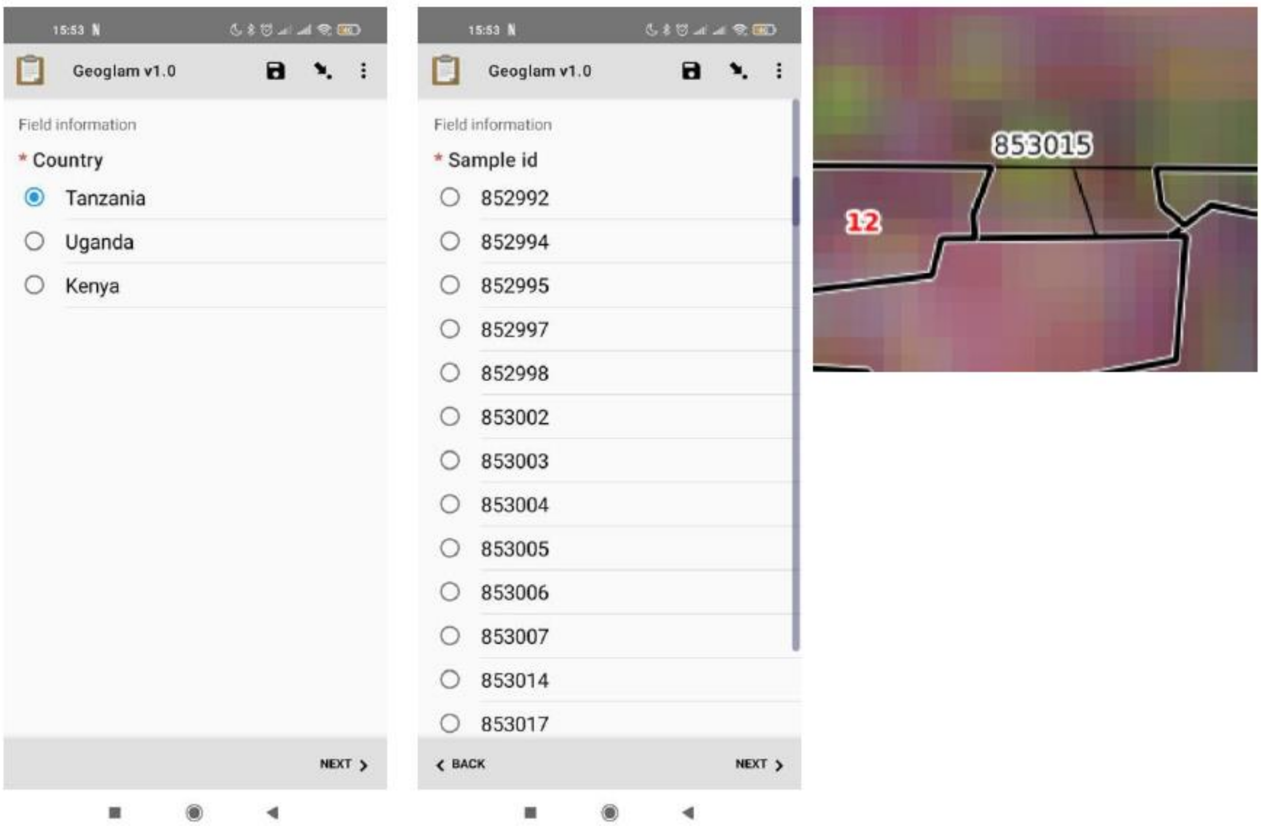


Figure 15 Collecting meta information

Each field has a unique id and ranges from 0 to the number of fields in the segment (see Figure 16). 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.

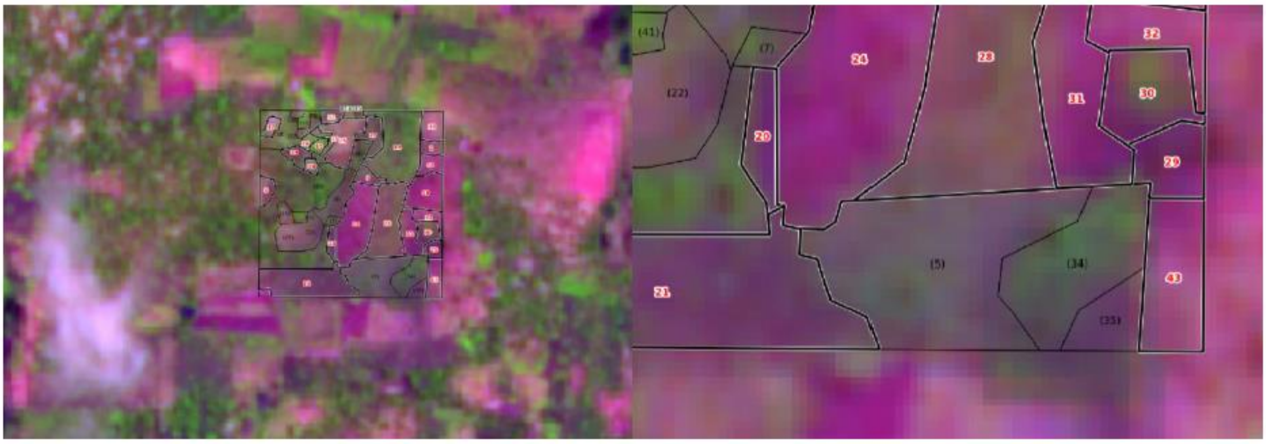


Figure 16 Digitalized sample with field IDs

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 4 and Figure 17.
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 4 and a small excerpt is shown in Figure 17.

Table 4: 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 3
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

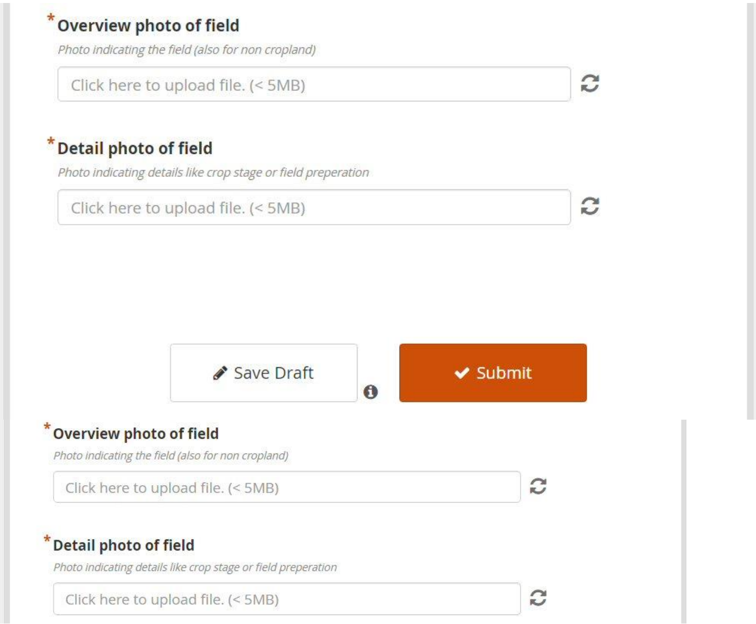


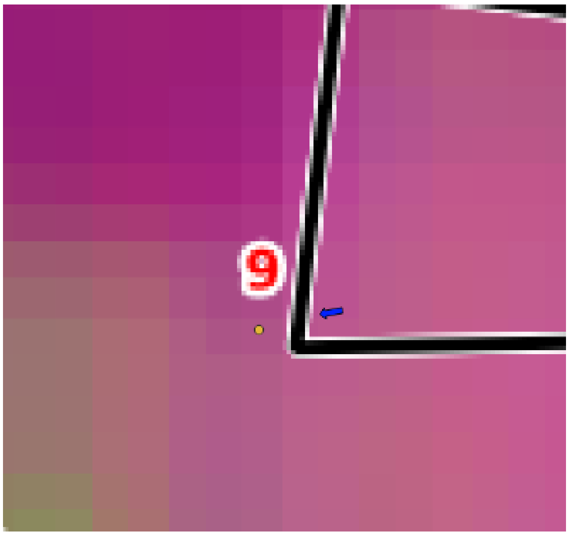
Figure 17 Example of characteristics captured with the form

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 18 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.

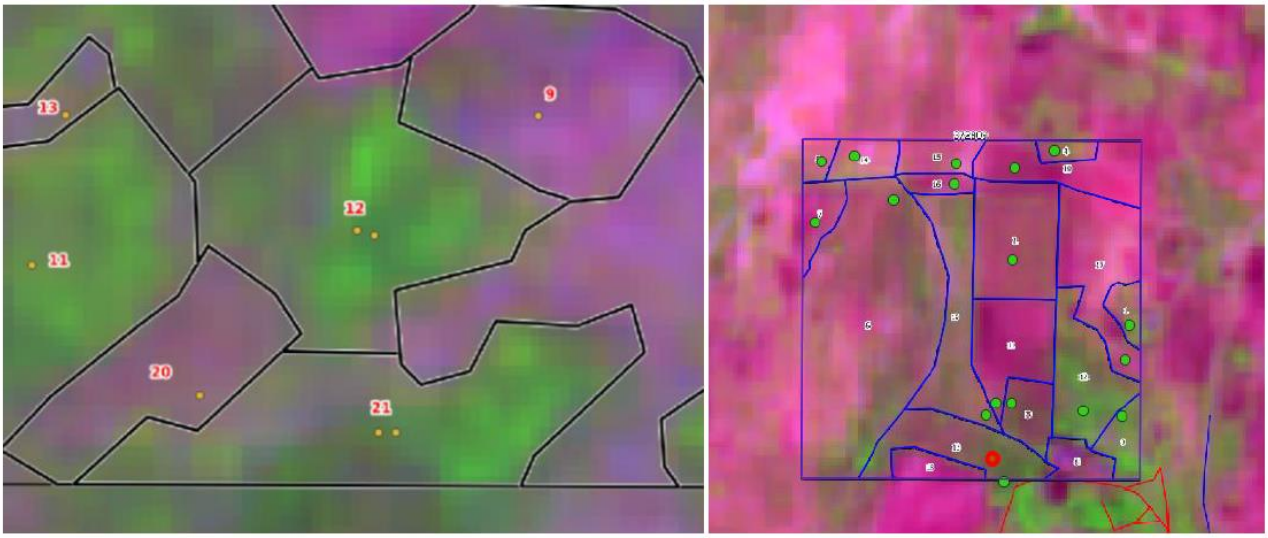


Figure 18: examples of incorrect placement of pin-points