

LUCAS 2015
(Land Use / Cover Area Frame Survey)

Quality Report

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Abbreviations

CAP	Common Agricultural Policy
CAPRI	Common Agricultural Policy Regionalised Impact
CLC	Corine Land Cover
CV	Coefficient of Variation
DG	Directorat Général
DLV	Deliverable
DMT	Data Management Tool
EEA	European Environment Agency
ESDI	European Spatial Data Infrastructure
ESS	European Statistical System
Estat	Statistical Office of the European Union
EU	European Union
FAO	Food and Agriculture Organisation
GPS	Global Positioning System
INE	Instituto Nacional de Estatística (Portugal)
INSPIRE	Infrastructure for Spatial Information
LAEA	Lambert Azimuthal Equal Area
LC	Land Cover
LU	Land Use
LUCAS	Land Use/Cover Area Frame Survey
MS	Member States
NACE	<i>Nomenclature statistique des activités économiques dans la Communauté européenne</i>
NUTS	<i>Nomenclature des Unités Territoriales Statistiques</i>
PI	Photointerpretation
QR	Quality Report
SAS	Statistical Analysis System
SQL	Structured Query Language
TW	Transitional Water

CHAPTER 1

Introduction

The scope of this document is to report on the quality of the "Land cover and Land use Area Frame Survey 2015" (LUCAS 2015), including the process, the micro data produced and the derived statistical tables. The structure of the report is defined by the ESS handbook for quality reports¹.

The LUCAS survey in its current form is carried out by Eurostat every 3 years, since 2009, based on standardised definitions and a standardised methodology. A pilot was run in 2006, using a slightly different sample design.

The data collected includes land cover and land use information in the strict sense, as well as territorial information (e.g. irrigation and land management).

The reference area in 2015 is the total area of the 28 EU countries.

The LUCAS survey is divided: an in-situ part or field survey (data is collected in the field) and a part where data are produced by photo-interpretation in the office. Photo-interpretation is used for areas that are difficult to access. The statistical tables derived are based on the data of both parts.

The sample for both parts is stratified by main land cover classes and includes more than 273 000 points for the field sample and some 66 000 for the sample that is photo-interpreted. Around 2/3 of the points are visited in subsequent surveys.

The legal base of the LUCAS survey has evolved over the years. A pilot a "Land Use and Cover Area frame Survey (LUCAS)" was launched by DG Agriculture and Eurostat in 2000, based on Decision 1445/2000/EC of 22/5/2000 of the Council and the European Parliament², dealing with the application of area frame techniques. In 2001 (postponed to 2002), the first LUCAS pilot survey was carried out in 13 of the 15 Member States of the European Union. The survey was carried out again in 2003 in all EU-15 Member States plus Hungary, allowing improvement of the data collection system and analyses of land use and land cover changes (2001-2003). The project was extended in duration from 2004 to 2007 by Decision 2066/2003/EC of 10/11/2003³. The coverage of the EU

¹ Eurostat (2014). *The ESS handbook for quality reports – 2014 Edition*. ISBN: 978-92-79-45487-5. Available at: <http://ec.europa.eu/eurostat/documents/3859598/6651706/KS-GQ-15-003-EN-N.pdf/18dd4bf0-8de6-4f3f-9adb-fab92db1a568>

² Decision No 1445/2000/EC of the European Parliament and of the Council of 22 May 2000 on the application of aerial-survey and remote-sensing techniques to the agricultural statistics for 1999 to 2003. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000D1445>

³ Decision No 2066/2003/EC of the European Parliament and of the Council of 10 November 2003 on the continued application of areal-survey and remote-sensing techniques to the agricultural statistics for 2004 to 2007 and amending Decision 1445/2000/EC. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32003D2066>

Member States and the related financing is laid down by Decision 786/2004/EC of 21/4/2004⁴. In 2006, the survey was carried out on 11 Member States (Luxembourg, Belgium, Czech Republic, Germany, Spain, Poland, Italy, France, the Netherlands, Hungary and Slovakia) to test the methodology at EU level with a restricted budget, by starting the current data collection frequency: every three years. From January 2008 onwards, LUCAS has been part of Eurostat's activities and budget. As from 2012 it is supported financially by other DGs of the Commission.

According to the handbook on quality reports, this document includes the following chapters:

- Methodology;
- Relevance, assessment of user needs and perception;
- Accuracy and reliability;
- Timeliness and punctuality;
- Coherence and comparability;
- Accessibility and clarity.

This report covers the 2 parts of the LUCAS survey (in-situ, photo-interpretation) as well as the statistical tables.

Main findings

- The sample of points (in-field visited and photo-interpreted points) for collecting land cover/use information has the largest concentration in the strata Woodland and shrubland areas (38%) and Arable Land (33%).
- The majority of points were surveyed at a distance lower than 100 m (85%), while a small percentage (9%) was photo-interpreted (PI) in the field due to accessibility problems.
- The ground survey showed a large variability in terms of:
 - Average number of points per surveyor (from 5 for Luxembourg to 732 for Portugal);
 - Average number of points surveyed per day (from less than 4 to more than 14 for Luxembourg and Portugal);
 - Average time spent per point for the different land cover classes at EU level (the largest amounts are required for Woodland (34%), Cropland (30%) and Grassland (21%)).
- The PI (Photo - Interpreted) points are a relevant percentage (about 28,5%) of the total points used in estimating the target variables in 2009, 2012 and 2015. These points by definition cannot change and so

⁴ Decision No 786/2004/EC of the European Parliament and of the Council of 21 April 2004 amending Decisions No 1720/1999/EC, No 253/2000/EC, No 508/2000/EC, No 1031/2000/EC, No 1445/2000/EC, No 163/2001/EC, No 1411/2001/EC, No 50/2002/EC, No 466/2002/EC, No 1145/2002/EC, No 1513/2002/EC, No 1786/2002/EC, No 291/2003/EC and No 20/2004/EC with a view to adapting the reference amounts to take account of the enlargement of the European Union. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32004D0786>

they are a source of stability in the estimates of changes. Hence, LUCAS results could underestimate both the “estimates of changes and amounts” between the surveys (2009, 2012, 2015). Nevertheless, it is likely that the bias is reduced because we can suppose that the unreachable points are, for their characteristics, also the more stable ones. On the other side, this method (that uses the point available information even if “old”), to handle with missing units was preferred to other methods that assign, by the estimating procedure, an “averaged value” in the strata or that replace the missing units by selecting from the “respondent population”.

- On each surveyed point: primary (LC1/LU1) and the secondary information (LC2/LU2) are collected for land cover and land use. Until 2009 and 2012, only LC1 and LU1 are given as estimates, therefore, implicitly, it is assumed that the secondary variables balance each other out in the final estimates. In order to ameliorate the results a unique variable for estimating “land cover” and one for “land use” have been calculated using the mentioned principal and secondary information, and the same methodology is applied to 2009 and 2012 data..
- To improve comparability with other land cover sources a new variable has been calculated to align LUCAS and FAO classification for forest classes. A set of mapping rules between the two classifications systems have been defined based on the semantic analysis of the classes, the changes occurred in the LUCAS forestry-related classes definition in the periods 2009-2012 and 2012-2015, and the data collection process during 2009-2015 field campaigns. Finally, an evaluation of the differences between the two classification for analysing the changes occurred in the period 2009-2015 have been assessed confirming a good correspondence between the two classification systems.

CHAPTER 2

Methodology

LUCAS surveys are carried out in-situ by collecting information on the ground by field surveyors on a set of points that are visited in subsequent years through a "mixed panel" approach. The surveyor classifies the land cover and the visible land use according to the harmonized LUCAS Survey land cover and land use classifications. The classification system has been defined to obtain a clear separation of land cover and land use, a full hierarchy and a comparability with other existing land cover/use systems.

Surveyors acquire landscape pictures in the four cardinal directions and a 250m transect is walked from the point to the east direction, where all transitions of land cover and existing linear features are recorded. A specific soil module was implemented in 2009, in 2012 (partly) and in 2015. Data collected produce three type of information: micro data, images and statistical tables.

The reference area is the total area of the EU countries included in the survey. Nevertheless, some areas are excluded from field survey (but still included into the final estimates), due to the difficulties to reach points located in very remote areas.

This chapter describes in detail the main components of the LUCAS methodology concerning the main phases from survey design to data post-processing.

2.1 *Sampling design*

The sampling design of LUCAS 2015 is a two phase sampling with stratification aiming to produce estimates at NUTS2 region level.

The two-phase sampling design is based on the definition of a base and Master sample followed by the extraction of the final sample.

The final sample is divided in 2 parts:

- A field sample selected among points likely to be physically accessible by a surveyor;
- A sample for the photo-interpretation in the office, that covers the areas not likely to be physically accessible.

If there would be only the field sample (points likely to be accessible by a surveyor) the numerous excluded points would be a likely source of bias that needs to be treated. To avoid or to reduce having a bias the excluded areas have been covered with a complementary photo-interpretation in the office. However the photo-interpretation in the office does not allow to collect all the detailed information that can be collected in the field.

The sample design takes into account the experience from previous campaigns (2006, 2009 and 2012)⁵ and stabilised at the end of the pilot phase concluded with the 2006 field survey, However in each round some improvements and fine-tuning have been added based on the experience gathered, while aiming to keep comparability with previous surveys.

In 2015, efforts were focused on reducing the points excluded from the second phase sample based on accessibility criteria, through:

- Improving the first phase sample (LUCAS master sample) by updating each point of the grid with the most recent available information (NUTS borders, road network, elevation, Corine Land Cover (CLC2012));
- Fine-tuning of the rules for eligibility of the point introducing an additional new indicator on accessibility based on CLC; the final criteria combine all the auxiliary information (Elevation, Road distance, Slope, CLC indicator).

2.1.1 Master

The base list was obtained using the 1 km² grid resulting from the INSPIRE (INfrastructure for SPatial InfoRmation in Europe)⁶ recommendations; it included around 4,000,000 points in the entire European Union territory. The projection used is the Lambert Azimuthal Equal-Area coordinate reference system (ETRS 1989 LAEA).

The LUCAS first phase sample or LUCAS master sample is a subset of the base file corresponding to a systematic 2-km grid in the Lambert Azimuthal Equal-Area coordinates.

Each point of the master sample has been photo-interpreted for stratification with a simple classification of 7 classes (1. Arable land, 2. Permanent crops, 3. Grassland, 4. Woodland and shrubland, 5. Bareland, 6. Artificial and 7. Water and wetlands) leading to 7 strata. Most of the points were photo-interpreted in 2005 on images that could not be kept because of copyright limitations. This photo-interpretation was based on the most recent orthophotos or, where orthophotos were not available, on satellite imagery.

⁵ A detailed description of the sampling strategy for Lucas 2015 is reported in Gallego et al., 2015.

⁶ INSPIRE. Available at: <http://inspire.ec.europa.eu/about-inspire/563>

Table 1 : Strata definition

Stratum	Description	LUCAS 2005 land cover classes
1	Arable land	Cereals, root crops, non-permanent industrial crops, dried pulses, vegetables and flowers (B11-B45); most of temporary artificial grassland (a fraction of E01,E02), and fallow land without vegetation (a fraction of F00)
2	Permanent crops	Fruit trees and bushes, other permanent crops: vineyards, olive trees, nurseries (B71–B84).
3	Grassland	Grassland, with or without sparse tree/shrub cover (E01–E02)
4	Wooded areas and shrub land	Forests, other wooded areas, shrub land (C11-C23, D01-D02)
5	Bare land, low or rare vegetation	Bare land: areas with no vegetation or areas covered less than 50% by dominant species of vegetation. (F00)
6	Artificial land	Artificial land (A11-A22)
7	Water	Surfaces covered by water, either permanently or for most of the year (G01-G05)

After excluding points located on small islands, it includes a total of 1 094 847 points across the 28 EU countries (Table 2)

Table 2 : Points of the Master by country and STRATA

Country	Arable Land	Permanent Crops	Grassland	Wooded areas and shrubland	Bare Land	Artificial Land	Water	TOTAL
AT	3,178	278	3,779	11,925	710	818	294	20,982
BE	2,077	50	2,507	2,117	24	813	91	7,679
BG	9,922	115	3,363	11,684	461	1,643	557	27,745
CY	655	129	284	948	123	160	15	2,314
CZ	7,660	96	2,699	8,205	111	739	207	19,717
DE	33,794	570	14,913	30,912	465	7,681	1,244	89,579
DK	7,572	1	762	1,675	82	569	119	10,780
EE	1,833	7	1,853	6,757	192	129	551	11,322
EL	6,592	2,647	4,048	17,738	387	1,101	409	32,922
ES	32,339	11,638	17,620	55,800	3,101	3,230	933	124,661

Country	Arable Land	Permanent Crops	Grassland	Wooded areas and shrubland	Bare Land	Artificial Land	Water	TOTAL
FI	5,502	37	5,078	60,819	2,704	1,516	8,666	84,322
FR	39,959	3,137	32,295	51,866	2,240	6,312	1,766	137,575
HR	4,244	146	2,075	7,048	46	404	181	14,144
HU	11,920	455	3,400	6,200	108	709	475	23,267
IE	929	0	12,079	2,940	579	521	538	17,586
IT	20,653	6,699	10,202	30,284	2,206	4,162	1,092	75,298
LT	6,241	26	3340	5,593	649	480	30	16,359
LU	165	4	163	257	4	47	4	644
LV	4,474	21	2,166	8,206	908	362	235	16,372
MT	15	6	9	16	6	26	1	79
NL	1,881	59	3,716	1,560	162	966	1,024	9,368
PL	35,351	243	10,923	27,393	201	2,745	1,600	78,456
PT	4,530	1,967	2971	10,918	594	975	345	22,300
RO	27,296	867	6,597	20,413	341	2,331	1,912	59,757
SE	7,045	8	5,520	82,979	4,605	2,112	10,183	112,452
SI	549	121	671	3,481	55	164	23	5,064
SK	3,704	110	1,693	6,180	105	367	106	12,265
UK	14,170	49	22,560	19,373	783	3,488	1,415	61,838
EU	29,4250	29,486	177,286	493,287	21,952	44,570	34,016	1,094,847

In producing master sample, in case of uncertain classifications or in other cases envisaged in interpretation guidelines, it was possible to classify the point under two different strata. The number of points that are assigned to dual strata may not exceed 10% of total number of the points. Validation procedures were developed and statistical quality controls conducted for providing a quantitative accuracy assessment of the photointerpretation and monitoring each interpreter throughout his/her working order to detect and prevent systematic errors.

In the following Table 3 the main results of the stratification (by photo-interpretation) of the grid 2 by 2 Km are summarised. The percentage of double classification can be considered an indicator of uncertainty in photo-interpretation process; it is in average 6.2% but it is greater for “grassland” and

“arable land” strata that represent respectively the 34.6% and 28.1% of the total double classifications.

Table 3 : LUCAS Master sample - Double classification of STRATA

STRATA 1	STRATA 2								TOTAL
	no strata 2	Arable land	Permanent crops	Grassland	Wooded areas and shrubland	Bare land, low or rare vegetation	Artificial land	Water	
Arable land	275,021	2	1,881	12,805	3,377	106	1,007	51	294,250
Permanent crops	27,028	723	1	331	1,369	7	26	1	29,486
Grassland	153,670	8,301	441	0	12,613	1,221	816	224	177,286
Wooded areas and shrubland	480,632	908	929	6,597	0	1,834	1,343	1,043	493,286
Bare land, low or rare vegetation	17,215	74	11	2,038	2,021	0	317	275	21,951
Artificial land	40,431	943	50	1,082	1,718	299	0	47	44,570
Water	32,498	21	1	212	999	240	40	0	34,011
TOTAL	1,026,495	10,972	3,314	23,065	22,097	3,707	3,549	1,641	1,094,840

For the 2015 sampling exercise Eurostat has corrected a number of anomalies in the previous 2-km grid that constitutes the master, including points out of the EU area and missing points inside different countries. Some 2000 points outside EU area correspond to transitional waters (estuaries, intertidal areas, coastal lagoons, etc.). There has been some discussion on the possible exclusion of these points from the set to be sampled for the field survey. Reasons for exclusion could be:

- The combination of different data sources to determine which points is part of transitional waters and/or are associated to a NUTS2 region produces ambiguous results. In fact, by definition, all points in transitional waters should be excluded from the NUTS limits, but in practice this does not occur due to usage of data sources coming from different providers;
- The observation of the distribution of the 1,942 points mentioned above on a map shows that a large number of points in transitional waters appear in the UK, Ireland, Scandinavian countries and Greece, and very few points in Spain, France, Portugal, Italy and Croatia;
- It would be better that the area estimates refer to an officially accepted definition of the territory. This can be the NUTS 2013 boundaries or a further version;
- In general surveyors will not reach the points in transitional waters (except some times in intertidal areas).

The main reason for keeping in the sample points suspected to belong to transitional waters is that there is a request of field information on this category for the validation of maps that include off-boundaries areas. The suggested compromise is that off-boundaries transitional waters are included for the second phase sampling (they will be generally observed from a certain distance), but their weight for the extrapolation should be zero. It might be good to include transitional waters in a photo-interpretation operation for points classified as “non-eligible” because they are difficult to reach.

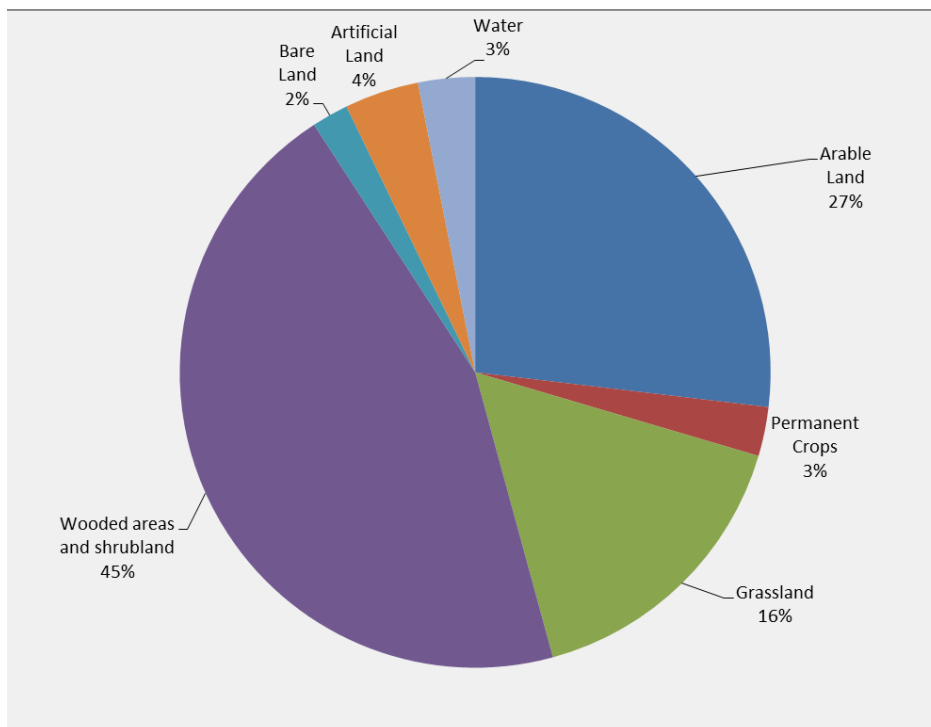
In the estimation procedure, the points belonging to “transitional water” and related areas are considered in the territorial level “country”, while they are not in the “NUTS0” level. So, for each country two areas are available: the first related to “country” and the second to “NUTS0”. To this last area, moreover, sum up the estimate at level of NUTS1 and NUTS2.

In Table 21 (Annex 1 - Tables and graphs) the number of point of the Master by STRATA and NUTS0 are reported; in the last column the difference between the number of points belonging to country and NUTS0 are given.

Figure 1 : Percentage distribution of Master’s points by Strata at EU level

2.1.2 Sample for field survey

From the first phase sample, a second phase sample of points, namely the field sample, is extracted to be classified during field visit according to the full land classification. This field sample is sampled



with a method that allows tuning the sample size per stratum and ensures a certain spatial homogeneity at the same time.

Table 4 : Number of points in the first phase sample

	Number of points
Total initial	1,097,607
Allocated to a NUTS region in the attribute table	1,093,834
Inside NUTS 2010 regions	1,091,892

Some of the master sample points were excluded for the second phase sample based on the following accessibility criteria:

- Altitude;
- Distance to roads;
- Accessibility indicator from CORINE Land Cover (CLC);
- Rule for eligibility.

Concerning altitude, the points above 1,500 m are deemed difficult to reach; these constitute a set of around 22,500 points. One way to deal with these points is defining separate strata with them. In 2009 a lower threshold had been used, but the experience in 2012 suggests that points between 1,000 and 1,500 do not present specific problems to access unless other circumstances appear (as better defined by the other mentioned criteria). The strata defined by this altitude threshold should be mainly surveyed by photo-interpretation. However points that fall at less than 600 m from the closest road and an altitude difference of less than 100 m are included in the second stage sampling for the field visits. It is clear that these points do not constitute a valid sample for area estimation, but they can provide valuable information for thematic studies.

The second criterion is the distance to the closest road. The distance has been computed on the basis of Tele-atlas road network. The road network generally excludes rural dirt roads used for the access to agricultural fields, usually good enough to allow the access of enumerators by car. All points in agricultural landscapes are deemed reachable thanks to dirt roads, although other obstacles may appear, such as private property delimited by fences.

For the criterion relative to accessibility CORINE Land Cover (CLC), agricultural areas are assumed to be rich in drivable dirt roads, in particular where there is a low density of paved roads. There is also an implicit assumption that the density of drivable dirt roads is much lower in other landscape types: forest, shrub, wetland, etc.. To this end, CLC is split into two categories: potentially easy and difficult accessibility. Difficult accessibility includes forest, scrub, non-agricultural bare land, wetland and water. We consider that a point in the master frame is potentially difficult to access if all CLC classes 600 m around are in the above mentioned categories..

Concerning the criterion based on the eligibility rule the CLC-based accessibility is combined with distance to roads and altitude. The following thresholds are defined:

- a) Points above 1,500 m (around 22,500 points) and distant > 600 m from the closest roads or with an elevation change >100 m from the closest road. 18,361 points are considered non-eligible with this rule, but almost 90% of them are also non-eligible using the CLC-related rule
- b) Points below 1,500 m with a land cover type neighbourhood (600 m circle) classified as potentially problematic accessibility (forest, shrub, water and wetland) and distant > 600 m from the closest roads or with an elevation change > 100 m from the closest road. 124,191 points fall in this category.
- c) Small islands. At the moment this criterion is not considered because the field (No_island), recovered from the master sample 2012 does not correspond to the set of islands that is considered difficult to reach for the 2015 survey. Points in islands are included in the second phase sampling. It should be a task of the contractor to propose and agree with Eurostat which points to photo-interpret because the access to the island is too difficult: no regular ferries or too long trip for a small number of points.
- d) Points that would have been eligible with the general rules, but could not be reached in 2009 (OBS_TYPE = 3 or 4) and were considered non-eligible in 2012.

Categories a) and b) can be merged in a set of strata to be treated with photo-interpretation. Category c) can be added to these strata. Category d) can be treated as missing data in the regular strata until a photo-interpretation is carried out.

With these rules, the master sample is split, regardless of the altitude, into 927,000 eligible points and 166,900 non-eligible points ca. (Table 5). The sample of points to be visited in the field is drawn from the eligible points, while for the non-eligible points a photo-interpretation operation was launched (see chapter 2.1.3)

Table 5 : Eligible and non-eligible points for the second phase

Eligible/Non eligible		Number of points
Eligible		927,566
Non eligible	altitude < 1500, CLC-difficult access dist to road > 600 m, difference altitude road > 100 m	124,191
	altitude < 1500, dist to road > 600 m, difference altitude road > 100 m	18,361
	Other non-eligible not reached in 2009 (OBS_type 2009 =3) and excluded for this reason in 2012	23,716

The subsampling method used to determine the sample for the field survey is a systematic procedure with multiple ranked replicates that ensure a certain spatial homogeneity in the distribution. The sampling rate could have been adjusted separately per domain (NUTS2 x Stratum), but the accuracy targets are rather arbitrary. A reasonable criterion is requesting a CV inversely proportional to the square root of the abundance of each class. This criterion is approximately optimized with a

homogeneous sampling rate that has the advantage of simplicity for users (minor impact if users do not use the extrapolation weights).

The only exception made to the homogeneous sampling rate per country is the rule of having a minimum of 2 sample points per stratum in each NUTS 2, unless there are not enough points in the master sample. This rule has introduced 151 points that would not have been selected with the general rule.

Some minor modifications have been introduced on the standard sampling procedure:

- For Cyprus and Malta the full first-stage sample was selected in 2012 and is kept as eligible and sampled for 2015;
- The soil bureau had sampled 24,026 points, most of them already surveyed in 2009. This sample includes 919 points that would not have been sampled for the field survey with the general rule, including 317 points that were classified as difficult to reach in the procedure described above. These 919 points have been in the 2015 sample and should receive extrapolation weight = 1 in the second phase.

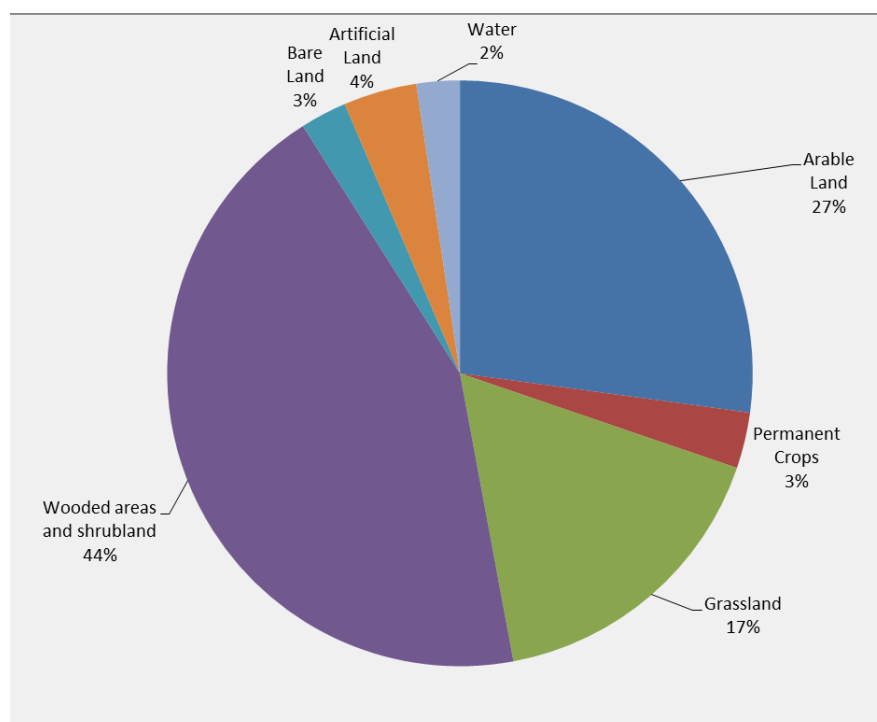
In Table 6 the number of selected points in second phase sample is shown as well as the sampling rates. The overall sampling rate is about 29% and it ranges from a minimum of about 21.6% in Hungary to the maximum of 35.6% in Portugal, excluding the particular cases of Cyprus (100%) and Malta (98.8%). The percentage distribution of the points by strata at EU level is depicted in Figure 2 while the number of points selected by strata and by country is reported in Table 23 (Annex 1 - Tables and graphs).

Table 6 : Final sample size, eligible points and sampling rate (%) per country

Country	Total Master	Field sample	Eligible	Sampling rate (%)
AT	20,979	6,679	15,704	42.5
BE	7,682	2,412	7,232	33.4
BG	27,741	6,623	22,696	29.2
CY	2,311	1,442	1,442	100.0
CZ	19,718	5,492	19,195	28.6
DE	89,501	24,900	85,300	29.2
DK	10,825	3,447	10,334	33.4
EE	11,354	2,255	9,594	23.5
EL	33,045	7,852	24,915	31.5
ES	124,613	35,231	106,524	33.1
FI	84,542	13,407	60,302	22.2
FR	137,306	38,417	125,042	30.7
HR	14,141	3,533	12,727	27.8
HU	23,271	4,626	21,429	21.6
IE	17,557	3,470	15,429	22.5
IT	75,335	20,931	62,273	33.6
LT	16,334	3,873	14,875	26.0
LU	646	206	642	32.1
LV	16,145	4,498	14,248	31.6
MT	80	79	80	98.8
NL	8,864	2,219	8,454	26.2
PL	78,141	21,721	73,671	29.5
PT	22,261	7,318	20,542	35.6
RO	59,610	14,233	51,369	27.7
SE	112,494	22,340	76,830	29.1
SI	5,067	1,614	4,705	34.3
SK	12,263	2,438	10,680	22.8

Country	Total Master	Field sample	Eligible	Sampling rate (%)
UK	62,008	12,144	51,332	23.7
EU28	1,093,834	273,400	927,566	29.5

Figure 2 : Percentage distribution of sample points by Strata at EU level



2.1.3 Sample for office photo-interpretation

Photo-interpretation played an important role during the 2015 data collection. Access to points can be difficult in absence of adequate road network, for the landscape characteristics. The territory was classified in eligible and not eligible for the field survey, using all geographical information available. However, the exclusion of points from the sample is a likely source of bias which has to be treated separately from the field survey. Therefore the non eligible excluded area need to be covered with a complementary photo-interpretation. The survey design of LUCAS 2015 consists in fact of a field sample (273.400) selected from eligible areas⁷ (easy to access) and a complementary sample of more than 66.000 points to be photo interpreted in the office according slightly simplified rules.

The photo-interpretation rules, including land use and land cover nomenclatures, were simplified to make them compatible with photo-interpretation. Table 23 (Annex 1 - Tables and graphs) reports the

⁷ See chapter on sampling

distribution of points photo-interpreted in the office by strata and country which amount to a total 66409 at EU level.

2.1.4 Full sample (field survey and office PI)

The distribution of the total number of points (field sample and photo-interpretation in the office) by strata at EU level is reported in Figure 3. The total number of points divided points visited in field and points photo-interpreted in the office organized by strata and country are reported in the Table 24 (Annex 1 - Tables and graphs).

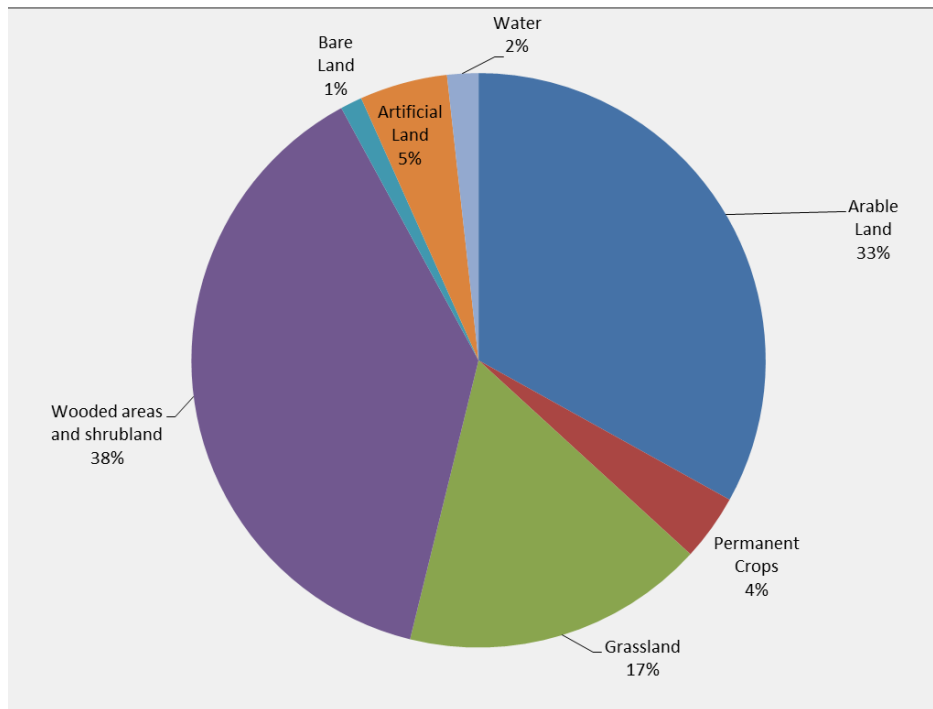


Figure 3 : Percentage distribution of sample points and office PI by Strata at EU level

2.2 Ground survey

2.2.1 Data collection

Each point belonging to the field sample is investigated by collecting a set of detailed information using a specific field form (LUCAS 2015 – Technical reference document C2 - Field Form and Ground Document (template)) with the guidance of comprehensive instructions for surveyors (LUCAS 2015 – Technical reference document C1 - Instructions for Surveyors). Data collected concern LC/LU, environmental information and “meta information”. In addition to the obligatory fields, the surveyor can - and in specific situations has the obligation - to add comments and remarks. The latter are essential to clarify any decision taken by the surveyor.

The information collected in the field can be grouped into the following categories:

1. Identification of the point
 - e) Access to point
 - f) Comments on the way to the point
 - g) Point observation

- h) Land cover and land use
- i) Land management, special status and special remarks on land cover/use
- j) INSPIRE Pure Land Cover Classes
- k) Water management on the field
- l) Soil
- m) Transect
- n) Photo (minimum 6 pictures N, E, S, W (4 photos), close-up of crop (not on artificial or vegetation-free areas), point in context (to be able to relocate), end of transect.

For the complete list of fields and the description of each parameter see Annex 1 - Tables and graphs:

The ground document indicates the location of the LUCAS point. The point as drawn on this orthophoto is the reference for locating the LUCAS point in the field. This is the point on which information has to be collected. The LUCAS point location and the real position of the surveyor might not be identical.

While the information of GPS coordinates and precision are referring to the position of the surveyor doing the observation, the information on LC/LU, environmental information and the photos of the point and of the crop/cover have to refer to the LUCAS point itself as determined by the orthophoto, even if it is further away from the real position of the surveyor.

In Lucas 2015 a pilot collection on INSPIRE pure land cover classes was introduced. Data are collected for the points where LC1 is either woodland (CXX), shrub land (DXX), grassland (EXX) or bare land (FXX) and is assessed within the homogeneous plot inside the extended window of observation (20m radius). Unlike what happens in LUCAS classes, where the sum of percentage of combined land cover can be more than 100%, in this case the sum of INSPIRE classes must be 100%. Assessment of the percentages is made using the “birds-eye” view.

Concerning water management, this is only relevant for points where LU = U111 or U112. In case of more than one source of irrigation or delivery system, the surveyor is requested to report the most important source. A note is added if irrigation is visible from the way to the point or along the transect.

It is mandatory that the surveyor does the anonymization directly before sending the photos to the upper level (i.e. the Regional or the Central Office). According to the LUCAS 2015 tender, non-compliance to this rule is considered a breach of contract and will lead to legal consequences.

In addition to the data collected on the field form, and the pictures, the surveyor shall collect point and line data in the GPS.

2.2.2 Implementation and schedule of the field survey

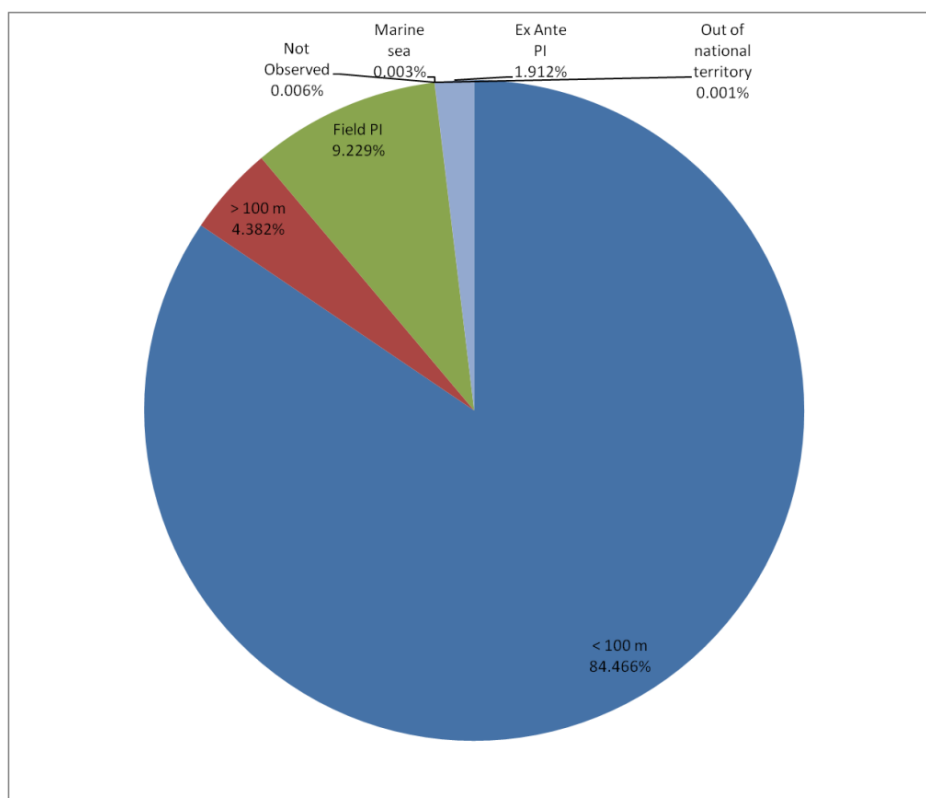
LUCAS 2015 was carried out in all 28 Member States. The territories/islands listed below were not included in the field survey; they are excluded from the reference population and hence the area is

not considered in the estimation process. The area of these territories sums up to less than 2.5 % of the total area of EU:

- ES63 (Ciudad Autonoma de Ceuta);
- ES64 (Ciudad Autonoma de Melilla) (ES63 + ES 64 = 0.03% of ES6 (SUR));
- ES70 (Canarias) ;
- FR9 (Departements D'outre-Mer) ;
- PT20 (Região Autónoma dos Açores);
- PT30 (Região Autónoma da Madeira).

All the survey has been conceived and designed by Eurostat with ad hoc technical support from JRC. The Contractors were responsible for the data collection in the 28 countries arranged in 5 lots and one IPA grant, the recruitment and management of the surveyors and the data delivery. The data collection started in field in March 2015 and was completed in office in May 2016, with the last quality checks; in the round more than 700 surveyors were recruited for a total of more than 273 000 points to be visited in the ground (Table 25 in Annex 1 - Tables and graphs).

Points were surveyed with different modalities, the majority were observed directly at a distance less than 100 m, a small percentage (less than 10%) was photo-interpreted in the field due to accessibility



problems (Figure 4).

Figure 4 : Percentage distribution of surveyed points by type of obseration at EU level

2.2.3 Survey performance

In 2015, 729 surveyors were recruited for a total of 273.401 points to be visited in the ground. The average number of points per surveyor was 375 (Table 25 -Annex 1 - Tables and graphs), compared to 366 in 2012 and 405 in 2009. There were however important differences between the countries and the maximum average number of points per surveyor was 732 (Portugal), the minimum was 5 (Luxembourg) (Table 25 -Annex 1 - Tables and graphs).

Figure 5 reports the average number of points visited by surveyor per country, while Figure 6 depicts the average number of points surveyed daily per country. In both cases the two extremes are Luxembourg (minimum) and Portugal (maximum). Figure 7 represents the average time spent per point by country, the two mentioned extremes are clearly reversed. The time spent per point on the field survey varies between 18 and 44 min, the average being 24 min, the same as in 2012.

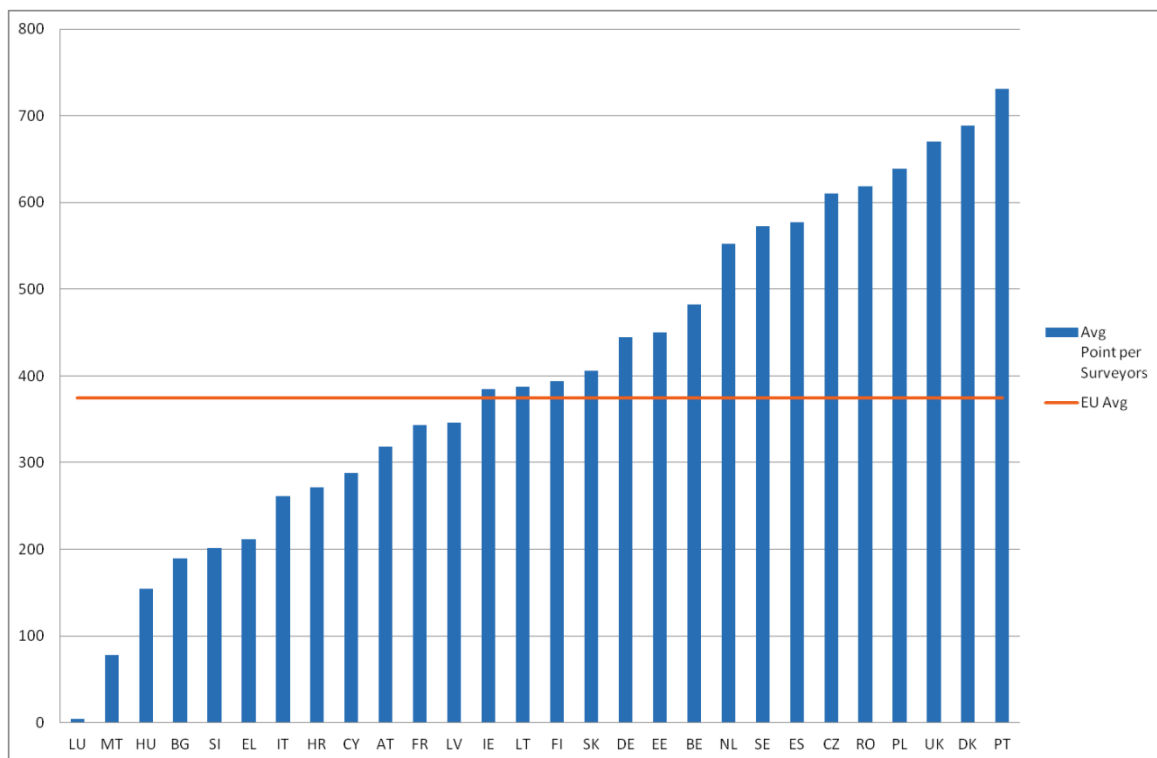


Figure 5 : Average number of points per surveyor by country and EU average

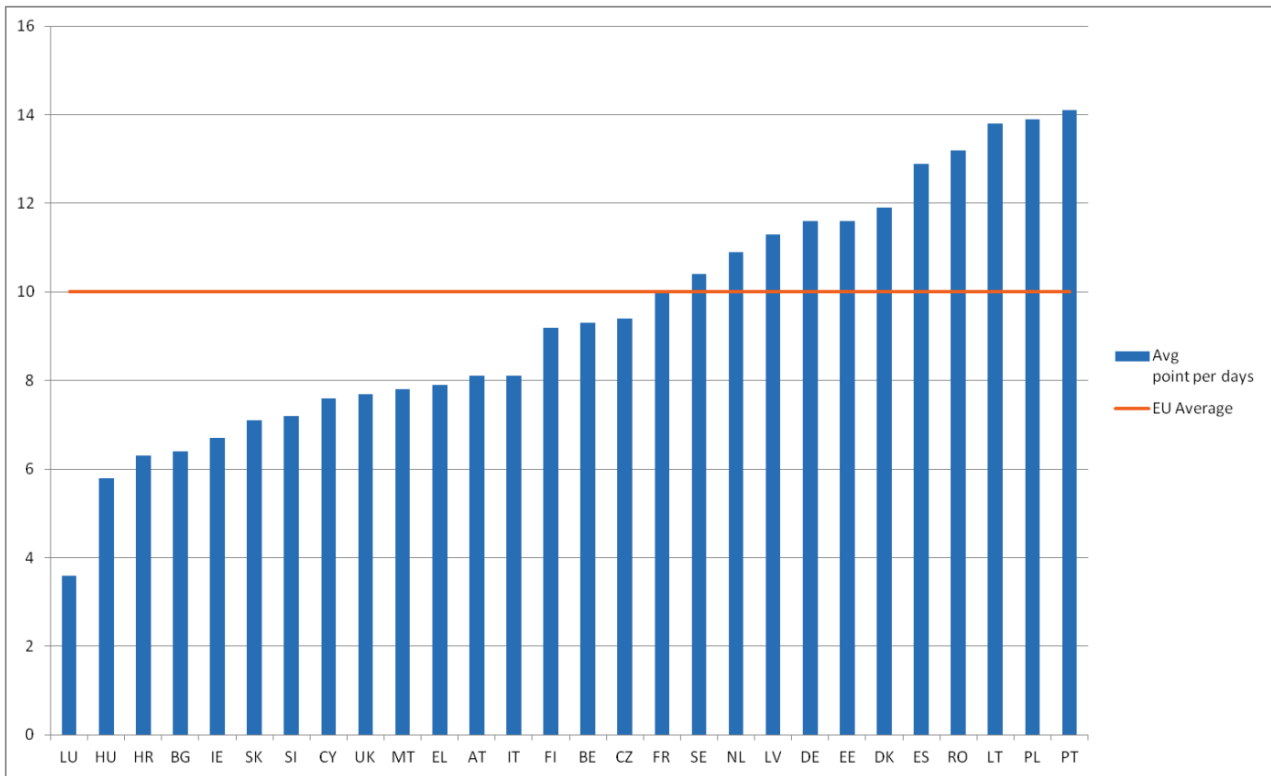


Figure 6 : Average number of points surveyed per surveyor per day by country and EU average

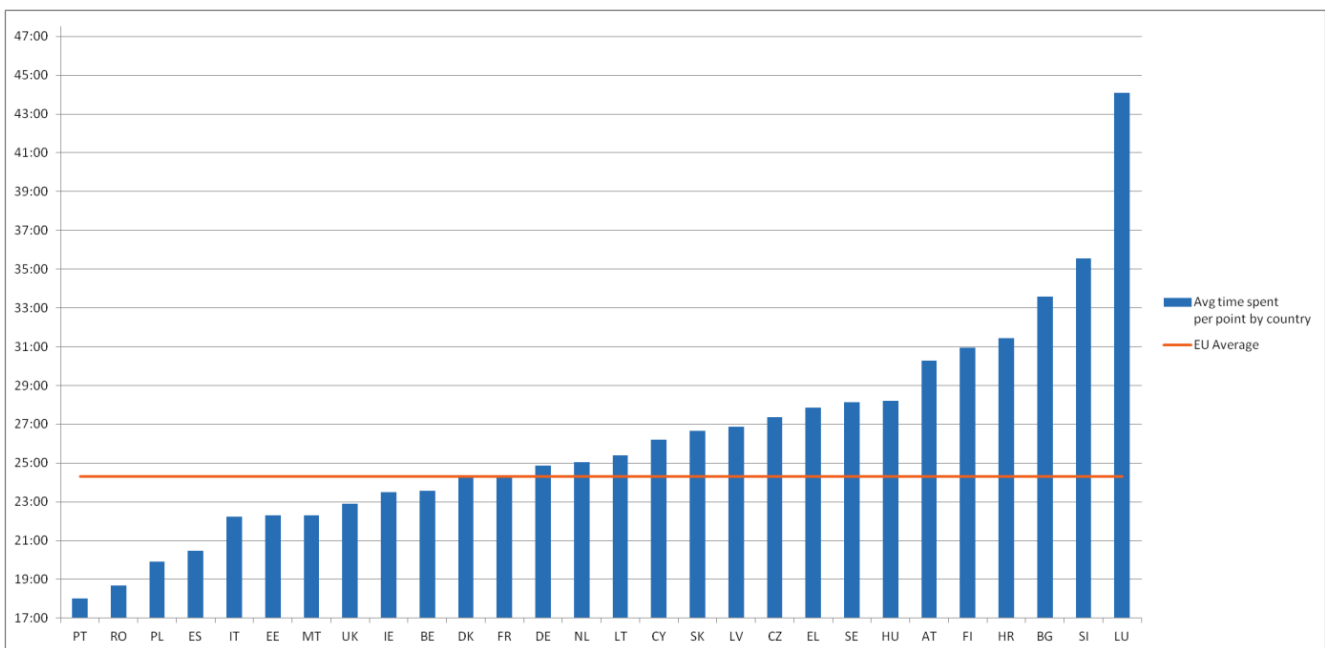


Figure 7 : Average time spent per point by country (in minutes) and EU average

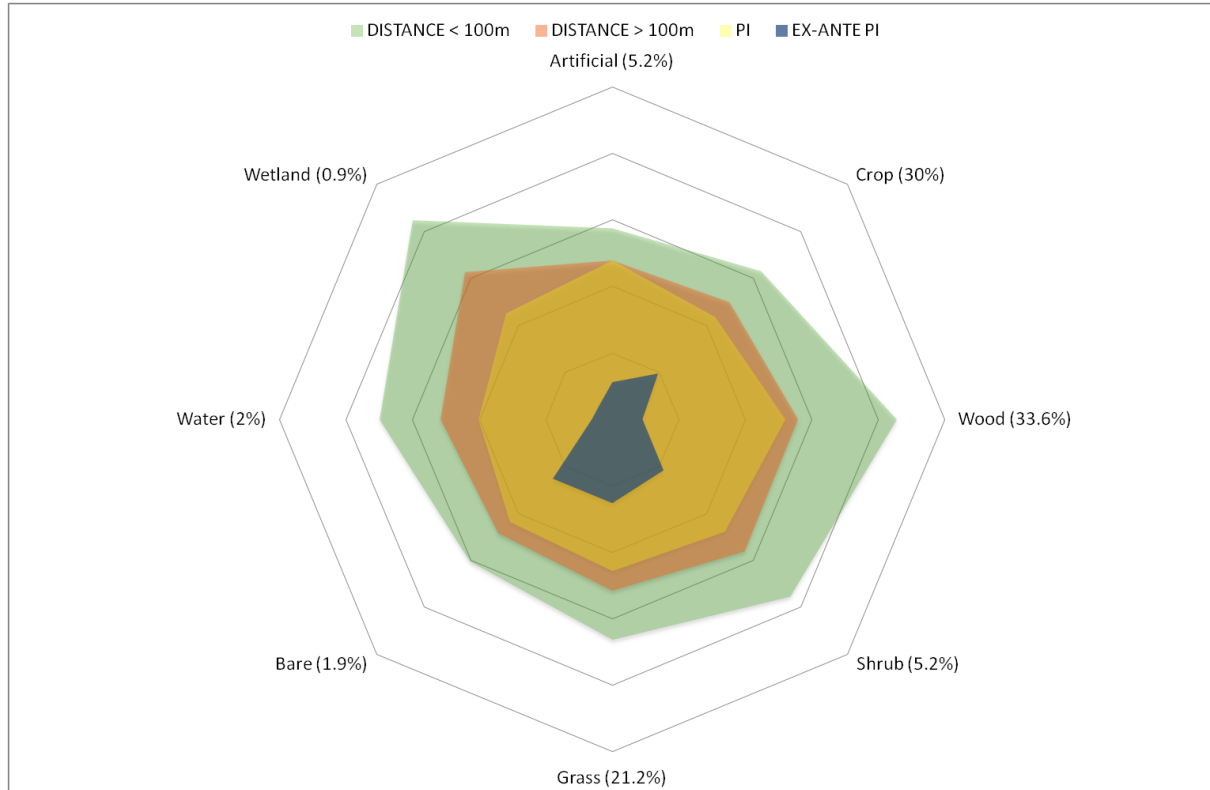
The average time needed to visit each point depends on land cover and land use of the point, surroundings and is obviously strongly related to the closeness of the point to the next road. Surveyors first of all have to reach the point and then they had to walk along a transect of 250 m towards the East. In general, points in the forest and wetlands were the most difficult to reach and require more time compared to the others. In the ex-ante photo interpreted points however, the longest time occurs in grassland and bare land points (Table 7).

Table 7 : Average time spent during the point survey and photo-interpretation (in the field and ex-ante) by land cover class

LAND COVER CLASS	DISTANCE < 100m	DISTANCE > 100m	PI	EX-ANTE PI
Artificial land(5.2%)	20:44	17:13	17:13	04:01
Cropland (30%)	22:44	17:57	15:42	07:00
Woodland (33.6%)	30:46	20:08	18:41	03:15
Shrubland (5.2%)	27:11	20:17	17:10	07:50
Grassland (21.2%)	23:54	18:37	16:24	09:06
Bare land (1.9%)	21:48	17:29	15:40	09:07
Water areas(2%)	25:11	18:36	14:29	02:13
Wetland (0.9%)	30:34	22:33	16:15	02:03

In terms of average distance of observations, the shortest occurs in artificial areas and the longest for wetland and water areas (Figure 9).

Figure 8 : Average time spent per point by land cover class and by observation type



(272,903 points) at EU level

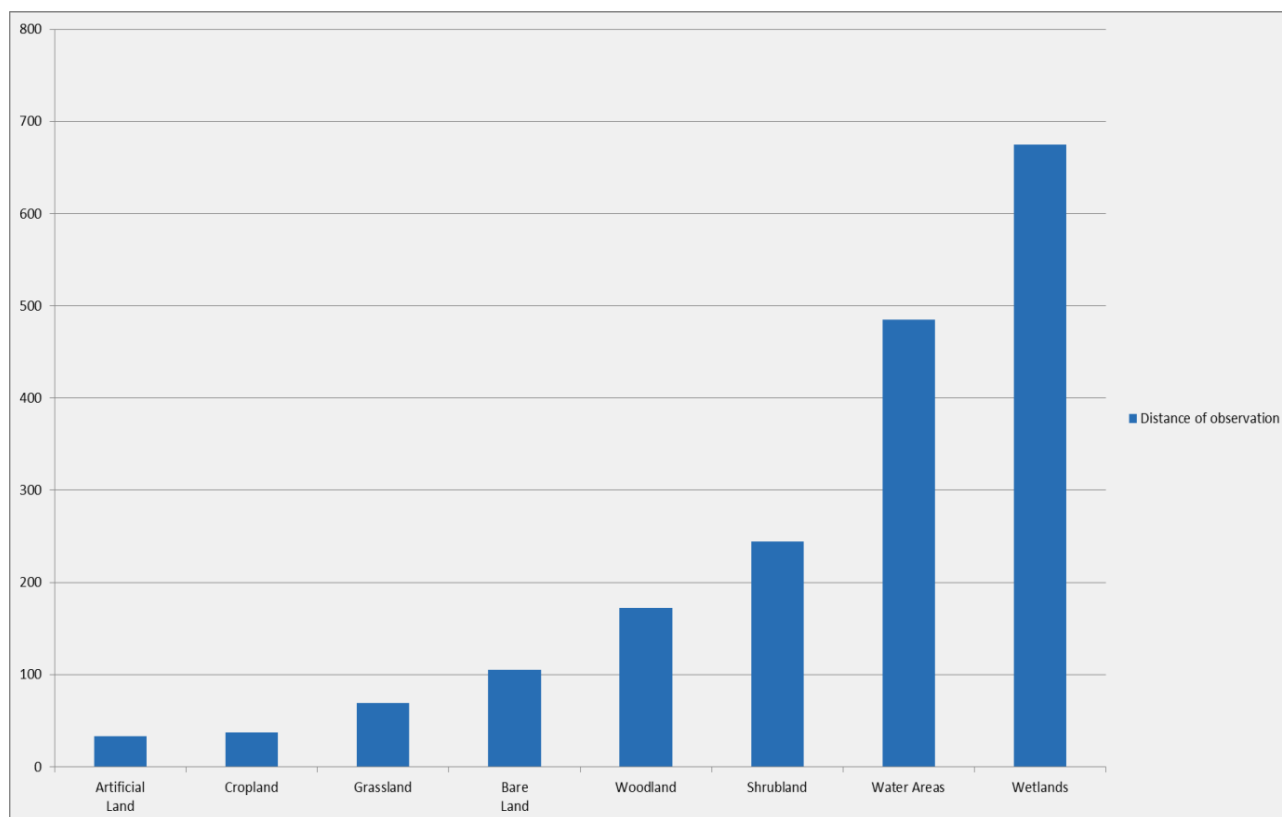


Figure 9 : Average distance of observation by land cover class

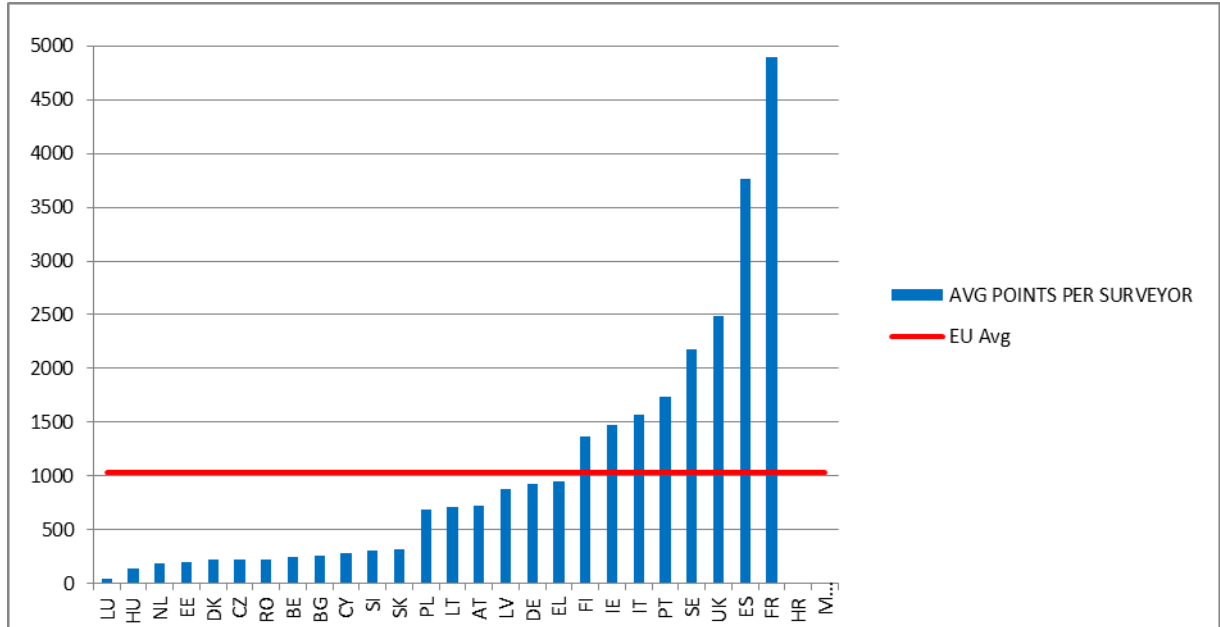
2.3 Photo-interpretation in the office

In addition to the "standard" LUCAS survey, a sample of over 66 000 points selected from the areas excluded from the field survey⁸, have been photo-interpreted using orthophotos. The activity was carried out by 64 photo interpreters. For the photo-interpretation the number of points per day is considerably larger than in the field survey, as expected (Table 25 -Annex 1 - Tables and graphs). In fact, the average number of points per surveyor was 1 038 (375 in the field survey) and the average number of points per day was 65 (10 in the field survey). The range of variation of the photo-interpreted points is delimited by Luxembourg and France having, respectively, the lowest (46) and largest number of points (4 896).

⁸ See chapter 2.1.3

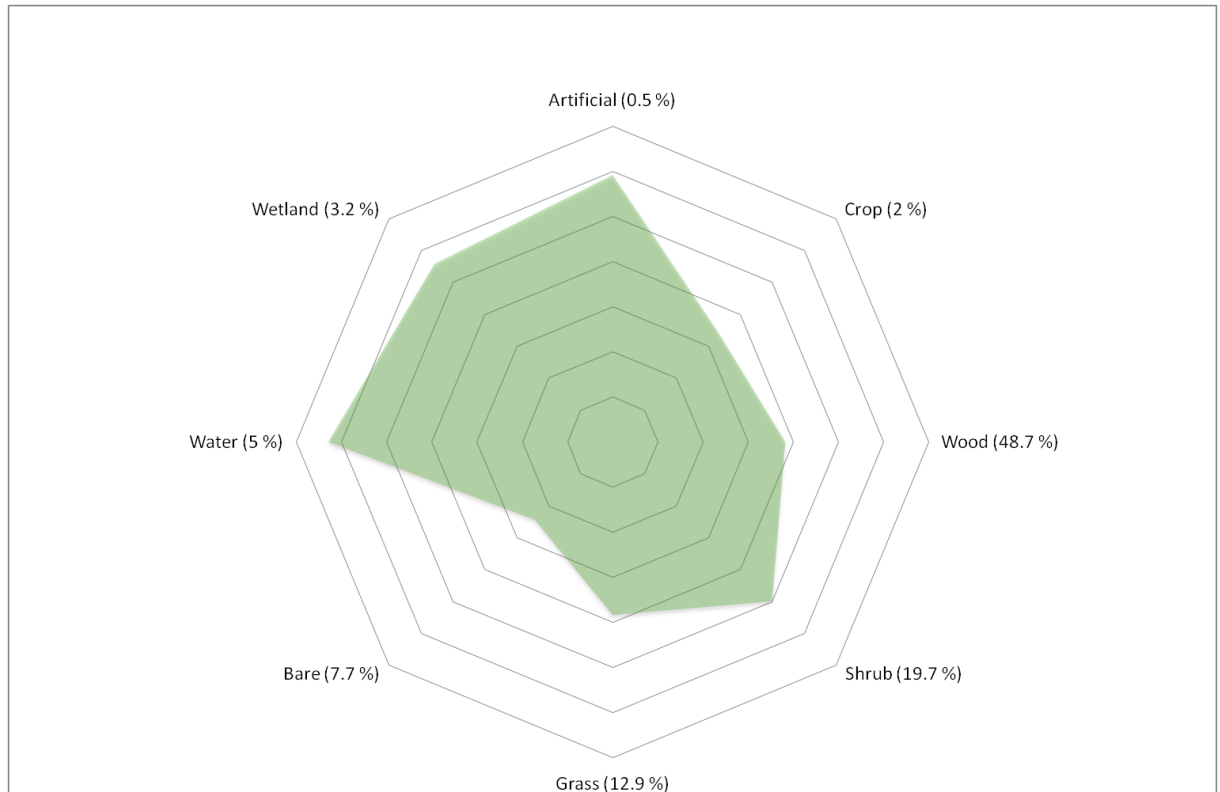
The information derived via photo-interpretation was kept as detailed as possible even though some details can be captured only by field visits. Only a few fields were excluded a priori being information not collectable by photo-interpretation: photos, GPS track and "height of trees at survey".

Figure 10 : Average number of points per surveyor photo-interpreted in the office by



country and EU average

Figure 11 : Average time spent per Ex-ante PI Extension point by land cover class



(66,402 points) at EU level

2.4 Quality assurance

Quality assurance is a central component throughout all the phases of the LUCAS survey to assure the quality and the comparability of results. Quality assurance includes a common framework or harmonised approach, automated quality controls implemented in with common IT tools.

2.4.1 The common framework

Quality assurance covers different aspects, first of all the provision of a common framework for all participants. This is especially important as the survey has been split up in several lots, which have been contracted to different entities and a common understanding across the lots needs to be assured. To this end the following actions have been foreseen:

- Common documentation and instructions for all surveyors;
- Common “Frequently Asked Questions and Answers” document updated regularly based on issues raised by the contractors during the running of the survey;
- Standardised and automated Data Management Tool (DMT);
- Common training for all the Survey Managers;
- Common set-up and follow-up visit to each country by a team of experts.

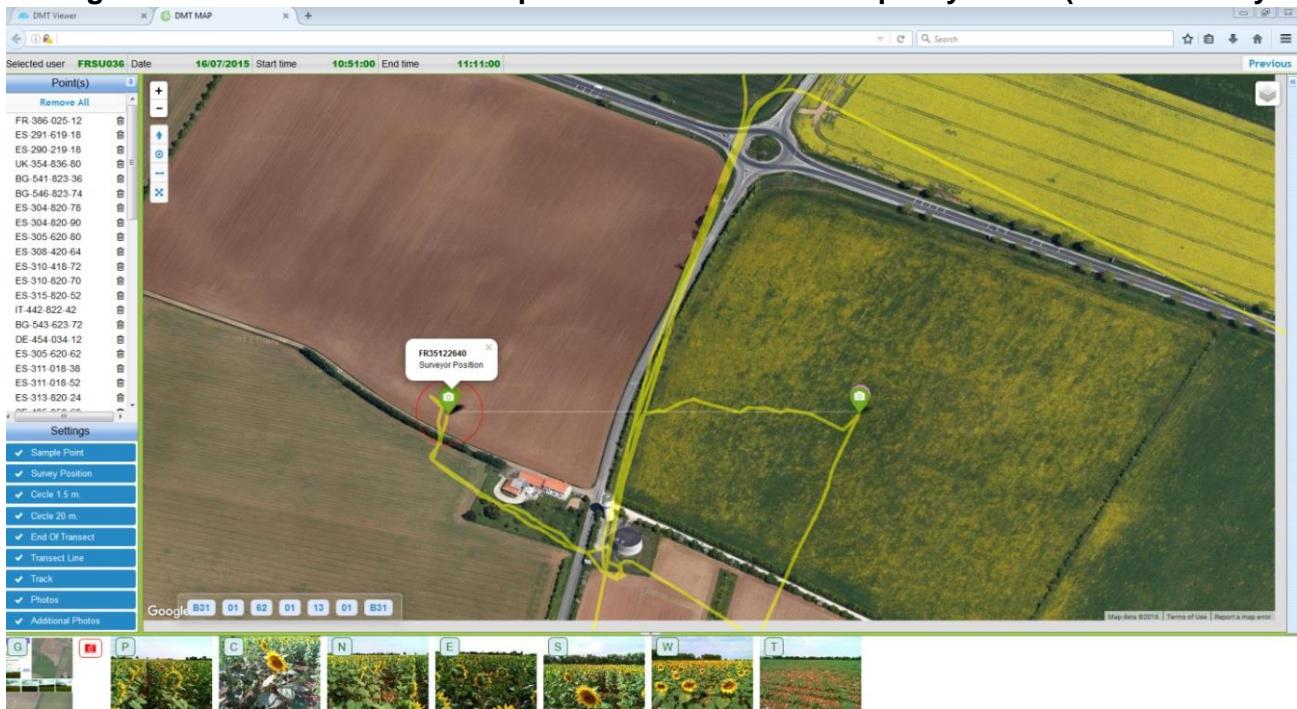
The training for the survey managers includes in-door sessions - covering the overall approach, the survey instructions and the data management tool - as well as a field trip to allow for hands-on experience.

An expert team did follow-up visits in all the countries to identify and correct systematic errors in data collection and survey management as early as possible. Information collected concerned the set-up of the survey, the number of surveyors and their training, communication and quality control. Based on the results a second round of follow-up visits were organised to propose corrective measures where needed.

2.4.2 IT tools – DMT 2015 Suite

In 2015 a significant change was introduced in the Data Management Tool, by creating a central server infrastructure which allowed for the immediate access to the data by the upper levels of control for monitoring purposes. The local client (in MS Access) was kept, and was still used for updating the database: data collection & validation of internal consistency and linked to the visual quality control, including acceptance and rejection of points. Working on the local client requires download and upload of data and files from and to the central database.

Figure 12 : LUCAS 2015 DMT Map can be used for visual quality check (but data entry



via DMT Client)

The tools for monitoring included also a DMT Map component for an integrated display of all the elements of a point. This tool has also been used for quality checks. However any update of the database (comments related to the quality checks, the acceptance and rejection of the points had to be done in the local DMT client. In this campaign an additional control for checking photo anonymization was available.

2.4.3 Quality control during the field work

Data quality checks run in parallel to the collection of the data. The aim is to identify and correct systematic errors during the data collection as early as possible. These quality checks take place at 2 different levels.

These quality checks take place at 2 different levels:

- Internal quality check;
- External, independent data quality control.

The internal quality check took place at the field work contractor's regional or central offices and concerned all the data collected for all the LUCAS points in the 28 participating countries.

An independent external data visual quality control on over 1/3 of the points was assured by a separate expert team of data controllers. All available information (ancillary information, ground documents, metadata on the survey, land cover and land use classification, transect data, GPS tracks,

photos, justification for photo-interpretation) is analysed to evaluate the reliability of the results. Point data that clearly requires correction or clarification is rejected and send back to the field work contractors, the other points are transmitted to Eurostat. After a revision by the field work contractors of the points rejected once these points go once more to external quality control.

The second control of the data can lead to acceptance or rejection. In both cases the data was forwarded to Eurostat. Here points rejected twice are checked to guarantee the compliance with the tender specifications (for each country no more than 1% of the points of the survey can be rejected twice).

During these quality controls all available information (ancillary information, ground documents, metadata on the survey, land cover and land use classification, transect data, GPS tracks, photos, justification for photo-interpretation) are analysed to evaluate the reliability of the results.

2.4.4 Eurostat quality control (review, validate and edit)

In Eurostat the quality control first includes the consolidation of the “raw” data set. Further steps of the validation process⁹ include for example the consistency checks with other datasets of the same domain (previous years LUCAS data) and consistency with data of other data providers. More details of the state of the art of the validation process can be found in Annex 2.

Eurostat also performs a number of macro and micro editing techniques in order to fine tune the final estimates. The identification of possible influent errors might be fed into the validation process and imply further corrections to the micro data.

⁹ Bosch et al. (2015) Methodology for data validation. ESSNET VALIDAT Foundation in https://ec.europa.eu/eurostat/cros/system/files/methodology_for_data_validation_v1.0_rev-2016-06_final.pdf (2016.10.17)

CHAPTER 3

Data processing

After the activities of data collection and quality assessment during the field work and at Eurostat office, the data were processed to create new variables, to calculate weights, to realign the 2015 classifications to the previous surveys ones, to make the data suitable for statistical analysis and, finally, to produce estimates.

3.1 Realignment of classifications

The comparison between the results of different waves of the survey is one of the target of LUCAS project. During the period 2009-2015, classifications of LC/LU were improved; the 2009 classifications was already realigned to the 2012 one, hence only one procedure of realignment (2009/2012 to 2015) is needed. Unfortunately, most of the changes were done only during the field work and so it is quite impossible to change the codes in 2009/2012 data sets according to 2015 classification, because the information needed is not available on the record. Only two rules can be adopted to change the 2009 and 2012 microdata by an automated data processing (Table 8). The first rule is applicable in 2012 data to 2 cases, the second one to 7 cases while no cases have to be corrected in 2009 data.

Table 8 : Analysis of changes in classifications from 2012 to 2015 survey

2015 changes	Actions in 2012 data	Notes
Land cover class B77j was dropped as it referred to "Abandoned citrus orchards" ("abandoned" is a land use, not a land cover)	If LC1_species = B77j then: LC1_species = 8 LC1 = B77 LU1 = 410 Land_cover = cropland Land_use = unused and abandoned.	The same rule holds for LC2_species=B77j and the variables LC2 and LU2.
Cropland, and namely energy crops (B84) are no longer linked to U210 Energy production	If LC1=B84 and LU1= U210 then LU1= 8	The same rules hold for LC2.

3.2 Others minor data treatments

Minor changes in microdata of the three surveys were made in order to guarantee their comparability, by setting up a common format to process the microdata with the same procedures.

- In the Master 2015 a new NUTS2 corresponding to transitional water is established assigning the code T to NUTS1 and TW to NUTS2;
- The TW code is assigned also to the corresponding points in 2009,2012 and 2015 survey data;
- The variable names in the three data sets have been made uniform in order to facilitate the sas programming;
- Realignment of 2015 transect information to the 2009/2012 standard; in 2015 data there is only one text variable for all the transects in a specific point while they are reported as distinct variables in 2009 and 2012 data;
- The PI points were extracted from 2015 data and reassigned to the 2009, 2012 and 2015 according to the correspondent flag.

3.3 Weights calculation

The estimating procedure is based on a calibrated estimator. It assures that the estimates of some structural variables are forced to equalize “known totals” in some domains: other than in “administrative entities” (NUTS0, NUTS1 and NUTS2), also two differently aggregated classifications of elevation are taken into account, reported in the following Table 9.

Table 9 : Elevation classifications used in weights calculation

Elevation	
6 classes classification	4 classes classification
< 100	< 100
100 - 300	100 - 600
300 - 600	600 - 1,500
600 - 1,000	>1,500
1,000 - 1500	
>1,500	

So the sum of weights of sampled points are forced to equalize the totals of master points in the domains

- NUTS2*strata (the area of each Nuts 2 was specified from a specific file);
- NUST1*elevation (4 classes);
- NUTS0*strata*elevation(6 classes);
- Country (this marginal could permit the further representation of the area of the Countries);

In every of these domains the estimates sum up to the respective totals in Master. Considering the number of points is equivalent to consider the “area”, because it is obtained multiplying the number of points by a constant, the averaged area in the NUTS2. Because it is obtained from external reliable source, the “known total areas” of NUTS2, NUTS1 and NUTS0 are “true” while the areas of the domains obtained by their combination with “elevation” is an estimate, calculated from the first phase sample, because the corresponding true values are not available. Nevertheless, it is reasonable, given the number of points and the methods of selection that these estimates constitute a good approximation to the true totals

The weight of the single point is obtained, starting from the inverse of probability of selection, by an iterative proportional fitting (IPF) procedure that associates, in each iteration, new weights to each point up to equalize the sum of weights and the known totals of the domains to which the units belong.

The calibrated estimator takes over also the correction for missing units, where the “average collected point” is conceptually averaged taking into consideration the strata and the class of elevation at different level of NUTS.

In general, the estimation, in a NUTS2 region, of an area corresponding to a generic qualitative characteristic L, can be provided by

$$\widehat{S}_L = \widehat{Y}_L * S \quad (1)$$

where S is the total area in the NUTS2 from an external source, and \widehat{Y}_L the estimated percentage of points with characteristic = L .

The estimator for a percentage in double sample is

$$\widehat{Y}_L = \sum_h W_h \widehat{y}_{hL} \quad (2)$$

where \widehat{y}_{hL} are the related SRS estimates in different strata h. We can rewrite (1) as

$$\widehat{Y}_L = \sum_h W_h \left(\sum_{k \in L} I_{hk} y_{kh} / n_h \right) \quad (3)$$

Where $I_{hk} = \begin{cases} 1 & \text{if } y_{kh} = L \\ 0 & \text{otherwise} \end{cases}$

with $h=1$ to 7 and $k=1$ to n_h . Formula (2) can be developed as

$$\widehat{Y}_L = (1/N) \sum_h [\sum_k l_{kh} y_{kh}] * N_h / n_h \quad (4)$$

where N_h / n_h represent the inverse of inclusion probabilities p_{hk} .

Substituting (4) into (1) we obtain

$$\widehat{S}_L = (S/N) \sum_h [\sum_k l_{kh} y_{kh}] * N_h / n_h$$

and because $S/N = \bar{S}$ is the average point area in NUTS2 we can write

$$\widehat{S}_L = \sum_h [\sum_k l_{kh} y_{kh}] * \bar{S} * p_{hk} \quad (5)$$

Starting from the above probability of inclusion, a new weight is calculated by an iterative proportional fitting (IPF) procedure that forces the sum of weights of the units belonging to specific domain to equalize the known totals in the domain. So the (5) becomes

$$\widehat{S}_L = \sum_h [\sum_k l_{kh} y_{kh}] * \bar{S} * w_{hk}$$

where w_{hk} is obtained as the final result of the following iterations

$$w_{i;v_1,\dots,v_m}^{t^1} = \frac{N_{v_1,\dots,v_m}}{n_{v_1,\dots,v_m}} w_{i;v_1,\dots,v_m}^{t^0}$$

Where:

- t^1 and t^0 represent two consecutive iterations;
- i refers to the i -th point;
- v_1, \dots, v_m refers to the values observed for the $1, \dots, m$ variables;
- N_{v_1,\dots,v_m} are the number of points (derived from the master data set) of the values for the $1, \dots, m$ variables;
- n_{v_1,\dots,v_m} are the totals of the values for the $1, \dots, m$ variables as observed in the sample;
- $w_{i;v_1,\dots,v_m}^{t^1}$ and $w_{i;v_1,\dots,v_m}^{t^0}$ are, respectively, the new and the old weight for the i -th point.

In order to evaluate the changes made on the weights for each step of the IPF procedure, it is evaluated the mean square variation of these between each iteration. This corresponds to:

$$MV = \frac{\sum_{i=1}^n (w^{t^1} - w^{t^0})^2}{n}$$

When MV is less than 0.00001, the IPF procedures is stopped.

According to the above estimator, estimated area (in km^2) and corresponding percentages for LC and LU are reported in Annex 1 – Tables 28-29-30-31.

3.4 Calculation of the FAO variable

Several aspects need to be tackled in the alignment of LUCAS and FAO classification for forest classes. First of all the differences in the semantic definition of LUCAS wooded areas and FAO forest definitions: if an area has > 10% of trees (excluding fruit trees in permanent crops) in LUCAS is labelled as "wooded area", FAO takes this into account only if it is greater than 0.5 Ha.

In addition, a further concern arises from the changes occurred in survey protocol for the 2009, 2012 and 2015 LUCAS campaigns. In fact, variations in the definitions may cause inconsistencies when datasets are compared over time. Therefore, an evaluation of the impacts of these changes on the reported figures at different administrative levels is either beneficial for producer or user of the data.

The main changes in the LUCAS Land Cover (LC) and Land Use (LU) classification in the periods 2009-2012 and 2012-2015 that impact on forestry-related classes are reported in the following Table 10 and Table 11.

Table 10 : Main changes occurred in the classification of forestry-related classes between 2009 and 2012 LUCAS Surveys

LC/LU	Type of change (2012 vs. 2009)	Description
LC	New forest classes	Spruce (C21) and pine (C22) dominated coniferous and other coniferous (C23) woodland.
		This implies introduction of spruce (C31) and pine (C32) dominated as well as other woodland (C33).
	New coding	The prefix "CX" is updated to "CXX".
	Change of definition	Wet forests are to be classified in CXX and not in HXX.
LU	Suppression of classes	U364 Nature Reserve has been suppressed (moved to special status in field form).

Table 11 : Main changes occurred in the classification of forestry-related classes between 2012 and 2015 LUCAS Surveys

LC/LU	Type of change (2015 vs. 2009)	Description
LC	Harmonization of definitions	Areas below 10% of trees are to be classified according to the existing land cover. Previously CXX included forest nurseries and young plantations even if they do not reach a canopy of 10%.
		Forest nurseries included in CXX are now classified under B83
LU	Change of definition	U120 Forestry now explicitly includes extraction of cork (cork oak trees)

Finally, data collection process during field campaigns can be affected by errors that have an impact on forest areas (Woodland (C00)) figures. For instance, the assessment on the previous surveys revealed that the following errors occurred frequently: 1) it was common to forget to assess the 10%

cover of the canopy on the extended window when not on forest areas; 2) the surveyor used the CXX class when the canopy was less than 10% due to ambiguous instructions on the LUCAS 2012 documentation.

The rules for mapping LUCAS to FAO definition for forestry-related classes has been based on the semantic analysis of the classes reported in the documents FRA 2015 - Forest Resources Assessment Working Paper 180 and in the LUCAS 2015 - Technical reference document C1:Instructions for Surveyors published by FAO and Eurostat, respectively. The key elements and definitions for the forest classes used in LUCAS 2015 and in FAO (FRA 2015) are reported in Table 12 and Table 13, respectively.

Table 12 : Terms, definitions and remarks for the "woodland" class in LUCAS 2015 (Source Eurostat, 2015)

Term	Definition	Remark
Woodland (C00)	Areas covered by trees with a canopy of at least 10%. Also woody hedges and palm trees are included in this class.	Height of trees at maturity and width of woody features have to be assessed.
		The 10% of canopy cover has to be assessed in the extended window of observation (Area 0.13 ha).
		If the wooded area is larger than 0.5 ha, the height of trees is above 5 m at maturity and the width of the wooded feature is more than 20 m, the surveyor has to indicate the forest cover code in the respective "LC plant species" field, according to the forest type classification of the European Environment Agency.
		Trees that are known as forest trees can also be grown as an orchard

Table 13 : Terms and definitions of the FAO forestry-related classes (Source: FAO, 2012)

Term	Definition
Forest	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.
Other wooded land	Land not defined as "Forest", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
Other land	All land that is not classified as forest or other wooded land.
Other land with tree cover (sub-category)	Land considered as "other land", that is predominantly agricultural or urban land use and has patches of tree cover that span more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity. It includes both forest and

Term	Definition
	non-forest tree species.

The mapping procedure can be schematically described as follows:

1. Semantic analysis of the LUCAS and FAO definition for the forestry-related classes. Starting from FAO terms, definitions and explanatory a semantic analysis is performed to identify the correspondence with the LUCAS LC/LU classes both individually and in combination. The following FAO classes are taken into account and analyzed, then are coded to streamline the rules implementation:
 - a. Forest (Code 1);
 - b. Other wooded land (Code 2);
 - c. Other land with tree cover - subcategory of the class Other land (Code 3);
 - d. Other land (Code 0) excluding "other land with tree cover";
 - e. The sum of the above categories equals to "total area";
2. First definition of the mapping rules, based on the different combinations of land cover 1 and 2, land use 1 and 2 and some parameters. The parameters concerned are: species, area size, height of trees and special remarks (clear cut, burnt area and fire break);
3. Exploratory analysis;
4. For each rule the single classes or their combination have been analyzed and a visual check of the available LUCAS 2015 points has been performed. The resulting combinations have been checked once again in order to extract a simple set of rules for the selection. The queries have been fine-tuned to cover for classes/combinations left out in the first round. At this stage, in order to obtain the best matching between the two classifications, the correct sequence for applying the rules has been tested and defined. During the process a significant number of LUCAS 2015 points has been selected for further checks and harmonization;
5. Final definition of the mapping rules in SQL language.

A total of 13 rules are reported each one coded by a label and an ordinal number that specify the sequence to be followed when the rules are applied in data elaboration. After verification, the rules have been converted in a executable program that adds to a LUCAS dataset the new variable `FAO_CLASS` related to the FAO forestry classes (0, 1, 2 or 3). Moreover two new variables are calculated: `ALL_VALUES` obtained by linking together the names of all the variables used in FAO forestry coding, and the variable `CONDITION_FAO_CLASS`, that allows to identify which condition was satisfied by the current record, according to the rules properly defined.

In order to guarantee the comparability between the different waves of LUCAS survey, the procedure was also applied to the 2009 and 2012 survey data. The results obtained were analyzed by considering the changes occurred in the LC/LU classification between 2012 and 2015 and by verifying semantically if these changes affect the application of the rules to LUCAS 2012 dataset. In general, from a semantic standpoint, the rules defined for LUCAS 2015 can be deemed applicable backward to

2012 even if some slight changes in the classification occurred between 2012 and 2015 and concerns few of the variables involved.

The estimates with the FAO classification produced for 2009 and 2012 LUCAS dataset have been compared with statistics on forest areas published yearly at country level (NUTS0) by FAO on the FAOSTATweb portal. The area of the "Forest" variable at NUTS0 level, as defined in (Table 4) was extracted from the FAOSTAT database (FAOSTAT Domain: Inputs/Land) for the years 2009 and 2012 and compared with the estimates of the area for the FAO class with code 1 computed with the LUCAS to FAO mapping procedure.

The FAO statistics allow to set up a comparison due to a temporal coherence between FAOSTAT and LUCAS for the years 2009 and 2012. Notwithstanding, the main drawback is the lack of the FAO forest variables "Other wooded land" and "Other land with tree cover" that hinder the comparison with the FAO class coded with 2 and 3 generated by the mapping procedure.

The two missing variables are reported at NUTS0 only in the FAO database of Global Forest Resource Assessment (FRA) that is carried out at specific time intervals not corresponding with the LUCAS reference years (2009 and 2012). In addition, FRA data are a collation of countries reports that provides information often not homogeneous in terms of methods, national data sources and temporal reference (e.g. Italian forests statistics provided for the FRA are produced as follow: 1990 and 2000 estimation was made through a linear interpolation between 1985 and 2005 data; 2010 and 2015 estimation was computed with a linear interpolation between the 2005 and provisional data from the 2015 National Forest Inventory (FAO, 2014)). In general terms, the comparability between LUCAS and FAO statistics can be deemed satisfactory (see more details in Coherence - cross domain).

3.5 Calculation of a unique land cover and land use variable and other data treatment

On the sampling units (points) two different modalities for land cover (LC1 - the primary information and LC2 - the secondary one) could be collected. Currently, only LC1 is used in estimating the different land cover typologies; doing so, implicitly, it is assumed that the secondary variables balance each other out in the final estimates. So, in order to refine the estimate of land cover and land use, both the information (the principal and secondary ones) and the percentage of LC1/LC2 collected by LUCAS Survey were used.

Variable Land cover

The estimation procedure assigns a weight to each point according to the sample design. The points that present only the primary LC1 variable are inflated with the usual standard method using the assigned weight. When LC1 and LC2 are both available for a point, the record will be replicated and

the associated weight for each of the two new records divided, respectively, by two factors having sum equals to 1. This will permit to not halter the weighted totals of points.

To represent such issue it is possible to consider the two coefficients, $p_{1,i}$ and $p_{2,i}$ that will be associated to the i -th point, so that:

$$p_{1,i} + p_{2,i} = 1;$$

In the point i the estimates for the two different values (k and j) of Land Cover (i.e LC1 and LC2) will be:

$$LC1(k)_i = p_{1,i} * W_i$$

$$LC2(j)_i = p_{2,i} * W_i$$

where W_i is the initial weight assigned to point i .

For the same point i , according to the field instructions, should be not allowed to have the same modality for LC1 and LC2; but, when a classification more aggregated than the original one is used, this condition does not hold (especially for LC2 code). In any case it will not affect the estimation procedure.

Note that $LC1(k)_i + LC2(j)_i = W_i$ represent the weight assigned to the i -th point and hence the established total areas at different territorial levels are preserved.

For the points that present a unique land cover (e.g the k modality), the estimates will be

$$LC1(k)_i = W_i$$

as in the standard procedure.

So the estimate of total for k modality is obtained summing up

$$Tot_LC(k) = \sum_i \{ LC1(k)_i + LC2(k)_i \}$$

where, in the single point, $LC1(k)_i$ or $LC2(k)_i$ or both can be equal to zero; of course in every record at least one land cover modality exists.

Variable land use

The variables LU1 and LU2, according to the field instructions, can be referred to LC1 or LC2, but no rule is given to attribute it to one or both the land cover variables. In order to produce consistent land use estimates, we use the same approach above described, dividing every weight by two parameters $q_{1,i}$ and $q_{2,i}$ that sum up to 1. But given that no information is available for 2009 and 2012 data (as the class percentages for land cover) while for the 2015 survey the collected information have to be further assessed, we set $q_{1,i} = q_{2,i} = 0,5$. So when LU1 and Lu2 are present in a single record

$$LU1(k)_i = 0.5 * W_i$$

$$LU2(j)_i = 0.5 * W_i$$

Or for the points that present a unique land use:

$$LC1(k)_i = W_i$$

The estimate of total for k modality is obtained summing up

$$Tot_LU(k) = \sum_i \{ LU1(k)_i + LU2(k)_i \}$$

In case of the existence of the primary and secondary land cover variables, it is expected that also the two classes of percentages are reported in the record. For checking this “rule”, Table 14 has been produced, where all the combinations of existence/missing of the four variables are analytically reported. In the table, the 1 value represent the existence while the 0 value the missing variable.

Table 14 : Frequency of different combinations of variables existence

LC1	LC2	LC1 percentage	LC2 percentage	Total	%
1	0	0	0	244,307	73.4%
1	1	0	0	3,764	1.1%
1	0	1	0	69,934	21.0%
1	1	1	0	8,268	2.5%
1	1	0	1	1,259	0.4%
1	1	1	1	5,266	1.6%
				33,2798	100.0%

One of the requirements of the above reported estimation method is that the two percentages for LC1 and LC2 must sum up to 1 that is $p_{1,i} + p_{2,i} = 1$. This rule is needed for the procedure, otherwise the total area at country level and the coherence at NUTS1 and NUTS2 levels is no more preserved; but it is rightly not specified in data collection instructions to take into account the actual situations on the field.

Table 15 shows the coherence of LC1_percent and LC2_percent with respect to the rule $p_{1,i} + p_{2,i} = 1$ for the different surveys: in grey are showed the not coherent combinations, in green the coherent ones while in yellow the coherence is limited to only one value.

Table 15 : Coherence of the combinations of LC1_percent, LC2_percent with respect of the rule $p_{1,i} + p_{2,i} = 1$

LC1_percent	LC2_percent						
	0-5	5-10	10-25	25-50	50-75	75-90	90-100
0-5							
5-10							
10-25							
25-50							
50-75							
75-90							
90-100							
Total							

Because no information on the distribution of the percentages inside the class percentages is available, as generating probability function the uniform one was adopted. Two numbers in the interval (0;1) are generated from this function and scaled-down, according to the classes of percentages found in the record; then they are divided by their sum in order to guarantee the $p_{1,i} + p_{2,i} = 1$.

3.6 Procedure for replications of records

The estimation procedure is carried out at the same time for LC/LU and the original information on LC1, LC2, LU1 and LU2, reported in every point, could be found in one of the following four combinations (Table 16).

Table 16 : Combinations of land cover/land use original information

LC1	LU1	LC2	LU2	combination
1	1	0	0	a
1	1	1	0	b
1	1	0	1	c
1	1	1	1	d

For every combination a different number of weights (and hence of percentages p and/or q), are needed to inflate both land cover and land use in a coherent way. But, instead of reporting on a single record more than one weight (for example one for LC1 and one for LC2) it is preferable, in order to facilitate the calculations, to generate a number of records equal to the number of different weights needed.

combination(a): no generation of percentage is made because land cover and land use coincide with LC1 and LU1; only one record is generated with weight = W_i

combination(b): two percentages are generated for LC1 and LC2; to both is attributed LU1; two records are generated:

- the first one has Land cover= LC1, Land use = LU1 and a weight = $p_{1,i} * W_i$
- in the second one land cover= LC2 , Land use = LU1 and weight = $p_{2,i} * W_i$

combination(c): land cover coincides with LC1 to which are attributed the two land use with a percentage = 0.5; two records are generated:

- to the first one is assigned a land cover= LC1, a Land use = LU1 and a weight = $0.5 * W_i$
- to the second one land cover= LC1, Land use = LU2 and a weight = $0.5 * W_i$

combination(d): two percentages are generated for LC1 and LC2; to each land cover both LU1 and LU2 are attributed; four records are generated:

- to the first record are assigned land cover = LC1, land use = LU1 and a weight= $0.5 * p_{1,i} * W_i$;
- to the first record are assigned land cover = LC1, land use = LU2 and a weight= $0.5 * p_{1,i} * W_i$;
- to the first record are assigned land cover = LC2, land use = LU1 and a weight= $0.5 * p_{2,i} * W_i$;
- to the first record are assigned land cover = LC2, land use = LU2 and a weight= $0.5 * p_{2,i} * W_i$;

Table 17 summarizes the above rules and the results of the applied procedure.

Table 17 : Rules for record applications and results

LC1	LU1	LC2	LU2	Weight (W)	Replication of the record	Number of points	% of points
1	1	0	0	W	No	30.9306	84.6%
1	1	0	1	$0.5 * W$ $0.5 * W$	2 records with the same LC and LU equals, respectively, to LU1 and LU2	27.568	7.5%
1	1	1	0	$p * W$ $q * W$	2 records with the same LU and LC equals, respectively, to LC1 and LC2	9.800	2.7%
1	1	1	1	$0.5 * p * W$, $0.5 * p * W$, $0.5 * q * W$, $0.5 * q * W$,	4 records with all the combinations: (LC1,LU1), (LC1,LU2), (LC2,LU1), (LC2,LU2)	19.092	5.2%
						365.766	100.0%

3.7 Estimates production

The last step of the statistical production is the output of 49 Tables containing the estimates of the new variables Land cover (LC) and Land use (LU) as well as FAO classifications at different aggregation levels. Estimates of areas, percentages of areas (calculated over the total of corresponding territorial level, e.g. NUTS2 if the Table is related to NUTS2), number of sampled points, coefficients of variation and extremes of confidence intervals are provided. Moreover three auxiliary variables (Type1, Type 2 and Type 3), useful for analyzing the “trend” of estimates are given; Table 18 reports their classifications.

Table 18 : Classification of auxiliary variables Type1-Type3

Variable	Codes	Meaning
Type1	0	Not evaluated
	1	Estimates of 2012 less than 2009 and 2015 (2012 not internal)
	2	Estimates of 2012 less than 2009 and greater than 2015 (2012 internal with a decreasing trend)
	3	Estimates of 2012 greater than 2009 and 2015 (2012 not internal)
	4	Estimates of 2012 greater than 2009 and less than 2015 (2012 internal with an increasing trend)
Type2	0	Not evaluated
	1	Estimates of 2012 greater than the upper limit of the confidence interval
	2	Estimates of 2012 in the confidence interval
	3	Estimates of 2012 less than the lower limit of the confidence interval
Type3	0	Not evaluated
	1	Confidence interval of 2012 inside the confidence interval that considers 2009 and 2015
	2	Confidence interval of 2012 outside the confidence interval that considers 2009 and 2015

In the tables are considered the following territorial levels; Europe, Country, NUTS0, NUTS1 and NUTS2. The level “Europe” summarizes the estimates of the participant countries in every survey. The level “Country” includes the “transitional water (TW) area” which is not included in NUTS0; so the total areas of the two levels do not coincide if TW are present. The sum of areas of at level of NUTS1 and NUTS2 is the same of NUTS0. The confidence intervals are given at a probability level of 95%.

The tables are provided with and index and some metadata; the structure and the contents of the tables are summarized in the following Table 19.

Table 19 : Structure and contents of Tables produced

Variable	Territorial level	Years	Digit code	Estimates	Aux variables
Land cover	NUTS0 NUTS1 NUTS2 total EU Country	2009 2012 2015	1, 2, 3	Areas area percentage coefficients of variation number of sampled points extremes of confidence intervals	Type 1 Type 2 Type 3
Land use	NUTS0 NUTS1 NUTS2 total EU Country	2009 2012 2015	2, 3, 4	Areas area percentage coefficients of variation number of sampled points extremes of confidence intervals	Type 1 Type 2 Type 3
FAO classification	NUTS0 NUTS1 NUTS2 total EU Country	2009, 2012, 2015	1	Areas area percentage coefficients of variation number of sampled points extremes of confidence intervals	Type 1 Type 2 Type 3
Land cover	NUTS0 NUTS1 NUTS2 total EU Country	2009 2012 2015	1, 2, 3	Areas area percentage coefficients of variation number of sampled points extremes of confidence intervals	Type 1 Type 2 Type 3

The main results for the new variables land cover and land use, at level of NUTS0, are reported in terms of absolute values (km²) of different LC modalities by NUTS0 and in terms of percentage distribution of the modalities in Table 28 and Table 29 (Annex 1 - Tables and graphs), respectively. Table 30 and Table 31 (Annex 1 - Tables and graphs) the results in terms of absolute values (km²) and percentage by NUTS0 of the variables LU are given.

CHAPTER 4

Relevance, assessment of user needs and perceptions

LUCAS provides information for monitoring for a range of socio-environmental challenges, such as land take, soil degradation, environmental impact of agriculture or the degree of landscape fragmentation. More specifically data from LUCAS can be used to help analyse and contribute to the development of various EU policy areas:

Common Agricultural Policy

Integrating environmental concerns into the Common Agricultural Policy;

Soil thematic strategy

Protecting the soil, as detailed in the soil thematic strategy;

EU biodiversity strategy

Promoting biodiversity and conservation, through the EU's biodiversity strategy;

Europe 2020

Encouraging the efficient use of resources for sustainable growth, as in the resource-efficient Europe initiative;

Copernicus

Land monitoring, spatial planning and resource management, as carried out by the Copernicus earth observation programme;

Climate change

Tackling climate change, through monitoring conducted by the European Environment Agency, as well as actions under the European climate change programme.

LUCAS use includes the microdata, the photos, the soil and the statistical tables produced by Eurostat with the microdata.

In the Commission departments the LUCAS micro data is particularly relevant for modelling as can be seen in the collection of use cases presented on the Eurostat website: <http://ec.europa.eu/eurostat/web/lucas/publications/use-cases>. Examples presented here include the use of LUCAS data as ground control data for the production, verification and validation of Copernicus products derived from satellite data (Corine Land Cover and High Resolution Layers), modelling in the agricultural field (CAPRI) as well as the production of agri-environmental indicators on soil organic matter and soil erosion (AEI 26: Soil quality – CMEF Impact and Context indicator, AEI

21: Soil erosion – CMEF Impact and Context indicator). Information on soil is relevant for agriculture for the environment and for climate change. Eurostat uses the microdata on land cover and land use to produce statistical tables on this topic for the whole of Europe.

User needs of the Commission departments are regularly assessed and basically confirmed the relevance of the currently collected information. Interest in collecting more information on biodiversity was expressed. This aspect could not be picked up in 2015 but has been integrated in LUCAS 2018.

LUCAS data also provides a rich source of information for the research community and requests for access to the LUCAS photos are regularly received. Micro-data is freely accessible and the access to it is not monitored.

CHAPTER 5

Accuracy

The accuracy is tackled at Eurostat level, by eliminating as much as possible non-sampling errors and by calculating sampling errors. The missing data phenomena is almost negligible in the survey. In case surveyors could not reach the points they were obliged to fill in the field form on the basis of the information that he/she could collect from orthophotos interpretation. Estimates are reliable for areas > 500 Km².

The following paragraphs report the evaluations carried out on:

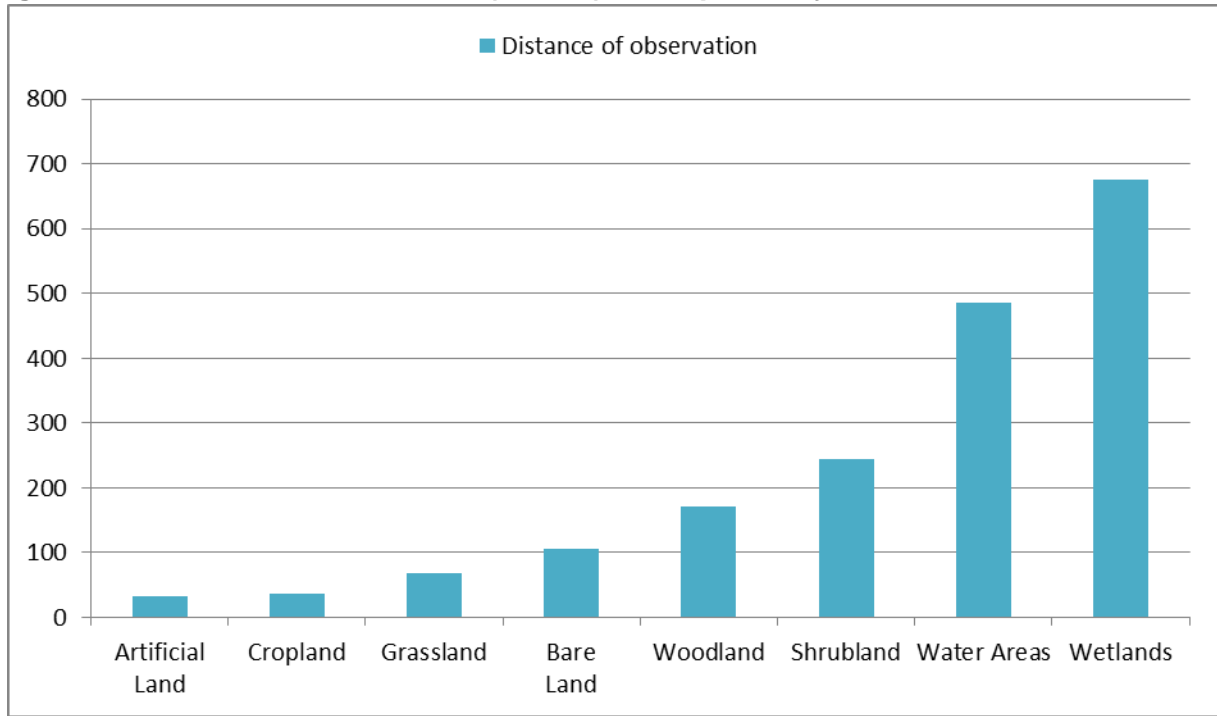
- Locational accuracy, in terms of distance of observation of the point during the survey;
- Sampling errors and the coefficients of variations associated to the estimation of LC/LU areas by country and LC/LU;
- Points rejected based on the quality check performed by an external company on a third of the points.

5.1 *Locational accuracy*

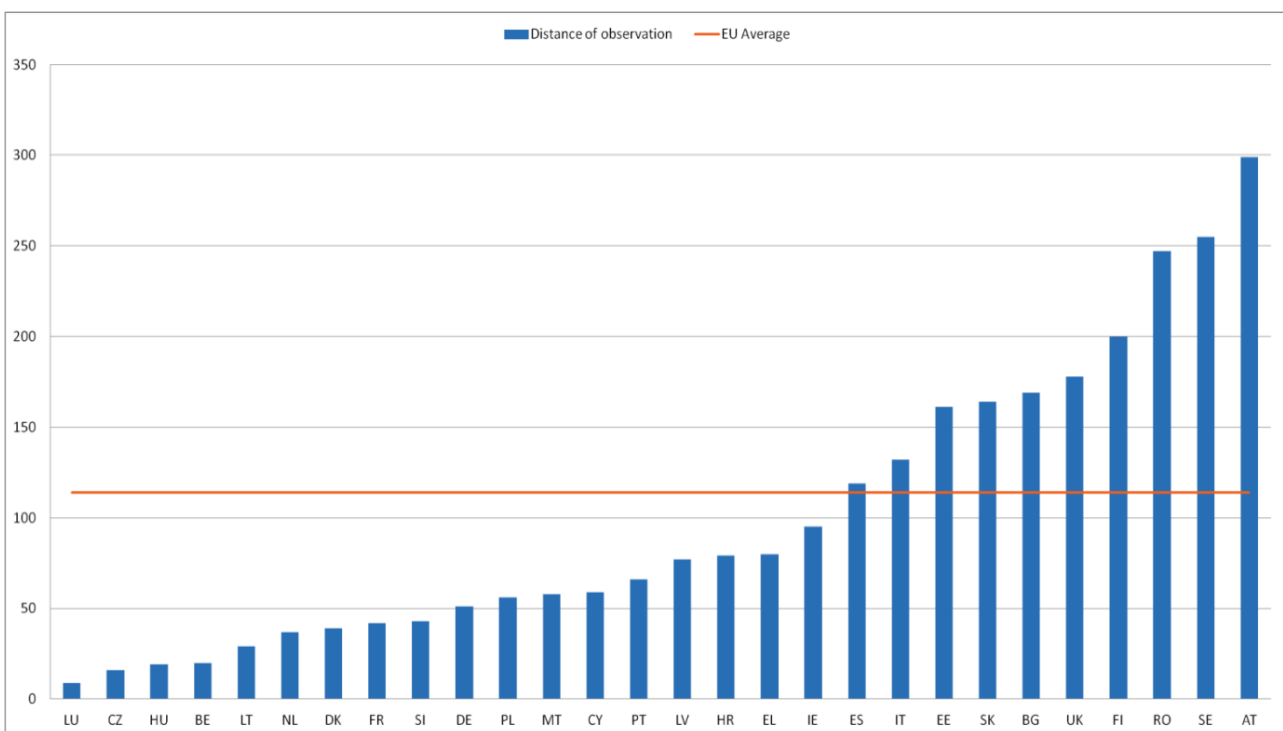
The locational accuracy is analysed by considering the distance of the surveyor from the point surveyed.

Figure 13 : Distance of observation (meters) of the points by country and average at EU level

Figure 14 : Distance of observation (meters) of the points by land cover class



5.2 Points rejected



A data quality check was performed by an external company on around 33% of the points. Since the progress of the survey in the various areas was uneven, the final control rate by country is unequal too. In Table 26 (Annex 1 - Tables and graphs), the rejection rate during the external quality control done by the contractor is given; the ratio can be considered an indirect indication of the quality of the results. The percentage of points refused at least once by country is reported in Figure 15, the two extremes are HR (70% ca.) and BG (less than 10%), the EU average is 25.5%.

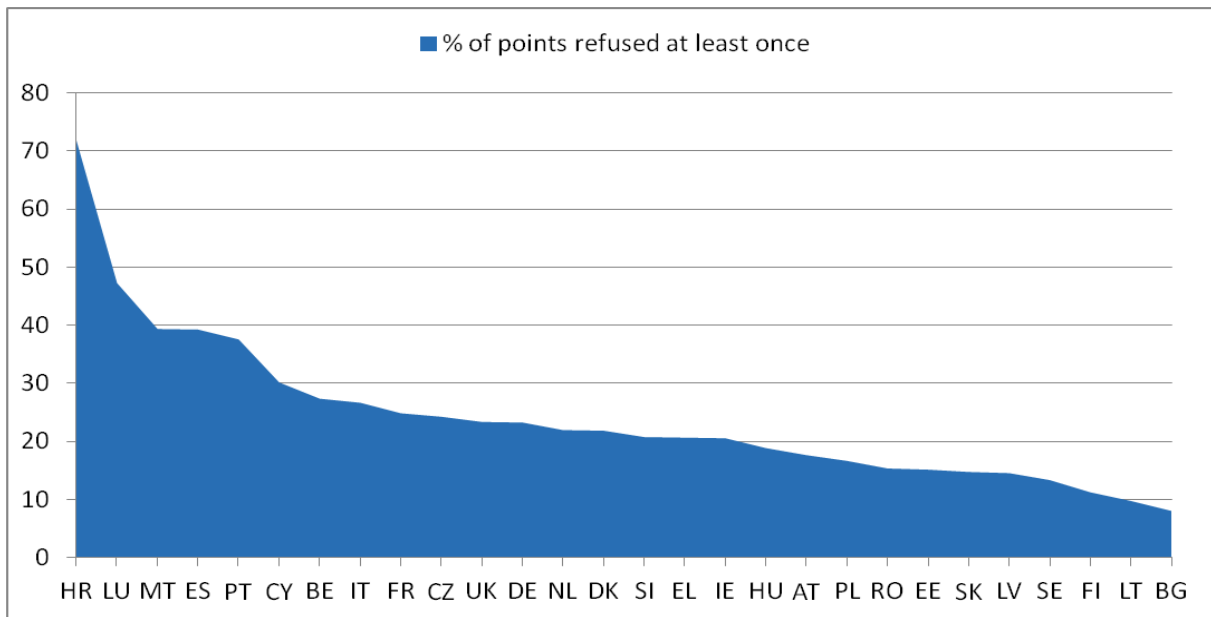


Figure 15 : Percentage of points rejected at least once by country

5.3 Sampling errors

We can consider having the following data set related to the points surveyed in a particular year:

Grouping variable	Observed value of the variable of interest	Strata (from master)		Weight of the record
...
...

The above variables can be represented, for example, by:

Nuts0	Land cover	Strata (from master)		Weight from IPF
...
...

In this case, we considered the *Nuts0* (Country) as the grouping variable, while *Land Cover* is the variable for which the estimates will be produced; in other words we are interested in the estimates of the *Land Cover* for each *Nuts0* and to their associated Coefficients of Variation.

First of all, it has to be noted that the variable *Strata* is not necessary to evaluate such estimations; in fact we have that the percentage of Land cover for each *Nuts0* can be obtained just by considering the ratio between the sum of the weights for each type of land cover and the sum of the weights.

By means of a mathematical approach, it is possible to consider:

- To have $1, \dots, G$ different values of the *Grouping variables* (in the example $1, \dots, G$ different *Nuts0*);
- To have $1, \dots, n$ records, and for each of these it is known its weight: w_i ;
- To have $x^1, \dots, x^j, \dots, x^J$ different values of the variable of interest (in the example $x^1, \dots, x^j, \dots, x^J$ different values of Land cover);
- For the single record we can assume to refer to the symbol: x_i^j in order to represent its value of the variable of interest (i.e. the Land cover observed in it);
- There are 7 different strata (derived from the Master): $1, \dots, h, \dots, 7$ (the generic strata is associated to the symbol h).

In order to evaluate the relative frequencies of the different land covers for the generic *Nuts0* (g), it will be possible to consider the following expression (referring to the value $k \in x^1, \dots, x^j, \dots, x^J$ of the Land cover):

$$x^k(g) = 100 * \frac{\sum_{i \in g} w_i (\text{if } x_i^j = k)}{\sum_{i \in g} w_i}$$

To evaluate the related Coefficient of Variation, it is possible to consider that we will have to refer to the calculation of the variance associated to a frequency.

In the following section we will use to the expression derived from Fattorini et al. (2006) and by considering some information derived from the Master; in particular:

- N_g specifies the number of points related to the generic value g of the grouping variable (in our case the number of points for each *Nuts0*);
- N_g^h the number of points related to the generic value g of the grouping variable and of the h strata;
- n_g^h the number of points related to the generic value g of the grouping variable and of the h strata (observed in the sample).

According to the previous notation, it is possible to represent the Variance of the estimated frequency (for the k value of the variable of interest and for the g value of the grouping variable) with:

$$V(\widehat{x^k(g)}) = \frac{1}{N_g - 1} \left[\frac{1}{N_g} \sum_{h=1}^7 \frac{N_g^h (N_g^h - 1)}{n_g^h - 1} x^k(g) (1 - x^k(g)) + \frac{1}{N_g} \sum_{h=1}^7 N_g^h (x^k(g))^2 - \left(\frac{1}{N_g} \sum_{h=1}^7 N_g^h x^k(g) \right)^2 \right]$$

Once the variance was evaluated, it will be possible to derive the *standard deviation* and the coefficient of variation considering:

$$CV^k(g) = 100 * \frac{\sqrt{V(x^k(g))}}{x^k(g)}$$

According to the above methodology, in Annex 1 – Tables 31 and 32 the CVs for estimates of LC and LU (2 digits code) by country are reported, respectively.

CHAPTER 6

Timeliness and punctuality

The first version of the LUCAS microdata is published the summer after the survey, in this case summer 2016. The first statistical tables are published by the end of that same year.

Successive versions of the microdata and/or the statistics may become available after additional quality controls.

CHAPTER 7

Coherence and comparability

7.1 Coherence

7.1.1 Coherence – cross domain

Coherence of statistics is their adequacy to be reliably combined in different ways and for various uses. Various sources of data currently provide information on land uses and agro-environmental topics. They include area sample surveys conducted by member States, NATURA 2000 maps and Corine Land Cover (CLC) among others. These sources are often not completely coherent with LUCAS data.

While reading the results and comparing them with other sources it is important to have in mind that the LUCAS survey clearly distinguishes between land cover and land use. Despite the effort of harmonization of the definitions, some differences (sometimes not negligible) can be observed when comparing different sources. These differences can be due to the following reasons:

- Different methodologies;
- Certain margin of subjectivity in the application of the definitions;
- The (im)possibility to clearly distinguish between coverage and use in the figures available from other domains;
- Variability of the estimates due to the sampling methodology.

Areas of crops and grassland

All the above explanations apply to the comparison between cropland in LUCAS and the figures on crops coming from other sources within Eurostat (for example the Farm Structure Survey or the Crop Statistics). Since the LUCAS survey collects indeed land cover and land use independently, areas covered by 'grassland' not belonging to farms and not used for agriculture are nonetheless classified as grassland. Note that the 'grassland' might be used as private gardens or public parks, but also for agriculture, sport and other uses. Grassland with agricultural use is an important component of the Utilized Agricultural Area and can be derived from the LUCAS classification by combining land cover and use attributes.

FAO forest definitions

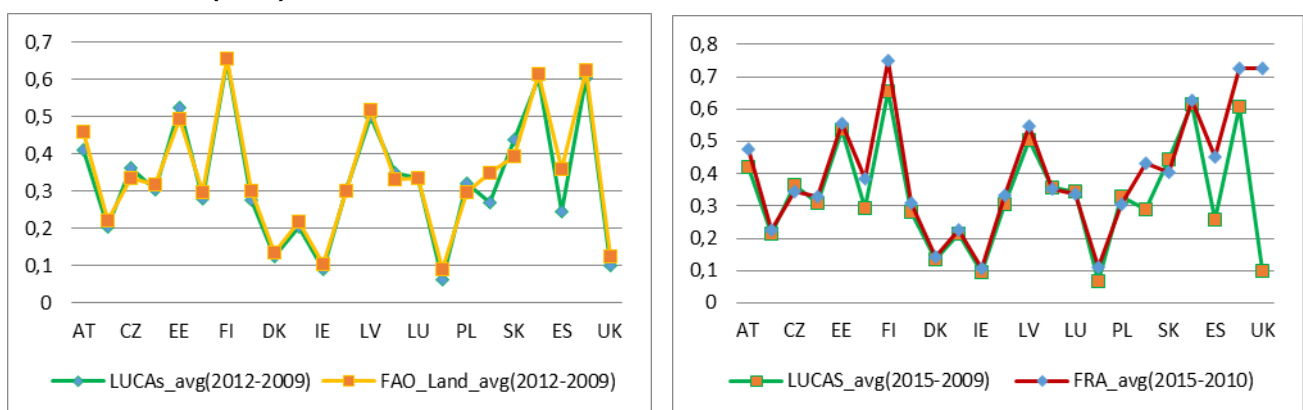
In LUCAS, Woodland has been defined in a way that allows providing estimates compatible with the FAO results. In particular the comparability with FAO forest classification has been strengthened with the inclusion of variables area size, height of trees, width of features and percentage of land cover.

However, differences between the semantic definition of LUCAS wooded areas and FAO forest definitions have to be taken into account: if an area has > 10% of trees (excluding fruit trees in permanent crops) in LUCAS is labeled as "wooded area", FAO take this into account only if it is > than 0.5 Ha. Then, woodland in LUCAS includes: 'Forest' and 'Other wooded land' as defined according to FAO standards and other areas covered by trees not respecting FAO definition.

In addition, a further concern arises from the changes occurred in survey protocol for the 2009, 2012 and 2015 LUCAS campaigns. In fact, variations in the definitions may cause inconsistencies when datasets are compared over time. Therefore, an evaluation of the impacts of these changes on the reported figures at different administrative levels is either beneficial for producer or user of the data.

In 2016, Eurostat carried out an analysis to map LUCAS to FAO forest classes, for the 2009, 2012 and 2015 surveys, by developing a set of rules that allowed relating each LUCAS class containing forest related features to FAO forest classes. Results of the mapping procedure was evaluated for each year by comparing LUCAS and FAO statistics for forest related classes in terms of area at country level and coefficient of variation. In addition, the variations of forestry statistics over time was also computed (Figure 16) by comparing LUCAS results with the statistics released by FAO (FAOSTAT (Domain Inputs/Land) and FAO Forest Resource Assessment (FRA) (2010 and 2015)).

Figure 16 : (from left to right) Comparison of the average changes per country between LUCAS and FAO for the period 2009-2012 / Comparison of the average changes in the period 2015-2009 and 2015-2010 for the LUCAS and Forest Resource Assessment (FRA) dataset



7.1.2 Coherence – internal

The coherence between the total area of the countries and their split according to land cover and land use is guaranteed by definition. A standardized methodology and classification has been applied in all the countries and from one round to another since the 2006 pilot survey. Therefore the internal coherence is perfectly assured.

7.2 Comparability

Different aspects of comparability have been assessed through:

- Comparison of the main features of 2009, 2012 and 2015 surveys by focussing on the following elements: sample design, sample size, countries involved, sampling unit and data collection method;
- Comparison of the information collected with the previous surveys (comparison of the variables reported in the field forms);
- Comparison of the definition of the variables collected with the previous surveys (information reported in the metadata and/or in the Technical Reference Documents).

In general, the LC/LU classification is comparable with others LC/LU systems (e. FAO, CLC), hence compatibility of the adopted definitions with the main international concepts and definitions is guaranteed. Additional parameters have been introduced where needed to allow the match, while keeping an independency and flexibility in the main item classification. This is the reason why the heading "Total woodland" in LUCAS Statistical classification includes: 'Forest' and 'other wooded area' as defined according to FAO standards and other areas covered by trees not respecting FAO definition.

Table 20 : Main features of the LUCAS survey 2009, 2012 and 2015

Item	2009	2012	2015
Reference population	EU 23	EU 27	EU 28
Sampling unit	Point	Point	Point
Sampling scheme	Two-phase design with stratification	Two-phase design with stratification	Two-phase design with stratification
First Phase Sample - Master Grid (size)	989,951	1,097,607	-1,091,882
Second phase sample Field Sample (size) (No. of points surveyed)	234,545	270,260	273,153 + 66.604 (PI)
Number of MSs involved	23	27	28

Item	2009	2012	2015
Main information collected	Land Cover/Land Use details (i.e. height of trees, width of feature, plant species and degree of coverage (percentage); soil data; water management information and transect data. Soil	Land use data; land cover details (i.e. height of trees, width of feature, plant species and degree of coverage (percentage); soil data; water management information and transect data.	Land use data; land cover details (i.e. height of trees, width of feature, plant species and degree of coverage (percentage); soil data; water management information and transect data. soil
Information collected walking a transect	Yes	Yes	Yes
Stratification	Yes	Yes	Yes
Estimator ¹⁰	H-T for two phase stratified design with post stratification	H-T for two phase stratified design with post stratification	- H-T for two phase stratified design with post stratification

7.2.1 Comparability – geographical

The survey is fully harmonized and comparable, since the surveyors use the same methodology in all countries.

7.2.2 Comparability – over time

LUCAS Survey is designed in order to achieve harmonization and comparability among campaigns. For these reasons, Eurostat launched a project in order to overcome the problems of comparability among survey from 2009 onward.

In the last two campaigns, one of the main obstacle for comparing the collected data, were the changes done in 2012 classifications of “land cover” and the solution was to recode the 2009 survey data. In some cases it was sufficient to replace the original 2009 code by the new one in 2012 in a deterministic way. When land use is equal to “hunting”, “nature reserve” and “unused and abandoned areas” and in the same time the land cover is changed, the deterministic mode cannot be applied because the uncertainty of the correction and, hence, a specific procedure was implemented. The new land use is derived from a probabilistic imputation that is a random selection of the code among the three most frequent land use codes, given the related land cover; the probabilities are derived by considering the cross distribution of land cover and the land use for those point in common to 2009 and to 2012 (and the points are restricted only to those that, in 2009, had the land use that will be changed).

The 2015 LUCAS classification is not fundamentally different from the one defined in 2012, the main changes are reported below.

¹⁰ The estimation method used in 2015 is applied to the back series 2009 and 2012

- New class A30 Other built - up: includes all constructions not covered in the other AXX classes;
- Class B77j was dropped as it referred to "Abandoned citrus orchards" (when abandoned is to be classified as a use) 8 / 93;
- Clarified that turnips (as a root crop) are to be classified as B23e and not B23n. Also that B23 refers to species of turnips planted as root crops as opposed to rape and turnip rape (Brassica rapa var. oleifera) which are planted for their seed;
- Clarified that chervil (Anthriscus cerefolium) mentioned in B37d is the aromatic plant also known as "garden chervil". A previous mention to chervil in B43b was removed, as it referred to the root crop B23l – tuberous chervil;
- Clarified that B43f corresponds to cultivated mushrooms (including all cultivated truffle) whereas B43g refers to the collection of wild products (truffles in the wild included);
- B83 Nurseries now includes also forest nurseries. Sub - classification (B83a..f) was created for specialized nursery types;
- Cropland, and namely energy crops (B84) are no longer linked to U210 Energy production;
- Harmonization of the woodland definition: in 2012 CXX included forest nurseries (now to be classified under B83) and young plantations, even if they do not reach a canopy of 10%. In order to have a coherent definition, areas below 10% of trees are to be classified according to the existing land cover;
- Disaggregation of G10 - Inland water bodies into classes G11 - Inland fresh water bodies and G12 - Inland salty water bodies in order to better map to INSPIRE PLC C classes (namely PLCC 017 – Salty waters, which includes inland salty lakes);
- Disaggregation of G20 - Inland running water into classes G21 - Inland fresh running water and G22 - Inland salty running water in order to better map to INSPIRE PLCC classes (namely P LCC 017 – Salty waters);
- Renaming of G30 - Coastal waters to G30 - Transitional waters, since in LUCAS coastal waters (also known as "open sea") are not relevant. In fact, the definition for G30 in 2012 was already compatible with the definition for transitional waters under the Water Framework Directive (Directive 2000/60/EC).

Main changes for land use are the following:

- All NACE categories have been covered;
- U111 Agriculture no longer includes NACE 81.3 Landscape care and maintenance (which is now included in U342);
- U120 Forestry now explicitly includes extraction of cork (cork oak trees);
- U130 Fishing refers only to commercial fishing;
- New class U150 Other primary production;
- For all industrial activities (U22X) it has been specified in which main INSPIRE category it has to be included: raw industry, heavy end product industry or light end product industry (Land use type);
- U226 Machinery and equipment now includes also wooden furniture (formerly U227) and excludes reproduction of recorded media (now U228);

- U227 no longer includes printing and reproduction (now U228), nor manufacture of furniture (U226);
- New class U228 Printing and reproduction (includes NACE 18 and NACE 58);
- Docks are part of the specific transport sector they belong to, as other related infrastructure (they were an exception before and were excluded from the specific transport sector);
- New class U319 Electricity, gas and thermal power distribution (includes parts previously included in U210 Energy production, as far as the network is concerned);
- Split class U340 in to U341 Commerce and U342 Financial, professional and information services;
- Included class U363 Holiday camps into U341 Commerce.

CHAPTER 8

Accessibility and clarity

All the microdata as well as the statistical tables produced can be accessed via the Eurostat website, either directly, or if this is not possible, the website provides further information on how to access the data.

The microdata is accessible here:

- <http://ec.europa.eu/eurostat/web/lucas/data/primary-data/2015>

and the photos can be ordered here:

- <http://ec.europa.eu/eurostat/web/lucas/data/primary-data/order-form>

Statistical data can be downloaded here:

- <http://ec.europa.eu/eurostat/web/lucas/data/database>

A LUCAS photo viewer allows to visualize maps of the data:

- <http://ec.europa.eu/eurostat/web/lucas/lucas-photo-viewer>

CHAPTER 9

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Annex 1: tables and graphs

Table 21 : Number of points of the Master by STRATA and NUTS0 with the difference between the number of points belonging to country and NUTS0

NUTS0	Strata								Δ country - nuts0
	Arable land	Permanent crops	Grassland	Wooded areas and shrubland	Bare land, low or rare vegetation	Artificial land	Water	total	
AT	3,178	278	3,779	11,925	710	818	294	20,982	0
BE	2,077	50	2,507	2,117	24	813	91	7,679	0
BG	9,922	115	3,363	11,684	461	1,643	557	27,745	0
CY	655	129	284	948	123	160	15	2,314	0
CZ	7,660	96	2,699	8,204	111	739	207	19,716	1
DE	33,794	570	14,913	30,913	465	7,681	1,099	89,435	144
DK	7,572	1	762	1,675	82	569	119	10,780	0
EE	1,833	7	1,853	6,757	192	129	551	11,322	0
EL	6,591	2,647	4,048	17,738	387	1,100	356	32,867	55
ES	32,339	11,638	17,620	55,798	3,100	3,228	873	124,596	65
FI	5,502	37	5,078	60,819	2,704	1,516	8,666	84,322	0
FR	39,953	3,137	32,295	51,866	2,239	6,310	1,443	137,243	332
HR	4,244	146	2,075	7,047	46	404	181	14,143	1
HU	11,920	455	3,400	6,201	108	709	475	23,268	-1
IE	928	0	12,077	2,939	575	520	382	17,421	165
IT	20,653	6,699	10,193	30,284	2,200	4,162	935	75,126	172
LT	6,241	26	3,340	5,593	553	480	0	16,233	126
LU	165	4	163	257	4	47	4	644	0
LV	4,474	21	2,166	8,206	907	362	0	16,136	236
MT	15	6	9	16	6	26	1	79	0
NL	1,881	59	3,716	1,559	162	966	932	9,275	93

	Strata								Δ count
PL	35,351	243	10,922	27,393	200	2,742	1,133	77,984	472
PT	4,530	1,967	2,969	10,918	594	975	228	22,181	119
RO	27,296	867	6,597	20,413	341	2,331	1,740	59,585	172
SE	7,045	8	5,520	82,979	4,605	2,111	10,143	112,411	41
SI	549	121	671	3,481	55	164	23	5,064	0
SK	3,704	110	1,693	6,180	105	367	106	12,265	0
UK	14,169	49	22,539	19,359	667	3,488	795	61,066	772
Total	294,241	29,486	177,251	493,269	21,726	44,560	31,349	109,1882	2,965

Table 22 : Average number of points per surveyor by country

COUNTRY	Average no. points per surveyors
LU	5
MT	78
HU	154
BG	189
SI	202
EL	211
IT	262
HR	272
CY	288
AT	318
FR	343
LV	346
IE	385
LT	387
FI	394
SK	406
DE	444
EE	450
BE	482
NL	553
SE	572
ES	578
CZ	610
RO	619
PL	639
UK	670

COUNTRY	Average no. points per surveyors
DK	689
PT	732
EU	375

Table 23 : Number of points selected by country and Strata

Country	Arable Land	Permanent Crops	Grassland	Woodland and Shrubland	Bare Land	Artificial Land	Water Areas	TOTAL
AT	1,371	119	1,679	4,874	337	339	120	8,839
BE	832	25	1,008	677	14	310	33	2,899
BG	2,876	36	943	3,079	121	479	144	7,678
CY	331	115	237	799	109	123	12	1,726
CZ	2,193	31	808	2,382	30	219	50	5,713
DE	10,512	206	4,550	8,430	182	2,317	548	26,745
DK	2,682	1	211	498	28	190	52	3,662
EE	451	2	463	1,559	47	35	79	2,636
EL	2,196	881	1,713	7,041	165	364	182	12,542
ES	11,725	4,251	7,407	23,794	1,609	1,146	345	50,277
FI	1,534	9	824	11,594	451	343	1,353	16,108
FR	13,534	1,027	11,688	17,677	1,512	2,107	659	48,204
HR	1,075	37	506	1,761	7	102	44	3,532
HU	2,610	95	754	1,382	25	176	127	5,169
IE	236		3,273	954	198	111	163	4,935
IT	7,224	2,395	4,231	11,607	1,388	1,434	477	28,756
LT	1,708	6	874	1,565	272	158		4,583
LU	69	3	62	99	2	15	1	251
LV	1,472	9	716	2,732	322	124		5,375
MT	15	6	9	16	6	25	1	78
NL	557	20	1,013	429	56	271	246	2,592
PL	11,017	98	3,331	7,325	62	807	443	23,083
PT	1,810	804	1,228	4,454	250	391	120	9,057
RO	7,443	244	1,916	5,900	99	644	473	16,719

Country	Arable Land	Permanent Crops	Grassland	Woodland and Shrubland	Bare Land	Artificial Land	Water Areas	TOTAL
SE	2,158	4	1,269	19,645	1,054	583	1,969	26,682
SI	206	34	252	1,324	48	54	5	1,923
SK	909	25	407	1,275	36	82	21	2,755
UK	3,428	11	5,809	6,251	288	813	443	17,043
EU	92,174	10,494	57,181	149,123	8,718	13,762	8,110	339,562

Annex 1: tables and graphs

Table 24 : Number of points for the field survey and for the points photo-interpreted in the office by Strata and country

Country	Arable Land			Permanent Crops			Grassland			Wooded areas and shrubland			Bare Land			Artificial Land			Water			TOTAL		GRAND TOTAL
	Field	ExtPI	Σ	Field	ExtPI	Σ	Field	ExtPI	Σ	Field	ExtPI	Σ	Field	ExtPI	Σ	Field	ExtPI	Σ	Field	ExtPI	Σ	Field	ExtPI	
AT	1,371		1,371	119		119	1,154	525	1,679	3,631	1,243	4,874	21	316	337	337	2	339	47	73	120	6,680	2,159	8,839
BE	697	135	832	24	1	25	836	172	1,008	546	131	677	14		14	267	43	310	28	5	33	2,412	487	2,899
BG	2,873	3	2,876	36		36	888	55	943	2,154	925	3,079	62	59	121	477	2	479	133	11	144	6,623	1,055	7,678
CY	168	163	331	107	8	115	217	20	237	726	73	799	106	3	109	106	17	123	12		12	1,442	284	1,726
CZ	2,193		2,193	31		31	794	14	808	2,183	199	2,382	30		30	218	1	219	43	7	50	5,492	221	5,713
DE	10,489	23	10,512	205	1	206	4,467	83	4,550	7,040	1,390	8,430	118	64	182	2,310	7	2,317	258	290	548	24,887	1,858	26,745
DK	2,609	73	2,682	1		1	179	32	211	412	86	498	21	7	28	189	1	190	32	20	52	3,443	219	3,662
EE	451		451	2		2	387	76	463	1,328	231	1,559	32	15	47	35		35	15	64	79	2,250	386	2,636
EL	2,187	9	2,196	878	3	881	836	877	1,713	3,457	3,584	7,041	70	95	165	340	24	364	42	140	182	7,810	4,732	12,542
ES	11,102	623	11,725	4,051	200	4,251	5,166	2,241	7,407	12,988	10,806	23,794	671	938	1,609	1,087	59	1,146	163	182	345	35,228	15,049	50,277
FI	1,533	1	1,534	9		9	637	187	824	9,581	2,013	11,594	267	184	451	343		343	1,009	344	1,353	13,379	2,729	16,108
FR	12,984	550	13,534	1,017	10	1,027	9,729	1,959	11,688	11,945	5,732	17,677	292	1,220	1,512	2,074	33	2,107	371	288	659	38,412	9,792	48,204
HR	1,075		1,075	37		37	506		506	1,761		1,761	7		7	102		102	44		44	3,532	0	3,532
HU	2,607	3	2,610	95		95	683	71	754	986	396	1,382	22	3	25	172	4	176	61	66	127	4,626	543	5,169
IE	221	15	236			0	2,529	744	3,273	482	472	954	98	100	198	105	6	111	26	137	163	3,461	1,474	4,935
IT	7,219	5	7,224	2,39	3	2,395	2,643	1,588	4,231	6,828	4,779	11,607	222	1,166	1,388	1,42	6	1,43	187	290	477	20,919	7,837	28,756

Country	Arable Land			Permanent Crops			Grassland			Wooded areas and shrubland			Bare Land			Artificial Land			Water			TOTAL		GRAND TOTAL
				2											8		4							
LT	1,693	15	1,708	6		6	849	25	874	1,085	480	1,565	85	187	272	155	3	158			0	3,873	710	4,583
LU	56	13	69	3		3	45	17	62	83	16	99	2		2	15		15	1		1	205	46	251
LV	1,470	2	1,472	9		9	677	39	716	2,135	597	2,732	87	235	322	119	5	124			0	4,497	878	5,375
MT	15		15	6		6	9		9	16		16	6		6	25		25	1		1	78	0	78
NL	519	38	557	19	1	20	929	84	1,013	370	59	429	35	21	56	266	5	271	73	173	246	2,211	381	2,592
PL	11,014	3	11,017	98		98	3,284	47	3,331	6,196	1,129	7,325	55	7	62	800	7	807	272	171	443	21,719	1,364	23,083
PT	1,630	180	1,810	732	72	804	963	265	1,228	3,395	1,059	4,454	172	78	250	370	21	391	53	67	120	7,315	1,742	9,057
RO	7,426	17	7,443	240	4	244	1,751	165	1,916	3,772	2,128	5,900	77	22	99	640	4	644	322	151	473	14,228	2,491	16,719
SE	2,158		2,158	4		4	869	400	1,269	16,645	3,000	19,645	639	415	1,054	581	2	583	1,421	548	1,969	22,317	4,365	26,682
SI	205	1	206	34		34	244	8	252	1,068	256	1,324	3	45	48	54		54	5		5	1,613	310	1,923
SK	909		909	25		25	390	17	407	995	280	1,275	17	19	36	82		82	20	1	21	2,438	317	2,755
UK	3,428		3,428	11		11	4,901	908	5,809	2,617	3,634	6,251	130	158	288	810	3	813	166	277	443	12,063	4,980	17,043
EU	90,302	1,872	92,174	10,191	303	10,494	46,562	10,619	57,181	104,425	44,698	149,123	3,361	5,357	8,718	13,507	255	13,762	4,805	3,305	8,110	273,153	66,409	339,562

Table 25 : Organisation of the work per country with the number of surveyors, the number of points surveyed of which number PI and the duration of the field survey

FIELD SURVEY									EX-ANTE Extension						
Country	# of Points	# of Surveyors	AVG points per surveyor	Start date	End date	Working days	Man days	AVG points per day	# of Points	# of Photo-interpretors	AVG points per surveyors	Start date	End date	Man days	AVG points per day
LU	206	46	5	21.Mai.15	12.Nov.15	16	57	3.6		46	1	46	10.Mrz.16	10.Mrz.16	1
HU	4,626	30	154	07.Jan.15	08.Okt.15	86	799	5.8		543	4	136	04.Mai.16	09.Mai.16	13
NL	2,211	4	553	04.Mai.15	16.Okt.15	114	203	10.9		381	2	191	16.Mrz.16	17.Mrz.16	3
EE	2,250	5	450	02.Mai.15	02.Dez.15	131	194	11.6		386	2	193	02.Mrz.16	15.Apr.16	18
DK	3,443	5	689	05.Mai.15	26.Sep.15	119	289	11.9		219	1	219	07.Mrz.16	09.Mrz.16	3
CZ	5,492	9	610	21.Apr.15	10.Sep.15	127	583	9.4		221	1	221	02.Mrz.16	09.Mai.16	19
RO	14,230	23	619	05.Mai.15	28.Okt.15	117	1,076	13.2		2,493	11	227	12.Feb.16	18.Feb.16	36
BE	2,412	5	482	23.Mai.15	10.Nov.15	110	260	9.3		487	2	244	28.Jan.16	01.Feb.16	5
BG	6,621	35	189	26.Apr.15	02.Mai.16	225	1,028	6.4		1,051	4	263	09.Mai.16	14.Mai.16	24
CY	1,442	5	288	30.Mrz.15	01.Okt.15	103	190	7.6		284	1	284	15.Mrz.16	16.Mai.16	19
SI	1,614	8	202	13.Mai.15	06.Okt.15	116	224	7.2		310	1	310	11.Mrz.16	30.Mrz.16	12
SK	2,438	6	406	04.Mai.15	23.Sep.15	96	341	7.1		317	1	317	01.Apr.16	25.Apr.16	17
PL	21,719	34	639	05.Jan.15	25.Mai.16	210	1,565	13.9		1,364	2	682	22.Feb.16	26.Mrz.16	22
LT	3,873	10	387	01.Mai.15	25.Nov.15	134	281	13.8		710	1	710	23.Mrz.16	15.Apr.16	16
AT	6,679	21	318	30.Apr.15	16.Dez.15	141	822	8.1		2,156	3	719	24.Mrz.16	06.Mai.16	52
LV	4,497	13	346	07.Jan.15	12.Jan.16	152	397	11.3		878	1	878	17.Mrz.16	06.Mai.16	32

FIELD SURVEY									EX-ANTE Extension						
DE	24,887	56	444	01.Mai.15	29.Jan.16	178	2,139	11.6		1,861	2	931	18.Feb.16	30.Mrz.16	36
EL	7,810	37	211	11.Apr.15	08.Nov.15	198	983	7.9		4,734	5	947	01.Mrz.16	09.Mai.16	98
FI	13,379	34	394	29.Mai.15	22.Okt.15	147	1,451	9.2		2,729	2	1,365	31.Mrz.16	26.Apr.16	32
IE	3,461	9	385	18.Mai.15	17.Dez.15	150	513	6.7		1,474	1	1,474	09.Feb.16	07.Mrz.16	18
IT	20,919	80	262	26.Feb.15	29.Jan.16	208	2,574	8.1		7,837	5	1,567	03.Feb.16	06.Mai.16	116
PT	7,315	10	732	08.Mai.15	29.Sep.15	118	520	14.1		1,742	1	1,742	05.Feb.16	04.Apr.16	31
SE	22,317	39	572	08.Mai.15	11.Feb.16	251	2,154	10.4		4,365	2	2,183	16.Feb.16	31.Mai.16	61
UK	12,063	18	670	20.Apr.15	23.Feb.16	180	1,570	7.7		4,980	2	2,490	03.Mrz.16	19.Apr.16	55
ES	35,227	61	578	13.Mrz.15	22.Sep.15	188	2,731	12.9		15,049	4	3,762	01.Jun.15	08.Mai.16	232
FR	38,413	112	343	12.Mai.15	10.Mrz.16	203	3,843	10.0		9,792	2	4,896	01.Feb.16	14.Mrz.16	50
HR	3,531	13	272	18.Mrz.15	18.Mrz.16	188	563	6.3		0	0				0
MT	78	1	78	10.Mai.15	20.Mai.15	10	10	7.8		0	0				0
EU	273,153	729	375	05.Jan.15	25.Mai.16		27,360	10.0		66,409	64	1,038	09.Mai.16	31.Mai.16	1,021

Table 26 : Number of surveyed points by type of observation (observed, missing, in field PI, ex-ante PI)

COUNTRY	FIELD SURVEY								EXTENDED PI
	Σ	< 100 m	> 100 m	Field PI	Not Observed	Marine sea	Out of national territory	Ex Ante PI	Σ
AT	6,679	5,426	89	1,163	1				2,156
BE	2,412	2,237	39	135	1				487
BG	6,621	5,290	335	964	3			29	1,051
CY	1,442	1,212	61	112			1	56	284
CZ	5,492	5,328	88	76					221
DE	24,887	22,707	1,409	770			1		1,861
DK	3,443	3,197	174	72					219
EE	2,250	1,799	91	341				19	386
EL	7,810	6,149	609	842				210	4,734
ES	35,227	30,353	1,367	3,507					15,049
FI	13,379	11,266	824	1,289					2,729
FR	38,413	35,487	762	2,128	6	2	1	27	9,792
HR	3,531	2,770	32	349	2			378	0
HU	4,626	4,376	108	142					543
IE	3,461	2,572	361	522	1			5	1,474
IT	20,919	15,808	1,634	3,446	1	1		29	7,837
LT	3,873	3,624	52	168				29	710
LU	206	203		3					46
LV	4,497	3,800	91	584		1		21	878
MT	78	69	1	8					0
NL	2,211	1,951	156	104					381
PL	21,719	19,655	841	1,223					1,364
PT	7,315	6,437	186	692					1,742
RO	14,230	10,220	751	3,259					2,493

COUNTRY	FIELD SURVEY								EXTENDED PI
SE	22,317	15,975	772	1,213		1		4,356	4,365
SI	1,614	1,503	14	97					310
SK	2,438	2,098	91	249					317
UK	12,063	9,210	1,031	1,752	1	4		65	4,980
EU	273,153	230,722	11,969	25,210	16	9	3	5,224	66,409

Table 27 : Number of total points surveyed, checked, refused once, checked rate and rejection rate by country

Country	Surveyed points	Checked	Refused once	& of checked	% of refused at least once
HR	3,531	1,163	835	32.90	71.80
LU	206	110	52	53.40	47.30
MT	78	33	13	42.30	39.40
ES	35,227	16,654	6,538	47.30	39.30
PT	7,315	3,948	1,486	54.00	37.60
CY	1,442	635	192	44.00	30.20
BE	2,412	786	215	32.60	27.40
IT	20,919	4,499	1,201	21.50	26.70
FR	38,413	12,072	3,010	31.40	24.90
CZ	5,492	1,775	431	32.30	24.30
UK	12,063	5,597	1,307	46.40	23.40
DE	24,887	8,779	2,048	35.30	23.30
NL	2,211	771	170	34.90	22.00
DK	3,443	1,113	244	32.30	31.90
SI	1,614	544	113	33.70	20.80
EL	7,810	3,164	655	40.50	20.70
IE	3,461	1,547	319	44.70	20.60
HU	4,626	1,277	241	27.60	18.90
AT	6,679	2,127	377	31.80	17.70
PL	21,719	6,664	1,115	30.70	16.70
RO	14,230	4,027	619	28.30	15.40
EE	2,250	612	93	27.20	15.20
SK	2,438	789	117	32.40	14.80
LV	4,497	1,207	176	26.80	14.60
SE	22,317	5,765	370	12.40	13.40

Country	Surveyed points	Checked	Refused once	& of checked	% of refused at least once
FI	13,379	3,777	426	28.20	11.30
LT	3,873	1,093	107	28.20	9.80
BG	6,621	951	77	14.40	8.10
EU	273,153	88,479	22,547	32.40	25.50

Table 28 : Land cover estimates by NUTS0 (absolute values - km²)

	ARTIFICIAL LAND	CROPLAND	WOODLAND	SHRUBLAND	GRASSLAND	BARE LAND AND LICHENS	WATER AREAS	WETLANDS	TOTAL
NUTS0	A	B	C	D	E	F	G	H	
AT	3,396.98	12,836	35,845.25	4,752.99	20,786.48	4,566.8	1,467.59	284,02	83,936.11
BE	3,455.19	8,753.45	7,574.01	501.96	9,524.01	253.1	450.24	144.16	30,656.12
BG	2,143.57	32,386.15	45,589.15	6134.97	20,775.08	2,589.12	1,140.01	194.23	110,952.3
CY	515.28	1,787.1	2,102.73	2,075.01	1,217.14	1,485.95	42.3	18.47	9,243.98
CZ	3,634.3	25,255.07	29,602.47	786.88	17,600.31	681.81	1,089.08	206.17	78,856.09
DE	24,787.96	115,676.8	121,176.8	3,805.1	78,436.44	4,418.37	6,564.06	2,022.06	356,887.5
DK	2,612.65	22,039.88	7,996.7	852.35	7,641.6	548.22	643.82	826.81	43,162.03
EE	679.18	6,141.88	25,968.8	732.54	7,244.02	403.81	2,168.24	2,008.96	45,347.43
EL	4,241.66	20,210.53	42,049.57	32,650.82	25,591.91	4,175.64	1,679.39	872.83	131,472.4
ES	16,157.68	106,470.8	14,3957.7	84,263.89	94,820.61	47,698.63	4,640.1	735.66	498,745
FI	5,044.41	19,825.88	22,9738.7	14,436.2	14,728.24	3,008.1	33,908.54	16,856.75	337,546.9
FR	28,753.06	15,9100.4	165,895.4	20,636.08	14,7216.4	19,082.91	7,777.33	1,525.96	549,987.5
HR	2,082.29	9,419.34	25,808.6	6,956.48	10,794.69	682.33	627.39	142.38	56,513.5
HU	3,799.84	40,667.9	22,331.27	1,859.3	18,463.86	2,666.89	1,948.5	1,275.13	93,012.69
IE	2,410.17	4,104.31	8,335.79	9,440.92	39,509.08	537.79	1,650.72	3,959.97	69,948.75
IT	19,708.15	75,683.58	99,631.73	19,457.62	65,443.33	14,371.39	5,610.13	629.07	300,535
LT	1,318.88	19,205.14	24,712.56	522.31	16,244.2	701.88	1,325.49	700.75	64,731.21
LU	219.69	613.63	8,94.06	86.96	762.17	10.73	8.1		2,595.34
LV	929.61	9,376.97	35,364.67	1,216.95	14,765.83	813	1,456.89	1,546.38	65,470.3
MT	7,4.72	81.99	16.26	43.92	74.19	20.36	3.99		315.43
NL	4,450.32	9,025.83	4,836.67	751.38	13,526.16	346.03	3,975.49	342.4	37,254.28
PL	10,467.6	103,767.7	111,635.8	3,160.24	70,627.77	5,220.6	5,334.05	2,027.66	312,241.4

	ARTIFICIAL LAND	CROPLAND	WOODLAND	SHRUBLAND	GRASSLAND	BARE LAND AND LICHENS	WATER AREAS	WETLANDS	TOTAL
PT	4,432.31	10,439.68	29,887.64	17,186.73	20,984.54	4,358.59	1,267.13	261.39	88,818.01
RO	5,329.47	76,882.62	77,923.82	4,918.72	64,657.54	1,972.84	3,622.76	3,722.49	239,030.3
SE	6,727.87	18,831.99	288,847.5	25,033.55	24,306.11	21,177.76	40,152.64	24,125.33	449,202.7
SI	624.21	1,938.9	12,402.67	530.14	4,400.61	193.81	157.66	28.68	20,276.68
SK	1,420.24	13,058.69	22,102.92	1,859.75	9,562.53	419.91	557.91	43.97	49,025.92
UK	15,059.21	48,531.21	29,040.19	46,791.81	88,927.97	4,012.83	4,119.82	7,930.19	244,413.2
Total	174,476.5	972,113.4	1,651,269	311,445.6	908,632.8	146,419.2	133,389.4	72,431.87	4,370,178

Table 29 : Land cover estimates by NUTS0 (percentages)

	ARTIFICIAL LAND	CROPLAND	WOODLAND	SHRUBLAND	GRASSLAND	BARE LAND AND LICHENS	WATER AREAS	WETLANDS	TOTAL
NUTS0	A	B	C	D	E	F	G	H	
AT	4.0%	15.3%	42.7%	5.7%	24.8%	5.4%	1.7%	0.3%	100.0%
BE	11.3%	28.6%	24.7%	1.6%	31.1%	0.8%	1.5%	0.5%	100.0%
BG	1.9%	29.2%	41.1%	5.5%	18.7%	2.3%	1.0%	0.2%	100.0%
CY	5.6%	19.3%	22.7%	22.4%	13.2%	16.1%	0.5%	0.2%	100.0%
CZ	4.6%	32.0%	37.5%	1.0%	22.3%	0.9%	1.4%	0.3%	100.0%
DE	6.9%	32.4%	34.0%	1.1%	22.0%	1.2%	1.8%	0.6%	100.0%
DK	6.1%	51.1%	18.5%	2.0%	17.7%	1.3%	1.5%	1.9%	100.0%
EE	1.5%	13.5%	57.3%	1.6%	16.0%	0.9%	4.8%	4.4%	100.0%
EL	3.2%	15.4%	32.0%	24.8%	19.5%	3.2%	1.3%	0.7%	100.0%
ES	3.2%	21.3%	28.9%	16.9%	19.0%	9.6%	0.9%	0.1%	100.0%
FI	1.5%	5.9%	68.1%	4.3%	4.4%	0.9%	10.0%	5.0%	100.0%
FR	5.2%	28.9%	30.2%	3.8%	26.8%	3.5%	1.4%	0.3%	100.0%
HR	3.7%	16.7%	45.7%	12.3%	19.1%	1.2%	1.1%	0.3%	100.0%
HU	4.1%	43.7%	24.0%	2.0%	19.9%	2.9%	2.1%	1.4%	100.0%
IE	3.4%	5.9%	11.9%	13.5%	56.5%	0.8%	2.4%	5.7%	100.0%
IT	6.6%	25.2%	33.2%	6.5%	21.8%	4.8%	1.9%	0.2%	100.0%
LT	2.0%	29.7%	38.2%	0.8%	25.1%	1.1%	2.0%	1.1%	100.0%
LU	8.5%	23.6%	34.4%	3.4%	29.4%	0.4%	0.3%		100.0%
LV	1.4%	14.3%	54.0%	1.9%	22.6%	1.2%	2.2%	2.4%	100.0%
MT	23.7%	26.0%	5.2%	13.9%	23.5%	6.5%	1.3%		100.0%
NL	11.9%	24.2%	13.0%	2.0%	36.3%	0.9%	10.7%	0.9%	100.0%
PL	3.4%	33.2%	35.8%	1.0%	22.6%	1.7%	1.7%	0.6%	100.0%
PT	5.0%	11.8%	33.7%	19.4%	23.6%	4.9%	1.4%	0.3%	100.0%

	ARTIFICIAL LAND	CROPLAND	WOODLAND	SHRUBLAND	GRASSLAND	BARE LAND AND LICHENS	WATER AREAS	WETLANDS	TOTAL
RO	2.2%	32.2%	32.6%	2.1%	27.1%	0.8%	1.5%	1.6%	100.0%
SE	1.5%	4.2%	64.3%	5.6%	5.4%	4.7%	8.9%	5.4%	100.0%
SI	3.1%	9.6%	61.2%	2.6%	21.7%	1.0%	0.8%	0.1%	100.0%
SK	2.9%	26.6%	45.1%	3.8%	19.5%	0.9%	1.1%	0.1%	100.0%
UK	6.2%	19.9%	11.9%	19.1%	36.4%	1.6%	1.7%	3.2%	100.0%
Total	4.0%	22.2%	37.8%	7.1%	20.8%	3.4%	3.1%	1.7%	100.0%

Table 30 : Land use estimation by NUTS0 (absolute values km²)

	PRIMARY SECTOR	MANUFACTURING AND ENERGY	TERTIARY SECTOR, TRANSPORT, UTILITIES AND RESIDENTIAL	UNUSED AND ABANDONED AREAS	TOTAL
NUTS0	U1	U2	U3	U4	
AT	62,975.09	204.92	6,170.32	14,585.78	83,936.11
BE	22,574.46	229.13	6542	1,310.54	30,656.13
BG	92,401.47	150.58	4,588.8	13,811.44	110,952.3
CY	4,572.89	9.19	820.14	3,841.75	9,243.97
CZ	67,571.14	373.92	6,411.26	4,499.77	78,856.09
DE	289,020.3	1,729.95	50,278.53	15,858.76	356,887.5
DK	32,658.13	141.53	6,467.08	3,895.29	43,162.03
EE	38,104.53	189.77	2,351.11	4,702.04	45,347.45
EL	84,253.48	539.18	6,367.58	40,312.11	131,472.4
ES	341,173.9	1,725.25	21,582.08	134,263.8	498,745
FI	241,937.8	344.82	44,704.66	50,559.56	337,546.9
FR	427,011.5	1,052.74	55,802.49	66,120.73	549,987.5
HR	34,666.6	122.11	2,843.44	18,881.36	56,513.51
HU	77,660.16	267.31	7,387.17	7,698.05	93,012.69
IE	49,626.07	49.86	4,208.33	16,064.49	69,948.75
IT	20,3611.1	1,581.85	26,779.29	68,562.73	300,535
LT	58,049.76	111.43	3,295.9	3,274.11	64,731.2
LU	2,267.06	9.72	265.39	53.17	2,595.34
LV	54,400.74	36.75	3,576.03	7,456.78	65,470.3
MT	141.17	82.42		91.84	315.43
NL	21,631.25	242.91	11,428.04	3,952.06	37,254.26
PL	260,639.9	842.52	26,108.05	24,650.97	312,241.4
PT	67,242.09	338.71	5,281.99	15,955.23	88,818.02

	PRIMARY SECTOR	MANUFACTURING AND ENERGY	TERTIARY SECTOR, TRANSPORT, UTILITIES AND RESIDENTIAL	UNUSED AND ABANDONED AREAS	TOTAL
RO	221,215.2	538.98	7,271.11	10,004.96	239,030.3
SE	298,876.3	2,183.02	61,469.72	86,673.68	449,202.7
SI	16,971.83	64.62	1,416.48	1,823.75	20,276.68
SK	41,223.08	194.97	3,019.94	4,587.95	49,025.94
UK	148,706.9	965.64	29,309.54	65,431.16	244,413.2
TOTAL	3,261,184	14,323.8	405,746.5	688,923.9	4,370,178

Table 31 : Land use estimates by NUTS0 (percentages)

	PRIMARY SECTOR	MANUFACTURING AND ENERGY	TERTIARY SECTOR, TRANSPORT, UTILITIES AND RESIDENTIAL	UNUSED AND ABANDONED AREAS	TOTAL
NUTS0	U1	U2	U3	U4	
AT	75.0%	0.2%	7.4%	17.4%	100.0%
BE	73.6%	0.7%	21.3%	4.3%	100.0%
BG	83.3%	0.1%	4.1%	12.4%	100.0%
CY	49.5%	0.1%	8.9%	41.6%	100.0%
CZ	85.7%	0.5%	8.1%	5.7%	100.0%
DE	81.0%	0.5%	14.1%	4.4%	100.0%
DK	75.7%	0.3%	15.0%	9.0%	100.0%
EE	84.0%	0.4%	5.2%	10.4%	100.0%
EL	64.1%	0.4%	4.8%	30.7%	100.0%
ES	68.4%	0.3%	4.3%	26.9%	100.0%
FI	71.7%	0.1%	13.2%	15.0%	100.0%
FR	77.6%	0.2%	10.1%	12.0%	100.0%
HR	61.3%	0.2%	5.0%	33.4%	100.0%
HU	83.5%	0.3%	7.9%	8.3%	100.0%
IE	70.9%	0.1%	6.0%	23.0%	100.0%
IT	67.8%	0.5%	8.9%	22.8%	100.0%
LT	89.7%	0.2%	5.1%	5.1%	100.0%
LU	87.4%	0.4%	10.2%	2.0%	100.0%
LV	83.1%	0.1%	5.5%	11.4%	100.0%
MT	44.8%	26.1%		29.1%	100.0%
NL	58.1%	0.7%	30.7%	10.6%	100.0%
PL	83.5%	0.3%	8.4%	7.9%	100.0%
PT	75.7%	0.4%	5.9%	18.0%	100.0%

	PRIMARY SECTOR	MANUFACTURING AND ENERGY	TERTIARY SECTOR, TRANSPORT, UTILITIES AND RESIDENTIAL	UNUSED AND ABANDONED AREAS	TOTAL
RO	92.5%	0.2%	3.0%	4.2%	100.0%
SE	66.5%	0.5%	13.7%	19.3%	100.0%
SI	83.7%	0.3%	7.0%	9.0%	100.0%
SK	84.1%	0.4%	6.2%	9.4%	100.0%
UK	60.8%	0.4%	12.0%	26.8%	100.0%
TOTAL	74.6%	0.3%	9.3%	15.8%	100.0%

Table 32 : Coefficient of Variations (CVs) relative to the estimates of LC by country

	ARTIFICIAL LAND	CROPLAND	WOODLAND	SHRUBLAND	GRASSLAND	BARE LAND AND LICHENS	WATER AREAS	WETLANDS
Country	A	B	C	D	E	F	G	H
AT	4.771	2.061	1.057	4.252	1.696	3.964	6.46	17.865
BE	4.373	2.484	2.661	15.981	2.616	21.205	12.087	29.045
BG	6.898	1.306	0.978	4.615	2.142	7.045	8.931	26.266
CY	8.916	4.986	4.075	4.226	5.794	5.642	35.069	50.582
CZ	4.535	1.445	1.165	12.661	2.153	13.798	7.475	24.824
DE	1.937	0.702	0.631	5.703	1.02	5.124	3.511	7.551
DK	5.894	1.409	3.098	11.904	3.498	14.067	11.541	11.87
EE	12.944	3.945	1.169	14.979	3.976	19.492	4.862	8.404
EL	4.308	1.784	1.12	1.405	1.653	4.545	6.194	10.147
ES	1.993	0.719	0.563	0.862	0.827	1.218	3.556	10.715
FI	5.72	2.106	0.433	3.739	3.51	8.052	1.388	3.348
FR	1.597	0.57	0.545	2.324	0.668	2.172	2.938	8.314
HR	7.778	3.195	1.461	4.35	3.237	15.067	13.136	32.223
HU	5.414	1.195	1.811	9.425	2.493	7.814	6.298	11.162
IE	7.104	5.438	3.499	3.645	1.203	16.186	5.915	5.909
IT	1.794	0.84	0.647	2.097	0.995	2.266	3.264	11.824
LT	8.354	1.974	1.344	16.386	2.416	14.142	7.703	13.064
LU	15.895	10.279	6.45	35.423	8.958	105.025	99.302	
LV	9.798	2.914	0.978	9.776	2.284	11.75	8.31	7.842
MT	19.801	18.471	47.674	28.152	19.958	40.725	0	
NL	4.116	2.9	3.917	12.87	2.274	19.917	3.819	21.151
PL	3.225	0.767	0.677	6.442	1.112	4.867	3.782	7.945
PT	3.893	2.514	1.276	1.952	1.682	4.214	7.686	20.12

	ARTIFICIAL LAND	CROPLAND	WOODLAND	SHRUBLAND	GRASSLAND	BARE LAND AND LICHENS	WATER AREAS	WETLANDS
RO	4.435	0.918	0.755	5.17	1.141	8.159	5.26	5.335
SE	4.486	2.181	0.389	2.47	2.347	2.638	1.276	2.512
SI	12.701	6.633	1.7	13.35	4.178	20.56	25.052	58.598
SK	8.465	2.121	1.408	9.419	3.236	18.665	12.024	60,018
UK	2.495	1.283	1.884	1.402	0.921	6.023	4.423	3.944
EU	0.71116	0.25413	0.17442	0.59615	0.29899	0.83412	0.68815	1.25397

Table 33 : Coefficient of Variations (CVs) relative to the estimates of LU by country

	PRIMARY SECTOR	MANUFACTURING AND ENERGY	TERTIARY SECTOR, TRANSPORT, UTILITIES AND RESIDENTIAL	UNUSED AND ABANDONED AREAS
Country	U1	U2	U3	U4
AT	0.565	20.472	3.399	2.159
BE	1.06	22.028	3.372	9.591
BG	0.46	28.958	4.585	2.875
CY	2.3	72.011	6.951	2.699
CZ	0.474	17.757	3.816	5.095
DE	0.256	8.173	1.283	2.714
DK	0.855	27.613	3.548	5.141
EE	0.818	28.527	8.09	5.574
EL	0.605	12.978	3.476	1.223
ES	0.259	6.961	1.774	0.633
FI	0.436	24.807	1.555	1.835
FR	0.227	9.907	1.216	1.192
HR	1.27	34.775	6.751	2.266
HU	0.541	24.658	3.937	4.396
IE	0.892	58.429	5.472	2.557
IT	0.357	7.697	1.591	0.967
LT	0.447	31.869	5.486	6.252
LU	2.223	110.576	17.863	46.5
LV	0.546	54.689	5,093	3.546
MT	12.183	18.543		17.498
NL	1.362	22.873	2.567	5.785
PL	0.269	12.131	1.942	2.184
PT	0.535	16.272	3.646	2.057
RO	0.192	15.489	3.812	3.391

	PRIMARY SECTOR	MANUFACTURING AND ENERGY	TERTIARY SECTOR, TRANSPORT, UTILITIES AND RESIDENTIAL	UNUSED AND ABANDONED AREAS
SE	0.402	8.494	1.386	1.208
SI	0.967	39.767	8.167	6.947
SK	0.739	28.648	6.315	5.678
UK	0.533	12.555	1.847	1.102
EU	0.09138	2.92071	0.46903	0.37516

Annex 2: Description of the surveyed parameters

Identification		
Items to be filled in (including the item number in the field form)	Observed feature (including the code in the field form)	Short explanation / description
Surveyor ID (A)	Value (Char 8)	Unique identity code of surveyor. To be defined by contractors, according to rules.
Point ID (B)	Value (Char 8)	Unique code of the point as provided by Eurostat.
Access to point		
Date (1)	DD/MM (e.g. 25/03)	Date of observation. Valid date with DD=01..31 and MM=01..12
Start time (2)	HH/mm (e.g. 14:02)	Observation time starts when leaving the car. Valid time with HH=00..23 and mm=00..59
End time (3)	HH/mm (e.g. 14:50 h)	Observation time ends after returning to the car. Valid time with HH=00..23 and mm=00..59
Car park latitude (4)	DD.dddddd	GPS position (WGS84 latitude) of the location where the car was parked
Car park longitude (5 6)	W/E DD.dddddd	GPS position (WGS84 longitude) of the location where the car was parked
Type of observation (7)	(1) Field survey, Point visible, ≤ 100 m Parcel with survey point Surveyors position Distance surveyor – survey point	Regular observation of the point. If point is observed from a distance of > 50 m, thus not at the point directly, the reason needs to be noted in the remarks (fence, high crop etc.).
	(2) Field survey Point visible, >100 m Point visible Fence, barrier, high crop	If the point is not accessible in the field (e.g. wall, high crop), but still visible, observation from distance can be done in the field. The point has to be clearly visible from the closest reachable point and the LC and LU identifiable unambiguously. Example: a point in a large rape field, ready for harvesting, in 300 m distance. The point can be seen in the rape field, but is not accessible

		(as it would destroy the crop). From 300 m distance and on condition that the topography allows seeing the point the surveyor can identify the crop (rape). For all these points the reason needs to be noted in the remarks (fence, high crop, etc.).
	(3) Photointerpretation, Point not visible Fence, barrier, high crop, hedge etc. impeding the point observation Point not visible	If the point is not accessible and not visible in the field (e.g. the point is located in a large inaccessible forest), an interpretation over the orthophoto has to be done in the field. It is also important to indicate if the surveyor notices major differences (e.g. out dated orthophoto) between the land cover and the orthophotos. Those should be noted in the remarks field. If point is photo interpreted, the reason needs to be noted in the remarks (fence, high crop, etc.).
	(4) Point not observed Photointerpretation not possible	If the point is not accessible in the field (e.g. located in forbidden zone) or the parcel with the point location in it is not visible, and no photointerpretation can be done (no orthophotos or bad quality orthophoto; land cover/use cannot be recorded) the point is coded as not observed. If point is not observed because of inaccessibility, orthophoto unavailability or bad quality, the reason needs to be noted in the remarks.
	(5) Marine sea	The point is located in marine sea.
	(6) Out of national territory	The point is located out of the national territory.
GPS coordinate system (8)	(1) WGS84	Normal functioning of GPS using "WGS 84" as coordinate system.
	(2) Problem with signal	No signal, or bad reception. The reason needs to be noted in the remarks.
	(8) Not relevant	GPS was not used. The reason needs to be noted in the remarks.
Point latitude (9)	DD.ddddd	GPS position of the location from which observation is done (WGS84)

Annex 2: Description of the surveyed parameters

Point longitude (10 11)	W/E DD.dddddd	GPS position of the location from which observation is done (WGS84)
Elevation (12)	Value (in m)	GPS value of elevation of the location from which observation is done (in meters above sea level).
Precision (13)	Value (in m)	Indication of average location error as given by GPS receiver (in meters)
Distance to the point (14)	Value (in m)	Indication of the distance between observation location and the LUCAS point as provided by the GPS receiver (in meters).
Comments on the way to the point		
Description of the way to the point (15)	Structured comments Free text comments	If the point can be accessed without any problem, a specific comment is not necessary. However, in all cases where the way to the point was hampered (long distance to walk), a short comment should be given (proposals for an easier approach to the point etc.). This information helps during the next survey and explains for example the effort required to reach the point (duration of the observation). The structured comments should be used whenever possible. For free text the use of English is mandatory. Special characters are to be avoided.
Point observation		
Remarks about point observation (15)	Structured comments Free text comments	Possible remarks are linked to: Problems in the exact location of the point (radical changes in the field compared to the orthophoto, lack of adequate landmarks for orientation, loss of the GPS signal, wrong instructions from the previous survey, etc.), Restricted access to the point, The necessity to make the observation from far away, Point is photo interpreted, Problems in the coding of land cover or land use (e.g. crop recognition etc.). All such short comments should help to explain why the surveyor has taken a certain decision. For free text the use of English is mandatory. Special characters are to be avoided.

Land cover and land use		
Direction (17)	(1) On the point	Point regularly observed.
	(2) North	"Look to the North" rule is applied if the point is located on a boundary/edge or a small linear feature (<3 m wide).
	(3) East	"Look to the East" rule is applied if the point is located on a boundary/edge or a small linear feature (<3 m wide) directed North/South.
	(8) Not relevant	If not applicable.
Radius (18)	(1) 1.5 m	Simple observation of LC within a radius of 1.5 m.
	(2) 20 m	The extended observation window (20 m radius)
	(8) Not relevant	If not applicable.
Parcel area (in ha) (19)	(1) Area < 0.5	Size of the observed parcel is smaller than 0.5 ha.
	(2) $0.5 \leq \text{area} < 1$	Size of the observed parcel ranges between 0.5 and 1 ha.
	(3) $1 \leq \text{area} < 10$	Size of the observed parcel ranges between 1 and 10 ha.
	(4) Area ≥ 10	Size of the observed parcel is larger than 10 ha.
	(8) Not relevant	If not applicable.
Land cover 1 (20)	Land cover code	Coding of land cover according to LUCAS SU LC 2015 classification. BX1 or BX2 are only possible for points with observation type (17) = 3 (photo interpreted)
Land cover 1 Plant species (21)	BXXn CXXn	To be filled for crops (LC1=BXX) classified as "other" in LC1, and also for nurseries (see Annexes and Document C3 for code lists) Also to be filled for Forest Types (LC1=CXX), when parcel area (19) ≥ 0.5 ha, height of the trees at maturity (27) is above 5 meters and the width of the feature (28) is wider than 20m
Percentage of LC1 (22)	(1) %LC1 < 5%	Coverage of LC1 is less than 5%.
	(2) $5 \leq \% \text{ LC1} < 10$	Coverage of LC1 ranges between 5%

Annex 2: Description of the surveyed parameters

		and <10%.
	(3) $10 \leq \%LC1 < 25$	Coverage of LC1 ranges between 10% and <25%.
	(4) $25 \leq \%LC1 < 50$	Coverage of LC1 ranges between 25% and <50%.
	(5) $50 \leq \%LC1 < 75$	Coverage of LC1 ranges between 50% and <75%.
	(6) $75 \leq \%LC1 < 90$	Coverage of LC1 ranges between 75% and <90%.
	(7) $\%LC1 \geq 90$	Coverage of LC1 is 90% or more.
	(8) Not relevant	If not applicable.
Land cover 2 (23)	Land cover code	A second cover can be registered if necessary
Land cover 2 Plant species (24)	BXXn	To be filled for crops (LC1=BXX) classified as "other" in LC1
Percentage of LC2 (25)	(1) $\%LC2 < 5\%$	Coverage of LC2 is less than 5%.
	(2) $5 \leq \%LC2 < 10$	Coverage of LC2 ranges between 5% and <10%.
	(3) $10 \leq \%LC2 < 25$	Coverage of LC2 ranges between 10% and <25%.
	(4) $25 \leq \%LC2 < 50$	Coverage of LC2 ranges between 25% and <50%.
	(5) $50 \leq \%LC2 < 75$	Coverage of LC2 ranges between 50% and <75%.
	(6) $75 \leq \%LC2 < 90$	Coverage of LC2 ranges between 75% and <90%.
	(7) $\%LC2 \geq 90$	Coverage of LC2 is 90% or more.
	(8) Not relevant	If not applicable.
Height of trees at the moment of survey (26)	(1) < 5m	Applicable only in case area size ≥ 0.5 ha and if the LC is CXX or D10 or E10, assess the height of the trees at the moment of the survey.
	(2) ≥ 5 m	
	(8) Not relevant	If not applicable.
Height of trees at maturity (27)	(1) < 5m (2) More/equal 5 m	Applicable only in case area size ≥ 0.5 ha and if the LC is CXX or D10 or E10, assess the height of the trees at maturity.

	(2) $\geq 5\text{m}$	
	(8) Not relevant	If not applicable.
Width of feature (28)	(1) $< 20\text{m}$	If LC is CXX, D10 or E10, the area size ≥ 0.5 ha and height of trees at maturity is above 5 m, assess the width of the feature.
	(2) $\geq 20\text{m}$	
	(8) Not relevant	If not applicable.
Land use 1 (29)	Land use code	Coding of the land use according to LUCAS SU LU 2015 classification
Land use 1 Type (30)	U22Xn U315n	To be filled for the secondary sector (LU1=U22X) and for transport via pipelines (LU1=U315)
Percentage of LU1 (31)	(1) $\%LU1 < 5\%$	Coverage of LU1 is less than 5%.
	(2) $5 \leq \%LU1 < 10$	Coverage of LU1 ranges between 5% and $<10\%$.
	(3) $10 \leq \%LU1 < 25$	Coverage of LU1 ranges between 10% and $<25\%$.
	(4) $25 \leq \%LU1 < 50$	Coverage of LU1 ranges between 25% and $<50\%$.
	(5) $50 \leq \%LU1 < 75$	Coverage of LU1 ranges between 50% and $<75\%$.
	(6) $75 \leq \%LU1 < 90$	Coverage of LU1 ranges between 75% and $<90\%$.
	(7) $\%LU1 \geq 90$	Coverage of LU1 is 90% or more.
	(8) Not relevant	If not applicable.
Land use 2 (32)	Land use code	A second land use can be registered if necessary.
Land use 2 Type (33)	U22Xn U315n	To be filled for the secondary sector (LU2=U22X) and for transport via pipelines (LU2=U315)
Percentage of LU2 (34)	(1) $\%LU2 < 5\%$	Coverage of LU2 is less than 5%.
	(2) $5 \leq \%LU2 < 10$	Coverage of LU2 ranges between 5% and $<10\%$.
	(3) $10 \leq \%LU2 < 25$	Coverage of LU2 ranges between 10% and $<25\%$.
	(4) $25 \leq \%LU2 < 50$	Coverage of LU2 ranges between 25% and $<50\%$.

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	(5) $50 \leq \%LU2 < 75$	Coverage of LU2 ranges between 50% and <75%.
	(6) $75 \leq \%LU2 < 90$	Coverage of LU2 ranges between 75% and <90%.
	(7) $\%LU2 \geq 90$	Coverage of LU2 is 90% or more.
	(8) Not relevant	If not applicable.
Land management, special status and special remarks on land cover/use		
Land management (35)	(1) Visible signs of grazing	If signs of permanent or occasional grazing of the parcel can be found (e.g. animal tracks).
	(2) No signs of grazing	No signs of grazing can be found on the parcel. Note that this is the parcel where the area is assessed, not the homogeneous plot within the expended window.
	(8) Not relevant	If not applicable.
Special Status (31)	(1) Protected	If the area is protected under a special regulation on nature conservation, (e.g. NATURA2000, national schemes). Either signs are visible or local knowledge of the surveyor has to be applied.
	(2) Hunting	If signs of hunting are visible (e.g. hunting reserve signals, signs of hunting, fences around forests, feeding of game, shooting towers, etc.)
	(3) Protected and Hunting	If signs of both special status are visible
	(4) No special status	
	(8) Not relevant	If not applicable.
Special remark on land cover / land use (37)	(1) Tilled and/or sowed	THIS REMARK IS FOR THE REGIONAL / CENTRAL OFFICE: If the parcel is tilled and/or sowed and the crop cannot be recognised: the surveyor has to re-visit the point!
	(2) Harvested Field	The field has been harvested during the current season and the crop is not recognisable by residuals. In that case, LC=F40 and LU= U111
	(3) Clear Cut	If most of trees have been cut down uniformly. In this case LC = DXX or EXX or FXX and LU = U120

	(4) Burnt Area	Refers to a burnt area in any LC. Signs of fire need to be observed. The land cover observed is to be noted.
	(5) Fire Break	Man-made gaps in vegetation (cropland, woodland/forests, grassland, shrub land) in order to stop fires.
	(6) Nursery	Refers to nurseries under forestry use, normally found on forest areas that are classified as LC = CXX and LU = U120. Note that this is different from specialized forest nurseries (B83f).
	(7) No remark	
	(8) Not relevant	If not applicable.
	(9) Temporarily dry	Applies to river beds and lakes which are temporarily dry (lower water level). Normally the limit of the water level should be visible.
	(10) Temporarily flooded	Applies to areas that are flooded at the time of the visit.
INSPIRE Pure Land Cover Classes		
(38) Coniferous forest trees	Value (0-100%) in steps of 5%	Assess the percentage of coniferous trees
(39) Broadleaved forest trees	Value (0-100%) in steps of 5%	Assess the percentage of broadleaved trees
(40) Shrubs	Value (0-100%) in steps of 5%	Assess the percentage of shrubs
(41) Herbaceous plants	Value (0-100%) in steps of 5%	Assess the percentage of herbaceous plants
(42) Lichens and mosses	Value (0-100%) in steps of 5%	Assess the percentage of lichens and mosses
(43) Consolidated (bare) surface	Value (0-100%) in steps of 5%	Assess the percentage of consolidated (bare) surface (e.g. rock outcrops)
(44) Unconsolidated (bare) surface	Value (0-100%) in steps of 5%	Assess the percentage of unconsolidated (bare) surface (e.g. sand)
(45) Other	Value (0-100%) in steps of 5%	Sum of all classes must be 100%. This field covers for the difference, if it exists.
Water management on the field		

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Presence of water management (46)	(1) Irrigation	Indicate if irrigation is present. Irrigation is the process of supplying water to crops by ditches, pipes, sprinklers, or other conduits and conveyances.
	(2) Potential irrigation	When the field is not irrigated but evidence exists that it will be irrigated in the present year, or of having been irrigated during at least the previous years.
	(3) Drainage	Drainage is the removal of excess surface water or groundwater from land by means of ditches, or subsurface drains (if recognizable). Drainage has only to be noted if the ditch bordering the field is linked to the drainage of the field itself and not e.g. only to a road situated next to the field. No photo is needed.
	(4) Irrigation and drainage	Irrigation and drainage are present.
	(5) No visible water management	No visible signs of drainage or irrigation.
	(8) Not relevant	If not applicable. No irrigation photo to be taken.
Type of irrigation (47)	(1) Gravity	Water is delivered to the farm and/or field by canals or pipelines open to the atmosphere and water is distributed by the force of gravity down the field by: - Surface irrigation system (border, basin, furrow, corrugation, wild flooding, etc.) or - Subsurface irrigation pipelines or ditches.
	(2) Pressure: Sprinkle irrigation	Water is delivered to the farm and/or field in pump or elevation induced pressure pipelines and water is distributed across the field by sprinklers (centre pivot, linear move, traveling gun, side roll, hand move, big gun, or fixed set sprinklers).
	(3) Pressure: Micro-irrigation	Water is delivered to the farm and/or field by pressure and distributed across the field by micro-irrigation (drip emitters, continuous tube bubblers, micro spray, or micro sprinklers).
	(4) Gravity/Pressure	Farm delivery and field distribution of irrigation water are a combination of gravity and pressure

		facilities. For example, a valve is used to reduce pressurized water delivered to a farm or field for subsequent distribution by a gravity surface irrigation system.
	(5) Other/not identifiable	
	(8) Not relevant	If not applicable.
Source of irrigation (48)	(1) Well	A hole drilled or bored into the earth providing access to water.
	(2) Pond/Lake/Reservoir	Still water
	(3) Stream/Canal/Ditch	Running water
	(4) Lagoon/Wastewater	Wastewater
	(5) Other/not identifiable	
	(8) Not relevant	If not applicable.
Delivery system (49)	(1) Canal	An artificial waterway used for irrigation.
	(2) Ditch	A long, narrow trench or furrow dug in the ground, as for irrigation.
	(3) Pipeline	A conduit of pipe used for the conveyance of water.
	(5) Other/not identifiable	
	(8) Not relevant	If not applicable.
Soil		
Is this a soil point? (D)	Yes/No (pre-filled)	Indicates whether a point is to be considered for soil collection (Yes) or not (No)
Soil sample taken (50)	(1) Yes	If point belongs to triplet (D = Yes) and the soil sample was taken.
	(2) Not possible	If point belongs to triplet (D = Yes) and it is not possible to collect the soil sample (e.g. point not visible, LU <> U111 or U112, or near a road).
	(3) No, already taken	If point belongs to triplet (D = Yes) but the sample was collected in another point previously visited.
	(4) No sample required	If point does not belong to triplet (D = No)
	(8) Not relevant	If not applicable.

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Soil label (51)	Value (Char 5)	The number of the label placed on the plastic bag with the topsoil sample.
Signs of ploughing (52)	(1) Yes	If there are signs of ploughing in the parcel.
	(2) No	If there are no signs of ploughing in the parcel.
	(8) Not relevant	If not applicable.
Percentage of residual vegetation on the surface (53)	(1) %RC < 10%	If residual vegetation in the surface (assessed on the soil point: 2m radius circle) are less than 10%
	(2) $10 \leq \%RC < 25$	If residual vegetation in the surface (assessed on the soil point: 2m radius circle) ranges between 10% and < 25%
	(3) $25 \leq \%RC < 50$	If residual vegetation in the surface (assessed on the soil point: 2m radius circle) ranges between 25% and < 50%
	(4) %RC ≥ 50	If residual vegetation in the surface (assessed on the soil point: 2m radius circle) cover 50 % or more
	(8) Not relevant	
Percentage of stones on the surface (54)	(1) %S < 10%	If stones on the surface (assessed on the soil point: 2m radius circle) are less than 10%
	(2) $10 \leq \%S < 25$	If stones on the surface (assessed on the soil point: 2m radius circle) range between 10% and < 25%
	(3) $25 \leq \%S < 50$	If stones on the surface (assessed on the soil point: 2m radius circle) range between 25% and < 50%
	(4) %S ≥ 50	If stones on the surface (assessed on the soil point: 2m radius circle) cover 50 % or more
	(8) Not relevant	
Remarks on soil (55)	Structured comments Free text comments	For free text the use of English is mandatory. Special characters are to be avoided.
Transect		
Transect (56)	Transect codes	All LC codifications possible (except AXX codes, which are marked as "A").

		For all land cover areas ≥ 3 m, use relevant land cover codifications (A, BXX, CXX, DXX, EXX, FXX, GXX, HXX). Coding of linear elements below 3 m, irrespective their width (if not stated otherwise), has to be listed according to the linear feature codes (LUCAS 2015 SU LF).
	First entry = LC1 (+ LC2)	Normally the transect starts with the LC1 of the point and LC2 (if existing) is the next entry. Nevertheless there are exceptions to this general rule (e.g. if the “look to the North/East” rule was applied and LC1 does not exist to the East of the point, or for certain codes, like AXX, roads and railways).
	First entry = Linear Feature code (LF)	In case the rule “Look to North/East” was applied due to linear feature: 1st entry will be the linear feature code (one or more, as appropriate). In case of roads and railways, the LF code is used even if they are more than 3m wide. Following codes may not include LC1 (this can happen in case the “Look to the North” rule was applied and the LC1 does not exist to the East of the point).
	First entry = 8	If no transect has been mapped and the point has been surveyed, explain in remarks (57) why the transect could not be mapped.
	Following entries	Use the transect codes as appropriate. Be aware of exceptions (e.g. roads and railways are always classified as linear features; rivers and streams are always coded, even if within the urban (“A”) areas).
	Entry = PI	Use this code when photointerpretation of a not accessible part of the transect starts and when it ends.
	Entry = BX1 or BX2	When photo interpreting, use BX1 or BX2 for temporary and permanent crops (respectively) if the crop cannot be identified.
	Entry = Z	Use this code if a part of the transect cannot be seen nor photo interpreted (e.g. part of the image is covered by a cloud). Must be used always between the PI tags

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	Last entry = X	Transect could not be finished. Explain in remarks (57) why transect could not be finished.
Remarks about the transect (57)	Structured comments Free text comments	Whenever the transect had been (totally or partly) photo interpreted, could not be finished or had not been mapped at all, the reasons have to be noted here. For free text the use of English is mandatory. Special characters are to be avoided.
Photo		
Photo of the Point (58)	(1) Photo taken	The photo of the point is needed to find the point in the next survey. Therefore the photo should contain a recognisable and stable landmark. Use the flag when the point is reached. Never use the flag when the point is observed at more than 100m. The point photo is not to be taken when the point is PI.
	(2) Photo not taken	
	(8) Not relevant	If not applicable. It is the case of a point not observed or photo interpreted.
	(Yes/No) To be anonymized	Tick the box if in the photo there are either people or vehicle license plates (including the plates of the surveyors' car!).
	(Value) Photo ID	File name (in the camera). This information is for use as reference by the surveyor. The renaming of the photos by DMT is automatic.
Photo of Crop/Cover (59)	(1) Photo taken	Photo of the crop/cover should allow the identification of the crop and its phenological stage or the land cover. An adequate zoom (or macro) should be selected.
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
	(Yes/No) To be anonymized	Tick the box if in the photo there are either people or vehicle license plates (including the plates of the surveyors' car!).
	(Value) Photo ID	File name (in the camera). This information is for use as reference by the surveyor. The renaming of the

		photos by DMT is automatic.
North (60) East (61) South (62) West (63)	(1) Photo taken	The landscape photos have to be taken in the four cardinal directions. The obligatory sequence (N-E-S-W) has to be respected.
	(2) Photo not taken	
	(8) Not relevant	If not applicable (e.g. in the case the point is not observed)
	(Yes/No) To be anonymized	Tick the box if in the photo there are either people or vehicle license plates (including the plates of the surveyors' car!).
	(Value) Photo ID	File name (in the camera). This information is for use as reference by the surveyor. The renaming of the photos by DMT is automatic.
Photo of Irrigation (64)	(1) Photo taken	Photo of the irrigation system should allow its identification.
	(2) Photo not taken	
	(8) Not relevant	If not applicable (e.g. in case point is not observed or LU is other than U111 or 112, or no irrigation equipment is visible from the observation point)
	(Yes/No) To be anonymized	Tick the box if in the photo there are either people or vehicle license plates (including the plates of the surveyors' car!).
	(Value) Photo ID	File name (in the camera). This information is for use as reference by the surveyor. The renaming of the photos by DMT is automatic.
Photo of transect (65)	(1) Photo taken	Photo of the transect has to be taken towards the LUCAS point.
	(2) Photo not taken	
	(8) Not relevant	If not applicable (e.g. if the point was not observed or the transect was completely photo interpreted)
	(Yes/No) To be anonymized	Tick the box if in the photo there are either people or vehicle license plates (including the plates of the surveyors' car!).
	(Value) Photo ID	File name (in the camera). This information is for use as reference

Annex 2: Description of the surveyed parameters

		by the surveyor. The renaming of the photos by DMT is automatic.
Photo of soil (66)	(1) Photo taken	In case a topsoil sample has been taken, take a photo of the LUCAS point with the bag and as many as possible of the 5 holes clearly visible.
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
	(Yes/No) To be anonymized	Tick the box if in the photo there are either people or vehicle license plates.
	(Value) Photo ID	File name (in the camera). This information is for use as reference by the surveyor. The renaming of the photos by DMT is automatic.
Additional photos (67)	Type of photo	These additional pictures can be used to illustrate conflict (why a point has not been reached) or complement the mandatory photos. Types can be: point access, point observation, land cover, land use, transect, soil, water management or other
Remarks about photos (68)	Structured comments Free text comments	Whenever there were problems in taking of photos the reasons have to be noted here. For free text the use of English is mandatory. Special characters are to be avoided.

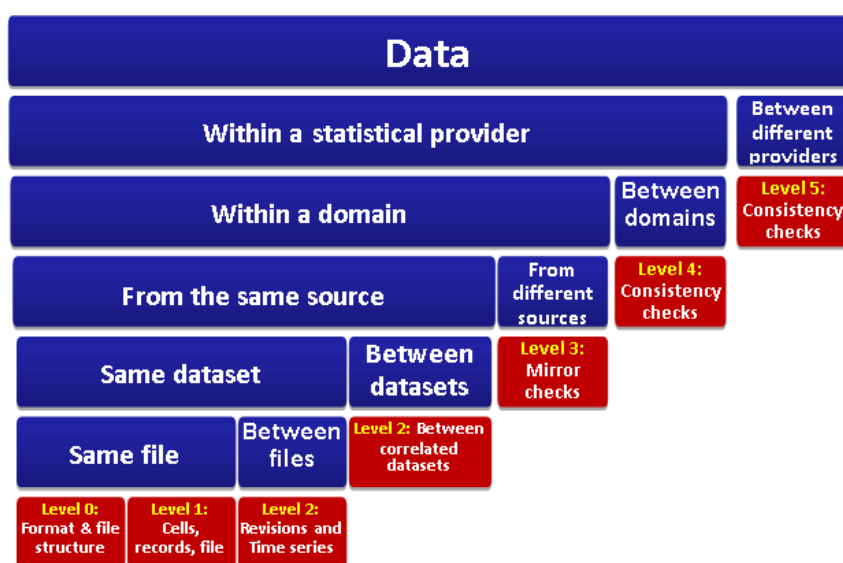
Annex 3 : Ongoing tasks for the validation of LUCAS's microdata

Data Validation is an activity verifying whether or not a combination of values is a member of a set of acceptable combinations. (in "Methodology for data validation"¹¹)

According to the authors, the set of 'acceptable values' may be a set of possible values for a single field. But under this definition it may also be a set of valid value combinations for a record, column, or larger collection of data. We emphasize that the set of acceptable values does not need to be defined extensively. This broad definition of data is introduced to make data validation refer both to micro and macro (aggregated) data. Data validation assesses the plausibility of data: a positive outcome will not guarantee that the data is correct, but a negative outcome will guarantee that the data is incorrect.

The relation with statistical data editing must be clarified. In the Generic Statistical Business Process Model (GSBPM) the process 'Validate and Review' is distinguished from the process 'Edit and Impute'. In the 'Validate and review phase' there is data validation as it is previously described, while in the 'edit and impute phase' it is placed the action of 'changing data'. This is the idea underlying the validation definition. (in "Methodology for data validation").

Figure 17 : Validation steps according to the ESSNET Validation Manual



¹¹ https://ec.europa.eu/eurostat/cros/content/methodology-data-validation-10-handbook-revised-edition-june-2016_en

Level 0: consistency of the data with their expected IT requirements

For these quality checks only the structure of the file or the format of the variables is necessary as input and no data checks are performed.

	Y/N	OBS	Next action
the file has been sent/prepared by the authorised authority (data sender);	Y	Finished	
the column separator / end of record symbol are correctly used	Y	Finished	
the file has the expected number of columns (agreed format of the file)	Y	Finished	
the column have the expected format of the data (i.e., alphanumeric, numeric, etc.)	Y	Finished	
the file complies to the naming convention (original)	Y	Finished	
the file complies to the naming convention (derived datasets)	pending	No naming convention was defined for derived datasets	Define naming convention for derived datasets

Level 1: consistency within the data set

Only the (statistical) information included in the file itself is needed. During the LUCAS Survey data collection, the DMT Tool already includes 218 embedded checks. This increases the quality of the data by avoiding systematic errors.

	Y/N	OBS	Next action
the records conform to the latest business checks included in the DMT Client Business rules (v.1.1.9)	Pending	Presently not all points have been checked against the latest version of the business rules (U:\LUCAS\010 CONTRACTS\2014\08441.2014.002-2014.408-LUCAS2015-LOT7-A1\003-FollowUp\004-Deliverables\Contrl\LUCAS_DMT_PARAMETER_20160301_19.mdb). It is known to which version a point was checked against.	A full check has to be run on all records.
the records conform to the checks indicated on the issue log	Pending	Presently only a minor part of the 149 [update 2016.10.17] bulk checks needed which were identified in the log was performed. U:\LUCAS\010 CONTRACTS\2014\08441.2014.002-2014.000-LUCAS2015\010-QualityChecks\24.Issue_Log.LUCAS2015_ESTATQC.20150618.xlsx	Prioritize, classify (see Annex A of the methodology handbook), and run the checks. Identify further needs for additional checks.

Level 2: consistency with other data sets within the same domain and within the same data source

Validation levels 2 is concerned with the check of consistency based on the comparison of the content of the file with the content of "other files" referring to the same statistical system (or domain) and the same data source.

Level 2A

In validation level 2A the other files refer to other versions of exactly the same file. In this case the quality checks are meant to detect "revisions" compared to previously sent data. Detection and analysis of revisions can be useful for example to verify if revisions are consistent with outliers detected in previous quality checks (corrections) or to have an estimate of the impact of the revisions in the "to be published" results, for the benefit of the users.

	Y/N	OBS	Next action
the records in latest version include all the corrections of the previous versions	Not applicable	Presently we are dealing with the raw micro data, not yet edited. May become relevant at a later stage	Not applicable

Level 2B

In validation level 2B, "other files" can be versions of the same data set referring to other time periods. These checks are usually referred to as "time series checks" and are meant to verify the plausibility of the time series.

	Y/N	OBS	Next action
the records are plausible against data from LUCAS SU 2006	pending	Panel points where issues were identified by the surveyor are coded (BP codes), but no action was performed	Quantify number of points and prioritize
the records are plausible against data from LUCAS SU 2009	pending	Panel points where issues were identified by the surveyor are coded (BP codes), but no action was performed	Quantify number of points and prioritize
the records are plausible against data from LUCAS SU 2012	pending	Panel points where issues were identified by the surveyor are coded (BP codes), but no action was performed	Quantify number of points and prioritize

Level 2C

In validation level 2C the "other files" can refer to other data sets from the same data provider, referring to the same or other correlated time periods. Sometimes a group of data sets (same country, same reference period) is sent at the same time. For example: an enterprise included in the admin data must

be part of the predetermined population (from the Business Register), three files could be sent at the same time, from the same country and referring to the same time period: one file includes data for "females", one for "male", one for "total". Consistency between the results of the three files can be checked. Another example is for results from annual data sets can be compared with the results of the corresponding quarterly data sets.

	Y/N	OBS	Next action
the records are plausible against data in the Master 2015 (strata)	pending	compare observed data against strata in the Master 2015	Quantify number of points and prioritize
all points in the LUCAS 2015 survey table are part of the Master 2015	Y	Finished	

Level 3: consistency within the same domain between different data sources

Validation levels 3 is concerned with the check of consistency based on the comparison of the content of the file with the content of "other files" referring to the same statistical system (or domain) but with a different data source.

For instance the "other files" can refer to the same data set, but from another data provider (e.g., other countries of the ESS). Mirror checks are included in this class. Mirror checks verify the consistency between declarations from different sources referring to the same phenomenon, e.g., export declared by country A to country B should be the same as import declared by country B from country A.

	Y/N	OBS	Next action
the records are plausible against data in the same domain coming from different data sources	Not applicable	the described case does not apply to LUCAS Survey raw micro data	Not applicable

Level 4: consistency between separate domains in the same data provider

Validation level 4 could be defined as plausibility or consistency checks between separate domains available in the same institution. The availability implies a certain level of "control" over the methodologies by the concerned institution. These checks could be based on the plausibility of results describing the "same" phenomenon from different statistical domains. Examples: unemployment from registers and from Labour Force Survey, or inhabitation of a dwelling (from survey of owners of houses and dwellings vs. from population register)

	Y/N	OBS	Next action
the records are plausible against data in separate domains in Eurostat	Not applicable	this validation is of interest for aggregated results (e.g. crop statistics, forest statistics, transport networks)	Not applicable

Level 5: consistency with data of other data providers

Validation level 5 could be defined as plausibility or consistency checks between the data available in the data provider (institution) and the data / information available outside the data provider (institution).

This implies no "control" over the methodology on the basis of which the external data are collected, and sometimes a limited knowledge of it.

	Y/N	OBS	Next action
the records are plausible against data of CLC	pending	possible against existing data of CLC00, CLC06 and CLC12	Contingency table of LUCAS x CLC ongoing
the records are plausible against data of OSM	pending	possible but according to previous trials still of low value as there are topological issues in the available OSM datasets	None for the moment
the records are plausible against data of the Urban Audit	pending	possible but probably of low interest as this is normally an aggregation of CLC classes	None for the moment
the records are plausible against data from EEA Transitional waters	pending	partly done, issues are identified	Prepare for correction
the records are plausible against data from EEA Coastal waters	pending	partly done, issues are identified	Prepare for correction
the records are plausible against data from EBM NUTS	pending	partly done, issues are identified	Prepare for correction