

Service contract for the Copernicus Land monitoring services



Crop Mapping for GEOGLAM Country Level Support



Framework Contract N°939708-2020-IPR

First Specific Contract

D2.1 Field Campaign for Kenya – Successful completion statement

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with support from:



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LIST OF ABBREVIATIONS

AOI	Area of Interest
CLS	Collecte Localisation Satellites
EO	Earth Observation
GEOGLAM	Group on Earth Observations Global Agricultural Monitoring
MAR	Model Assisted Regression
SIRS	Systèmes d'Information à Référence Spatiale
VHR	Very High 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.

Upande Ltd as a subcontractor to CLS was in charge of the field campaigns in Kenya, taking full profit of local knowledge regarding regulations, logistics and resources.

The present document covers the D2.1 Deliverable highlighting the successful completion of the field campaign and the presentation of the preliminary results derived from the field campaign implemented as described in the field campaign methodology report (D2.4). A first insight of the crop area estimates will be presented in this report. Consolidated figures will be provided in the Deliverable D3.3 when the crop mask and crop types classifications will be derived based on area estimate bias correction as described in the feasibility report for Kenya (D1.1).

2 Objectives of the field campaign

The objective of the survey was to collect in the field harmonized training data (also called ground truth data) for 1) the classification of crop mask and 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)

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 **98,690km²** (representing 17% of the country). Figure 1 shows the extent of the area of interest.



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

4 Results of the field campaign

The following preliminary results are based on the 271 segments visually interpreted following the landcover nomenclature shown in Table 1 and the 175 segments visited in the field resulting in 4,974 fields surveyed as described in the feasibility report for Kenya (D1.1) and the field campaign methodology report (D2.4). The field campaign permitted to collect information regarding the fields and crops characteristics. It should be noted that 26 segments that were due to be visited were not surveyed due to denied access. Nevertheless, the 26 non visited segments are randomly scattered over the area and will not pose an issue for subsequent activities.

Table 1: Main Landcover nomenclature

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

It should be stressed that the results presented in the next sections are preliminary and will be adjusted based on the area estimate bias correction as described in the feasibility report for Kenya (D1.1). The objective is to provide a first synthetic insight of the crop area estimates based on the harmonized field work dataset without taking into account the sampling rate. Therefore, considering that the non-surveyed crop segments are included in the following tables, the crop area estimates are likely to be slightly underestimated.

4.1 Overview

The Table 2 shows the segment-based areas and the AOI area estimates for the 8 main landcover classes identified.

Table 2: Area estimates for the 8 main landcover classes identified at both segments and AOI level

Landcover	Segment estimates		AOI estimates
	Area (km ²)	Area (%)	Area (km ²)
Cropland	23.22	34.27%	33,822.37
Forest	14.65	21.63%	21,345.27
Shrubland	12.87	19.00%	18,746.32
Grassland	7.61	11.24%	11,092.99
Bare soil	4.52	6.67%	6,585.96
Urban	3.70	5.46%	5,392.14
Wetland	0.69	1.01%	1,001.01
Water	0.48	0.71%	700.58
Total	67.75	100.00%	98,686.65

The preliminary results show that approximately 34% of the areas is covered by cropland, representing approximately 33,822 km² at the AOI level. Figure 2 illustrates the distribution of the 8 main landcover classes derived from the 271 segments interpreted and surveyed.

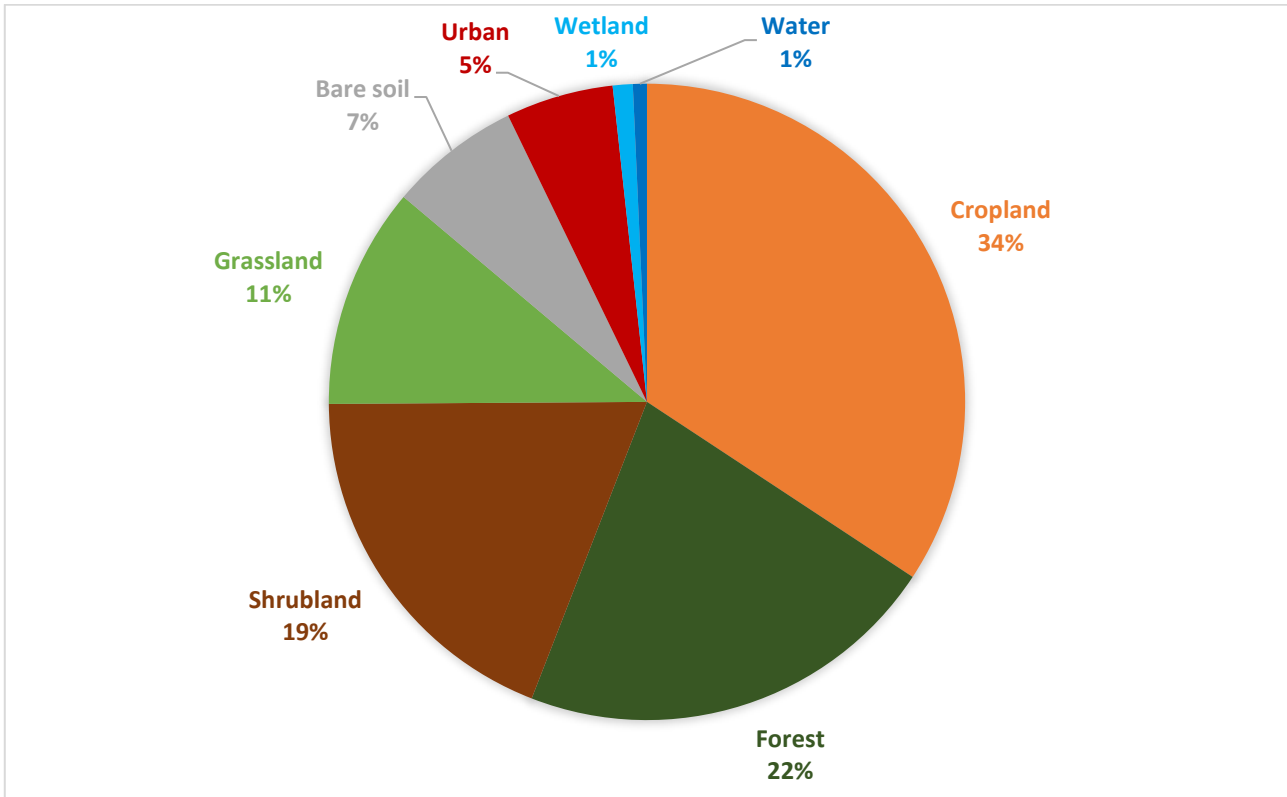


Figure 2: Distribution of the 8 main landcover classes derived from the 271 segments interpreted and surveyed

4.2 Cropping system

The Table 3 shows the segment-based areas and AOI area estimates regarding the cropping systems in the region.

Table 3: Area estimates for the cropping patterns at segment and AOI levels

Cropping pattern	Segment-based areas		AOI area estimates
	Area (km ²)	Area (%)	Area (km ²)
Agroforestry	0.13	0.19%	187.71
Mixed cropping	5.68	8.39%	8,275.86
Monoculture	10.40	15.36%	15,153.41
Undetermined* or Non-crop	51.53	76.07%	75,069.66
Total	67.75	100.00%	98,686.65

* 7.06 km² out of 23.22 km² of the fields identified as cropland during the interpretation based on VHR imagery were not surveyed due to budget constraint as explained in the field campaign methodology report (D2.4)

The preliminary results show that two third of the cropland is in monoculture and the other third in mixed cropping, representing respectively 15,153 km² and 8,276 km² of the AOI. The agroforestry system only represents 0.2% of the area, representing 188 km².

4.3 Crop stage

The Table 4 and Figure 3 show the segment-based areas and AOI area estimates regarding the crop stages.

Table 4: Area estimates for the cropping patterns at segment and AOI levels

Crop stage	Segment-based areas		AOI area estimates
	Area (km ²)	Area (%)	Area (km ²)
Bare soil	0.20	0.30%	296.22
Crop in ridges	1.66	2.45%	2,413.14
Crop not in ridges	6.09	8.98%	8,866.12
Field covered	7.53	11.12%	10,976.29
Ridges closed	0.73	1.08%	1,065.21
Undetermined* or Non-crop	51.53	76.07%	75,069.66
Total	67.75	100.00%	98,686.65

* 7.06 km² out of 23.22 km² of the fields identified as cropland during the interpretation based on VHR imagery were not surveyed due to budget constraint as explained in the field campaign methodology report (D2.4)

The preliminary results show that approximately half of the cropland is characterized with a field covered, representing 10,976 km² of the AOI. It is interesting to note that most of the crops were still in their vegetative state. The crop stages “Crop not in ridges”, “Crop in ridges” and “Ridges closed” represent 38%, 10% and 5% covering respectively 8,866 km², 2,413 km² and 1,065 km² of the AOI. The bare soil stage only represents 0.3% of the area, representing 296 km².

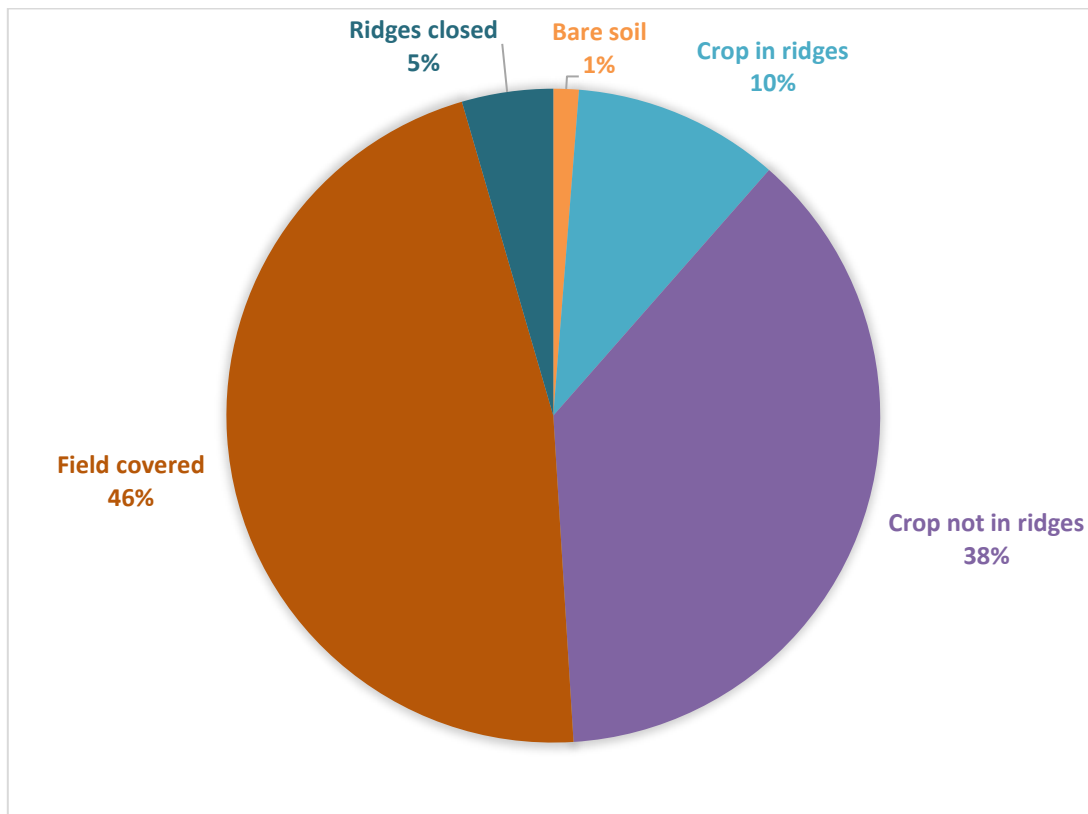


Figure 3: distribution of the different crop stages for the parcels where crops have been identified in the field

4.4 Crop types in monoculture

4.4.1 5 main crop types identified by the applicant country

The Table 5 shows the segment-based areas and the AOI area estimates for the 5 main crop types identified by the applicant country and the other monoculture or landcover classes of the AOI.

Table 5: Area estimates for the 5 main crop types identified by the applicant country in the AOI

Crop type	Segment-based areas		AOI area estimates
	Area (km ²)	Area (%)	Area (km ²)
Maize	5.60	8.26%	8,154.06
Potatoes	0.72	1.06%	1,046.75
Beans	0.37	0.55%	542.92
Wheat	0.17	0.26%	252.99
Rice	-	0.00%	-
Other monoculture	3.66	5.40%	5,331.46
Other (undetermined*, mixed cropping, non-crop areas)	57.22	84.47%	83,358.48
Total	67.74	100.00%	98,686.65

* 7.06 km² out of 23.22 km² of the fields identified as cropland during the first interpretation based on VHR imagery were not surveyed due to contractual reasons

The preliminary results show that the area estimates for the maize, potatoes, beans, wheat and rice are respectively 8,154 km², 1,047 km², 543 km², 253 km² and 0 km². The maize is the dominant crop type and represents approximately 8.3% of the area (53% of the crops in monoculture as shown in Figure 4). The 4 other crop types selected by the applicant country for this study represent approximately 1% and less of the territory. Despite the fact that rice has been identified as main crop type by the applicant country, such crop fields have not been found during the field campaign. So the training dataset based on the data collected in the field will be free of rice. Nevertheless, this crop type is well-known to be spatially located to very specific areas and we can envisage to add extra samples by mean of visual digitalizing of the EO imagery. It would permit the image classification of the rice fields if necessarily required. The other crop types in monoculture cover approximately 5% of the AOI (35% of the crops in monoculture), representing 5,332 km². The section 0 shows the area-based dominant crop types in monoculture.

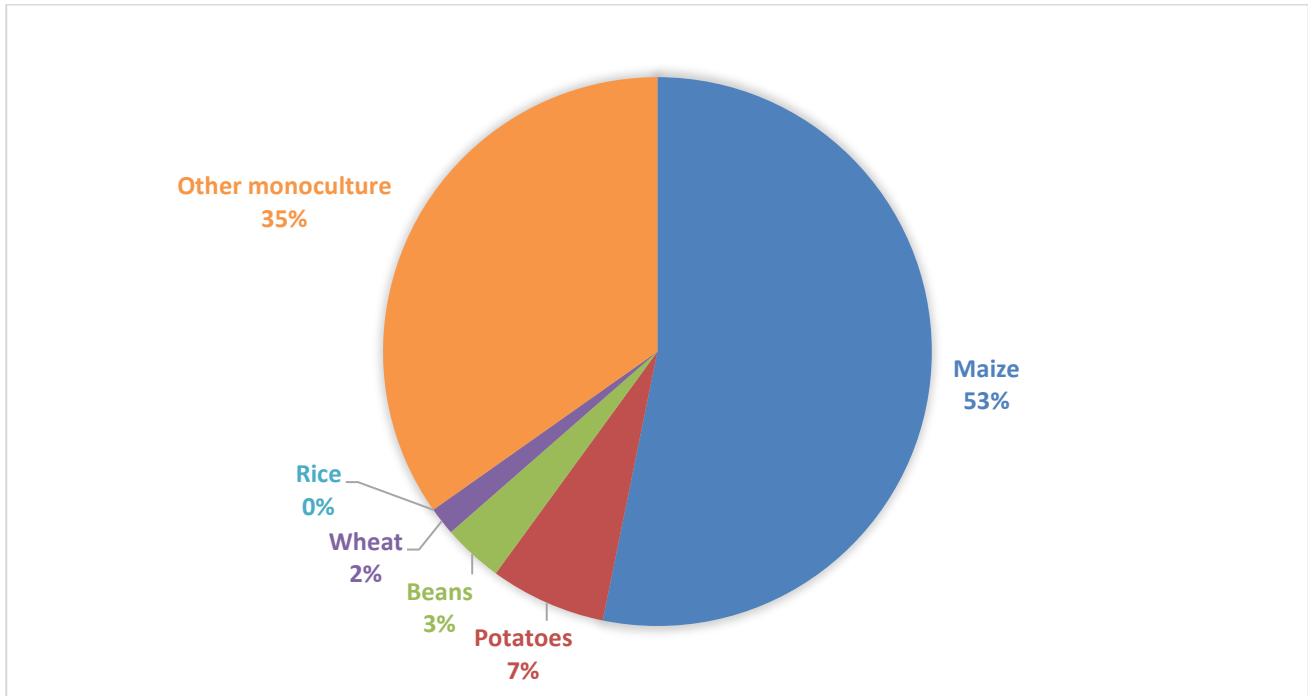


Figure 4: distribution of the 5 main crop types identified by the applicant country compared to the other crops in monoculture

4.4.2 Main crop types resulting from the field campaign

The Table 6 shows the segment-based areas and the AOI area estimates for the main crop types surveyed during the field campaign and the other monoculture or landcover classes of the AOI.

Table 6: Area estimates for the dominant crop types

Crop type	Segment-based areas		AOI area estimates
	Area (km ²)	Area (%)	Area (km ²)
Maize	5.60	8.26%	8,154.06
Sugarcane	1.12	1.66%	1,638.14
Tea	0.80	1.18%	1,164.18
Potatoes	0.72	1.06%	1,046.75
Beans	0.37	0.55%	542.92
Elephant grass	0.37	0.55%	542.17
Millet	0.27	0.40%	391.10
Coffee	0.20	0.29%	290.87
Other monoculture	1.07	1.58%	1,557.99
Other (undetermined*, mixed cropping, non-crop areas)	57.22	84.47%	83,358.48
Total	67.74	100.00%	98,686.65

It is interesting to note that the preliminary results show that the 5 main crop types identified by the applicant country are not the 5 most representative crop types of the AOI. In addition to maize, beans and potatoes, other crop types such as sugarcane, tea, elephant grass, millet and coffee can be mentioned. This crop types cover between 1,638 and 291 km², corresponding to 11% and 2% of the crop types in monoculture as shown in Figure 5. Nevertheless, the preliminary results are fully in line with the land cover characteristics as described in the feasibility study (D1.1) which indicates that croplands covering the area, consist of perennial crops like sugarcane, tea and coffee, and annual crops such as maize or beans. So these results demonstrate that the field campaign has been executed successfully.

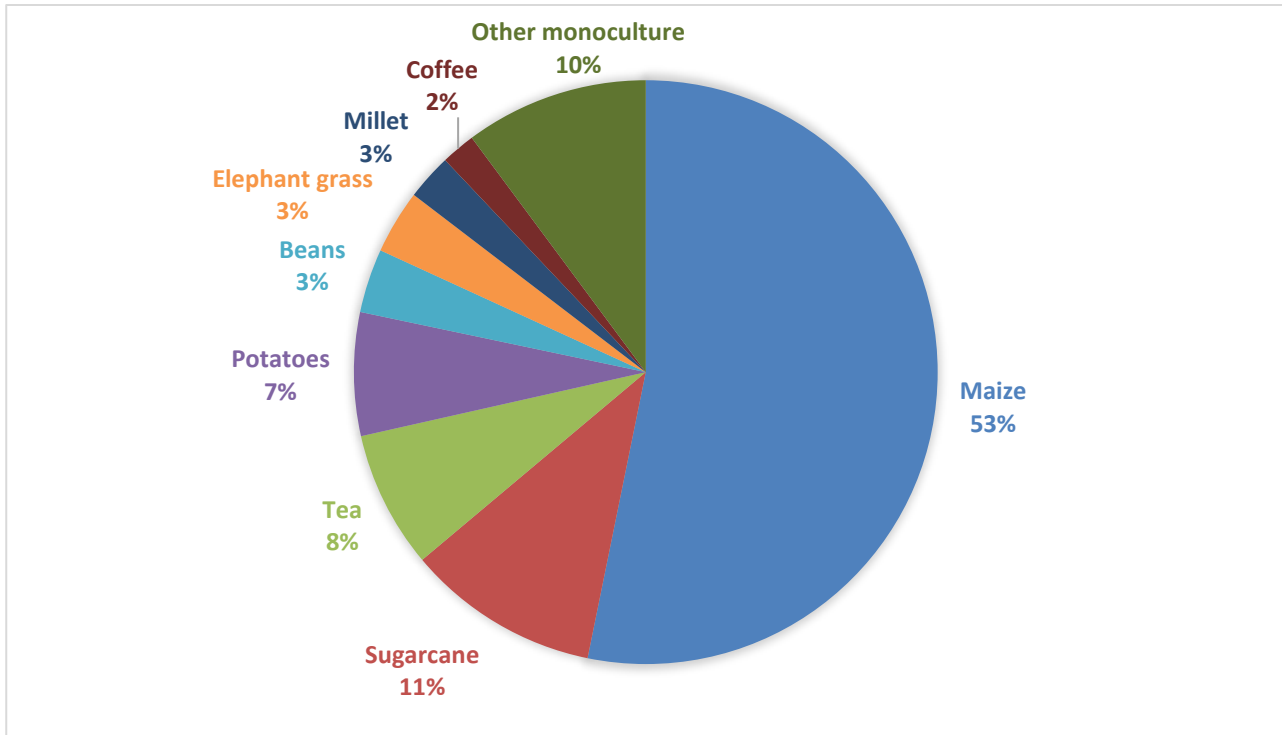


Figure 5: distribution of the dominant crop types in monoculture

4.5 Mixed cropping

Table 7 shows the segment-based areas and the AOI area estimates for the main mixed cropping classes surveyed during the field campaign and the other landcover classes of the AOI

Table 7: Area estimates for the dominant mixed cropping system

Mixed cropping	Segment-based areas		AOI area estimates
	Area (km ²)	Area (%)	Area (km ²)
Maize mixed with other crops	4.81	7.10%	7,010.95
Potatoes mixed with other crops	0.14	0.20%	199.50
Other mixed cropping	0.69	1.01%	999.51
Other (undetermined, monoculture, non-crop areas)	62.11	91.68%	90,476.69
Total	67.74	100.00%	98,686.65

The preliminary results show that maize mixed with another crop types is the main mixed cropping system of the AOI, covering approximately 7,011 km², representing 7% of the AOI (85% of the crop types in mixed cropping as shown in Figure 6). The potatoes mixed cropping class represents approximately 3% of the territory covering 200 km². The other mixed cropping classes represent less than 0.5% of the territory and covering 1,000 km².

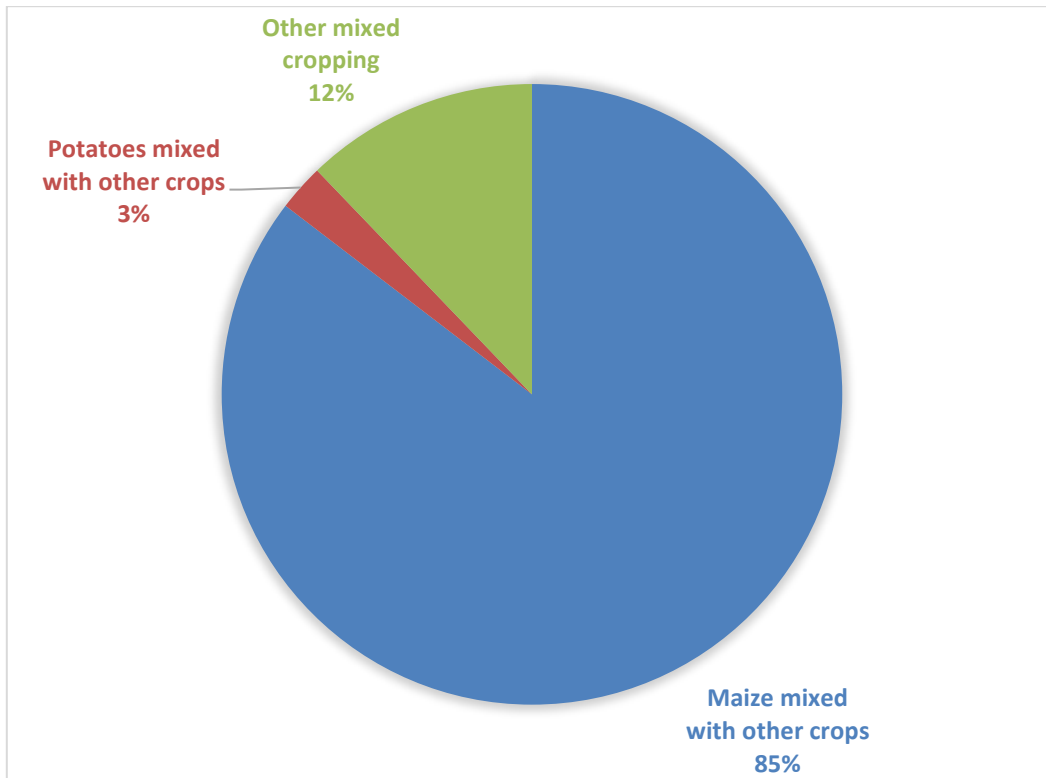


Figure 6: distribution of the dominant crop types in mixed cropping

5 Successful Completion Statement and perspectives

This report only presents the preliminary results of the field campaign.

The figures will be adjusted during the area estimate bias correction procedure which allows the correction of bias in the sampling rate and the provision of crop area statistics

With the different crop mapping derived, the following crop area estimates will be provided:

1. Direct expansion estimates from the field data
2. First Model Assisted Regression (MAR) estimates for in season crop mapping
3. Second MAR estimates for end of season crop mapping

Based on the results obtained, the consortium confirms that that the field campaign has been executed successfully and that the Tasks 3 to 7 can be executed on the basis of the data gathered during the field campaign.