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2018

LUCAS 2018

(Land Use / Cover Area Frame Survey)

Technical reference document C1
Instructions for Surveyors

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(up to level 3)

1 Table of Contents

DOCUMENT CHANGE RECORD			
ISSUE	DATE	CHANGE AUTHORITY / AUTHOR	REASON FOR CHANGE AND AFFECTED SECTIONS
V0.1			New chapter on Copernicus. New chapter on grassland.
V0.2	2016.12.22	EUROSTAT E4.LUCAS / HR	New chapter for erosion and soil. Integration of the new soil manual. Grassland and Water management moved to respect the order of the field form and workflow.
V0.3	2017.05.05	EUROSTAT E4.LUCAS/BE	Revise structure. Finalise new chapters.
V0.4	2017.12.06	EUROSTAT E4.LUCAS/BE	Fine tuning
V1.0	2018.02.20	EUROSTAT E4.LUCAS/BE	Revision after project manager training
V2.0	2019.02.14	EUROSTAT E4.LUCAS/BE	Integrated revised Copernicus chapter, errata
V3.0	2019.02.22	EUROSTAT E4.LUCAS/BE	Integrated FAQs from LUCAS survey 2018
V4.0	2023.02.20.	EUROSTAT E4.LUCAS	Revised images taken from LUCAS 2022 survey C1 document

2 Scope

The aim of this document is to provide instructions to the surveyor during the Land Use/Cover Area frame Statistical survey 2018 (LUCAS survey 2018).

The LUCAS survey serves to collect land cover/land use, agro-environmental and soil data by field observation of geographically referenced points. The surveyor documents its observations by filling in the field form, by taking photographs and by taking soil samples. All the data is stored in the Data Management Tool (DMT).

The document therefore covers the following topics:

- Safety
- Quality of the work
- Helpdesk
- Equipment
- Preparatory work
- Filling in the field form: step by step
- Annexes:

  Record descriptor, code lists, possible combinations of LC/LC – LU/LU – LC/LU, unlikely changes (LC, LU), EUNIS habitat classification, decision trees

This document is part of a series of technical reference documents defining the framework of the Land Use / Cover Area frame statistical Survey (LUCAS):

- C1: Instructions for surveyors
- C2: Field Form and Ground Document (template)
- C3: Classification
- C4: Quality control procedures
- C5: Plant Identification Guide
- C6: Grassland Identification Guide

Furthermore document "D1 – DMT user guide" is the guide for the use of the Data Management Tool (DMT) that allows entering data collected in the field into the central database:

3 Introduction

LUCAS stands for Land use and land cover area frame survey. It is a survey that takes place in the field, and in the current form it has been run every 3 years since 2009.

LUCAS survey 2018 can be divided in 3 parts:

- LUCAS core
- LUCAS specific module on grassland (Grassland module)
- LUCAS specific module on soil (Soil module)

LUCAS core includes the identification of the point, different aspects of land cover and land use information and land and water management and a new part on EUNIS and a test for Copernicus (94013 points).

The grassland module is a test module on 3734 points, to assess the practical and scientific feasibility to collect the relevant information.

The soil module, which takes place in 26,014 LUCAS points, consists of different parts. In all points a topsoil sample is collected either on its own (standard soil sample), or with the bulk density sample (9000 points). Furthermore a sample for biodiversity is collected in 1000 points and in 1470 points specifically selected the extend of the organic horizon is assessed.

The feasibility of the standard LUCAS core part and the standard topsoil sample have been assessed over the years and a thorough quality control takes place for these parts. On the other hand the grassland module, some smaller additions to the core part (EUNIS, Copernicus) and the new parts of the soil module have been introduced for testing purposes. The practical feasibility and in some cases the scientific feasibility of these modules are to be assessed during the LUCAS survey 2018. It is therefore of uttermost importance that this part of the survey is carefully planned and the assessment is done thoroughly. However the quality assessment is not as strict as in the other parts and aims at assessing the general plausibility of the results. On the other hand a request for correction is always possible.

To assess the scientific validity of the grassland module a detailed vegetation survey will take place in a selected number of points in parallel to the LUCAS survey.

The data collected during the LUCAS survey is used to produce statistical tables on land cover and land use, it is used for modelling agro-environmental aspects and it is used as ground control for satellite images.

The drafting of the document was part of the Eurostat contract N° 40301.2011.004-2011.256 on Land Use/Cover Area frame statistical Survey (LUCAS) 2012 Lot 6 Technical Assistance & Quality Control entrusted to LuxSpace Sàrl and initially developed by Prof. Dr. Hans Peter Piorr (University of for Sustainable and Applied Sciences – Eberswalde).

For the LUCAS 2022 field survey the document has been revised and updated mainly based on the rich archive of LUCAS images 2006-2018. The task has been performed on behalf of EUROSTAT by the LuxSpace Sàrl LUCAS 2022 Team and by the EUROSTAT LUCAS Team.

More information on land cover/use statistics and on LUCAS in general can be found on the Eurostat website: https://ec.europa.eu/eurostat/web/lucas/data/primary-data/2018
https://ec.europa.eu/eurostat/web/lucas

The LUCAS survey is co-ordinated by the Statistical Office of the European Commission (Eurostat).

4 Safety

Safety is of paramount importance and adequate safety measures need to be taken, as surveyors are sometimes in remote areas. The surveyor shall take into account that even if LUCAS points are chosen to be rather close to the road network, sometimes longer walks are needed. If the point can only be reached by foot, and the walking time for reaching the point and coming back to the car is estimated as lasting more than 1 hour (excluding time of the survey), the point is considered as inaccessible and will not be visited.

This will mean that the surveyor may have to go to areas where there may not be telephone or radio communication, with little or no traffic, sometimes more than one hour away from medical or emergency support, or where rough terrain, dense vegetation or other features make it difficult to obtain help in case of need.

At least one more person should be informed of the daily planning of the surveyor. This will normally be the role of the supervisor.

The surveyor and his supervisor shall take action to eliminate, minimize, avoid or report any hazards of which they are aware and follow occupational, safety and health instructions.

Safety devices and personal protection equipment shall be used at all times (e.g. reflecting jacket, flash light, etc.). This includes appropriate dress standards for the type of work and climate conditions (resistant shoes/boots, raincoat, cap, etc.).

The surveyor shall not place his or other people's safety or health at risk. They must accept appropriate medical advice where relevant and disclose to the supervisor any limitation imposed by their health that may affect their ability to participate safely in any field work activity. This obligation applies both before and during field work. Information provided must be treated as confidential information.

Everyone participating in field work must be adequately insured.

Information on any incident has to be transmitted to the supervisor as soon as possible, so that he can take appropriate measures, including informing other relevant parties about the types of risks encountered. Any relevant information will be published on CIRCABC.

5 Quality of the work

The elements of the good quality fieldwork are the following:

- correct and continuous use of GPS and orthophotos
- precise location of the point in the field
- correct and complete observation
- compliance with the instructions given in this document
- filling the questionnaire with readable marks/letters
- adding relevant remarks.

Besides the mandatory remarks foreseen in the workflow it is also very important to document every unusual circumstance in the **remarks** fields and to justify the decisions of the surveyor.

It is mandatory to use structured comments whenever possible.

No special characters should be used to fill in free text fields. The use of English is mandatory in case of free text comments.

The work is accepted only if the field form is precisely filled in with remarks as well, and if all the relevant photos are taken.

The fieldwork must be checked at least once by either the Central Office (CO) or the Regional Offices (ROs) – where existing - using the photos and the recorded GPS tracks taken by the surveyor.

More details on quality control can be found on document C4.

6 Helpdesk

Support on technical questions is available throughout the survey.

A general helpdesk is managed by the entity responsible for the external quality control together with Eurostat.

A specific helpdesk for questions related to grassland and one for IT questions related to the DMT software are also available.

The separate helpdesks for grassland and for IT questions assure the direct support of experts in these specific fields.

Contact details will be provided at the beginning of the project.

7 Equipment

7.1 Equipment for LUCAS core

The following items are always needed for the survey:

- Accreditation document (Document A1) and ID card
- Surveyors' instructions (Document C1 and Annexes)
- Blank field forms and Ground Document (Document C2)
- Classification (Document C3)
- Appropriate device to access the data management tool (DMT) 2018
- Mobile phone
- Hand-held GPS navigation device for:
    - locating the point and transect end point,
    - saving and exporting the points and the track the surveyor follows daily.
- Digital camera + memory cards
- Extra batteries
- Magnetic compass
- Point marker/flag
- Pencil or water resistant pens + writing pad
- Pre-addressed envelopes
- Plain DVDs / CDs / USB sticks
- 12V rechargers
- Back pack
- Safety equipment (e.g. first-aid kit, reflective coat, lantern, whistle, insect repellent, etc.)
- Suitable vehicle(s) to reach the point, including through unpaved roads (e.g. rented 4x4 car, motorbike)
- Car navigator with licensed maps of the survey area
- Road maps for efficient route planning

- Other, useful documents (charts, crop calendars etc.)

The **ID card and the accreditation document** are necessary for the surveyor to explain and justify his mission and to present it to the farmer or land owner, or local authorities.

The present document (Document C1) provides guidance on the survey implementation and gives answers to many technical questions on LUCAS. The **decision tree** (Annex 10.10) provides guidance for the correct survey sequence and a summary of the **information to be collected** can be found in Annex 10.1).

Both a detailed version (Document C3) and a short version of the **LUCAS classification** are given to the surveyor. Document C3 describes the land cover and land use categories precisely, while the short versions (Annexes 10.2) give only the list of codes and titles of categories.

A **suitable car** (4x4 if necessary) equipped with a **car navigation system** enables the surveyor to approach the point if roads are accessible roads.

A **hand-held GPS receiver** is to be used to approach the point. It is mandatory to register in the field form the GPS coordinates (Lat/Long) of the position of the car park, the position from which the surveyor observes the point on the ground and to record the GPS tracks.

The **ground document** includes a **topographic map** (the most widely used types of maps with a scale usually between 1:10.000 and 1:200.000) and an **orthophoto** (an orthorectified aerial photograph, that is, free from the distortion caused by inclination angle and relief, with a scale that normally, varies between 1:10.000 and 1:2.000)**.** The ground document is the base for the surveyor to locate the point and to estimate the area of the parcel the point is located in.

The surveyor will use a **clipboard** on which survey documents are fixed in order to be used in the field (e.g. a map for orientation or the **ground document**) and for filling in the **field form**.

A traditional **magnetic compass** has to be used to indicate a particular direction. North is indicated on both the topographic maps and the orthophotos. With the help of the compass, the surveyor can correctly orient the map and the orthophoto before examining them. Moreover, the compass is helpful to correctly take the photos in the cardinal directions (N, E, S, W) and collecting soil. Note that the GPS compass alone is not suitable for these tasks.

The **digital camera** (minimum 2 mega pixels) is used to take pictures of the point, the crop and the N, E, S, W landscape photos as well as the irrigation, grassland, soil and additional pictures. It is recommended to use digital cameras equipped with GPS to record the position of the photo taken.

A **portable computer** shall be put at disposal of the surveyor to enter the collected data into the LUCAS database using the Data Management Tool (DMT). The DMT integrates automatic controls and checks enabling the surveyor to deliver complete and formally correct data.

Charts, diagrams, decision keys, crop calendar and classification overviews etc. can be copied into a double-page, which can be plasticized as a visual help for the surveyors.

7.2 Equipment for the LUCAS Grassland module

Equipment needed in addition to the tools listed in chapter 7.1 Equipment for LUCAS core are as follows:

- Blank field forms for grassland

- Measuring stick (1 m)

7.3 Equipment for the LUCAS Soil module

Equipment needed in addition to the tools listed in chapter 7.1 Equipment for LUCAS core are as follows:

7.3.1 Standard soil sample

For the standard soil sample the equipment is as follows:

- Spade with a blade of approx. 20*20 cm^2,
- Trowel (small spade),
- Bucket,
- Meter stick,
- Robust plastic bags (2 per soil sample, one 25x40cm and one 40x60cm) and ties to close the bags,
- Box to store and transport the samples,
- Mail boxes to send samples to regional/central offices (suitable for 2.5kg to 5kg),
- Plastic labels (2 per point),
- Garbage bag.

7.3.2 Bulk density

In addition to the equipment needed for the standard soil sample, in case bulk density is also to be assessed (assessment done on 9000 points), the following equipment is needed:

- Metallic rings,
- Plastic bags and ties (for all sub-samples: in total 2 small plastic bags per point (for Portugal: 3) and 1 big plastic bag),
- Plastic labels: for all sub-samples: 3 labels in total per point (for Portugal 3 labels per point)),
- Scale,
- Flat-bladed knife,
- Rubber mallet,
- Wood block or similar.

Plastic bags and plastic labels listed here replace the material used for the standard soil sample,

7.3.3 Biodiversity sample

In addition to the equipment needed for the standard/bulk soil sample, in case a biodiversity sample has to be taken (sample to be taken in 1000 points), the following equipment is needed:

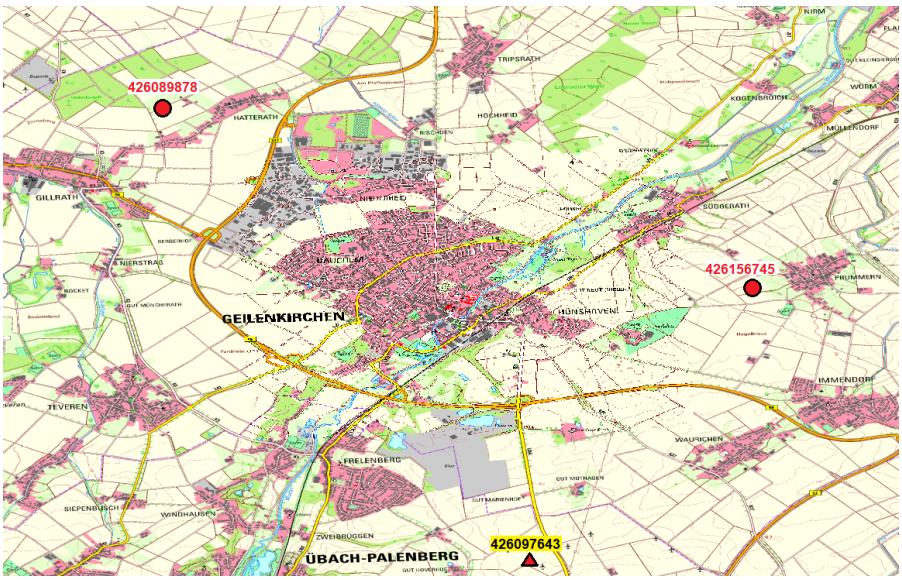
- Small plastic jar as container for the biodiversity sample (one for each biodiversity sample),
- Plastic gloves (2 gloves for each point with biodiversity sample),
- Plastic labels (2 labels per point),
- 1 insulated box (polystyrene) per biodiversity sample (for shipping biodiversity samples),
- 4 freezer packs per biodiversity sample (for shipping biodiversity samples),
- Packing tape to close the insulated box (for shipping biodiversity samples),
- Address label for the insulated box (for shipping biodiversity samples),
- Alcohol wipes,
- Water bottles (1 l per point).

7.3.4 Organic horizon

No additional equipment, in addition to the one listed under standard soil sample, is needed to assess the depth of the organic horizon. This assessment concerns 1470 points.

8 Preparatory work

The surveyor has to prepare his itinerary before going out in the field. This preparation is essential for the efficient conduction of the survey. It is recommended to use an up to date road map to find the most suitable access to the point. GPS can be helpful as well. The surveyor needs to identify the different problems or obstacles he will have to deal with during his journey.

Daily route planning increases efficiency: Small scale topographic map including LUCAS points	It is practical to use a small-scale topographic map to plan the travelling. The order of the points to be visited on the same day should be planned in advance to find the optimal route. Moreover, a quick photo analysis of the orthophoto, a look at the results of the previous survey, or additionally looking at the point on free accessible earth observation programs like Google Earth, is helpful before starting the work.
	 © Geobasis NRW, Digitale Topographische Karte 1:25 000 (TIFF), dtk25_32296_5648_4_nw_col.tif, Data licence Germany - Zero - version 2.0 Edited: addition of the 3 plausible LUCAS points Figure 1 Example of a topographic map including the LUCAS points to be observed
Be prepared for difficult conditions	The surveyor should be aware that any kind of field conditions may be encountered at the point. Sometimes difficult access to the point is not visible on the orthophoto. Adequate shoes and clothing are necessary. Even if the survey is in the spring and summer, clothing which covers the whole body might be necessary. A proper bag should be taken to protect the equipment and the documents in case of rain.
Be aware of handling of GPS	The instructions for the camera and the GPS should be studied and their use should be practised before the fieldwork. Spare batteries and memory cards must

and digital camera	be supplied to surveyors.
GPS	Before going out into the field, the coordinates of the points have to be uploaded into the GPS (It can be done by the contractor, centrally, or by the surveyors). Do not only rely on the GPS. Orthophotos and previous field forms should be examined before the field work, to become generally familiar with the natural and man-made elements. As orthophotos are taken from the air, the view of the landscape is quite unusual at first sight. Roads and tracks can be recognized easily. Plan the change of the battery in GPS so that no tracks are lost.

9 Filling in the field form: step by step

Filling in the form step by step, focuses on filling in the form in the field. Fields are presented in the order of appearance in the field form (C2), which sometimes might not correspond to the order of filling, e.g. the end time of the survey is compiled at the very end but in the field form it appears almost at the beginning, next to the start time.

If the point is photointerpreted in the office (point is part of the PI sample or has been classified as ex-ante) or if the point is photointeroreted in the field using orthophotos or satellite images some fields cannot be compiled, others can sometimes be filled in. As a principle during the photointerpretation in the office as much information as possible should be collected.

Please also check the flow-chart.

Recurring processes:

1) Remarks

When a comment is needed the surveyor always has to select a structured comment, then for some of these structured comments it is possible to add a "free text" comment.

For free text the use of English is mandatory. Special characters are to be avoided.

2) Photos

When a photo is required and cannot be taken or if there is a problem with the photo, a comment is required.

The photo ID needs to be recorded.

9.1 Section: Identification

This part of the field form is partly prefilled.

If the point is identified (pre-filled information) as being part of the PI extension (D) or as being ex-ante (E), it is not to be assessed in the field. The point will be assessed in the office through photointerpretation of available orthophotos and/or satellite images.

PI extension points are points that are part of the PI sample.

Ex-ante points are points that are part of the in-situ sample and in principle have to be visited in the field. If however there are evident reasons that make a visit in the field absolutely impossible, known a posteriori (e.g. access to the area is forbidden because of the risk of forest fires, area of landmines), then the point can be set to ex-ante and will not be visited in the field. This is to be seen as an exceptional measure.

User ID (A)	The surveyor's ID number, corresponds to the number given to the surveyor by the Central office and uploaded to the USER table,
Point ID (B)	The point ID: it is printed on the maps and orthophotos and loaded into the GPS. Might be pre-filled
Point altitude (C)	The theoretical elevation of the point, as determined in the LUCAS database (the LUCAS master). Pre-filled

Following appropriate preparation, the surveyor has to get as close to the point as possible by car. Most of the points can be reached only by foot.

When the surveyor reaches the car park he turns on the GPS and starts the GPS tracking (if not already on). The GPS track record should include only the route after leaving the car and not the car trip. Nonetheless if the memory capacity of the GPS allows it, the all day trip can be recorded.

The survey starts as the surveyor starts to approach the point by foot, so this is the starting time of the survey, which has to be recorded on the field form, together with the date. At the end of the survey, the end time is to be recorded. In case the survey duration is below 15 min or above 1h 15 min a comment is needed.

Date and time (7, 8, 9)	Date (7), start time (8) and end time (9) are to be registered here.

9.2 Section: Access to point

9.2.1 Fields: Access to point

Register the location of the car park

Car park coordinates	Don't forget to register the car park coordinates (11, 12, 13). This will help surveyors reach an appropriate location for parking the car in a future survey.

After leaving the car, the GPS is at first the most useful tool for orientation.

The surveyor will need to reach the point itself – or get as close as possible - for examining the environmental parameters, like estimation of cover percentages etc.

When the surveyor has gotten as close as possible to the theoretical LUCAS point all relevant information on the location of the LUCAS point has to be filled in: GPS coordinate system (14), precision (15), elevation (16), co-ordinates of the point (17, 18, 19) and distance to point (20) (all these from the GPS device) in the field form.

The DMT will automatically calculate the value for the field "GPS calculated distance to point" (21) based on the GPS coordinates of the point reached, the theoretical LUCAS point and the GPS precision and compare it to the distance to point inserted by the surveyor.

The reading of the GPS coordinates of the point can be done either at the beginning or at the end of the point assessment (so in any case before doing the grassland and/or the soil assessment, as this includes a change of location). As the precision of the GPS coordinates increase over time, a reading at the end is more precise.

If the GPS cannot receive the signal, select option 2 "Problem with signal" in field 14: GPS coordinate system. In this case neither the coordinates of the parking nor the co-ordinates of the point will be filled in.

Remark needed:

In this case ("Problems with signal") the surveyors have to note down in the comments field the reason for not having the GPS signal.

Remark needed:

If the point can be accessed without any problem, a specific comment on "Description of the way to the point" is not necessary. However, in all cases where the way to the point was hampered (long distance to walk), a short comment is to 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 (F) should be used whenever possible.

Field F "Way to the point" provides a description of the way to the point from previous campaigns (if available).

9.2.2 How to find the exact LUCAS point

Use the orthophoto for approaching the point	 (Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0)). Edited: addition of the EW of observation *Figure 2* When the surveyor is close enough, the larger-scale topographic map can be used together with the orthophoto and the previous survey photos to locate the point.

	There are several stable elements marked on a topographic map, like water-towers, bigger roads, rivers, lakes, look-out towers, etc. which can be a good reference for orientation, as well as the point photo. More detailed topographic features can be found on the orthophoto. The points are marked on the orthophoto and the topographic map by a specific sign, i.e. the intersection of two bars resulting in a cross. To locate a point, the surveyor must give priority to fixed landmarks rather than to uncertain ones, such as limits of parcels. In regions where agriculture is receding, the border of a forest can gain ground over fields or meadows and can't be used as a landmark.
Point shown on the orthophoto is the reference location	The exact location of the point can be identified by using the GPS, the compass, the orthophoto and the topographical map together. The GPS signal might show a relevant deviation from the orthophoto (e.g. in case only very few or bad signals are received). Also, the topographic map might not be up-to-date. The orthophoto has to be taken as main reference. In most instances, it is easy to orientate, especially when the image is a recent one, by comparing the image and the more stable landmarks such as roads or buildings.
Check the enlarged subset for exact location of the point	  (Source of the ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0). Edited: addition of the EW of observation) *Figure 3* *Figure 4* The ground document includes an enlarged subset of the orthophoto enabling the exact location of the LUCAS observation point.
Imagery date and land cover/use changes.	If the orthophoto is an old one, the surveyor has to pay attention to landscape modifications. For instance, an isolated tree or a hedge or a dirt track may have been removed. Buried - and invisible - tanks may have replaced water towers shown on a topographic map. In any case, difficulties to exactly locate the points are to be noted on the field form. In such a case (the old/unclear orthophoto does not show the current land cover/use), the surveyor tries to reach the point as close as possible with the help of the GPS device. A structured comment should be added in the remark field for helping quality check.
Quality	To ensure the highest quality of the survey, the above-mentioned tools for locating

	the point have to be used together!

9.2.3 Difficult cases in reaching the point

In specific circumstances it can be impossible to reach the point (e.g. excess of time needed to reach the point, access restrictions…).

9.2.3.1 Point is at more than 30 min walking distance

If the point can only be reached by foot, and the walking time for reaching the point and coming back to the car is estimated as lasting clearly more than 1h (excluding time of the survey), the point is considered as inaccessible and not visible.

In any case the surveyor has to take an additional (conflict) photo to document impossibility to reach the point in the set time frame.

On the point reached he has to take all the landscape photos and to photointerpret the LUCAS point according to the rules. He shall note the GPS coordinates of the point where he takes the photos.

If the point can only be reached by foot, and the walking time for reaching the point and coming back to the car is not clear, the surveyor will try to reach the point.

If at a certain moment it becomes clear that it is not possible to reach the point, the surveyor has to take an additional (conflict) photo to document impossibility to reach the point in the set time frame.

On the point reached he has to take all the landscape photos and to photointerpret the LUCAS point according to the rules. He shall note the GPS coordinates of the point where he takes the photos

9.2.3.2 Point is located in restricted or inaccessible area

If the point is located in a restricted or inaccessible area such as: a large wetland area, an impenetrable natural forest or in a forbidden zone (military camp) or in a fenced pasture for fighting bulls (signs, fences etc.) or privately owned zones with clearly restricted access, the surveyor cannot reach the point. In the last case the surveyor should try to get access permission from the owner.

These points have to be either observed by approaching the point as close as possible so that the surveyor can see the point (if the point is visible from the distance) or they have to be photointerpreted in the field (if the point is not visible). See the chapter 9.3.1 on "Observation of the point" for further information on the photointerpretation in the field.

9.2.4 Panel points

Panel points are points that were visited in more than one campaign (be it in consecutive campaigns or not).

These points are used to derive information on land use and land cover change, so it is of utmost importance that they are comparable over time.

If the point observed in a previous campaign was located differently, the surveyor has to assess the correct LUCAS point and add a remark.

9.2.5 Care to be taken

Private property	When the surveyor enters fields or forests, he is usually on private property. He must be able to explain his mission and present his accreditation documents if

	asked by the farmer or owner of the property. If a point is in a building or a parcel next to it and enclosed by a wall, the surveyor will ask permission to enter or stay outside to observe the point.
Don't damage the existing crops	The surveyor must not damage fences or crops. In order to avoid damaging high crops, the surveyor should move along rows between the plants and in tractor tracks for its assessment.

9.3 Section: Point observation

9.3.1 Observation of the point

It needs to be stressed that land use and land cover must be observed **at the LUCAS point and from a position as close to the LUCAS point as possible.**

The land cover and land use (as well as the other information) to be assessed refer to the exact LUCAS point.

Only within the section on "Copernicus" additional information on the point the surveyor reached is requested.

9.3.2 Field: Type of observation (24)

9.3.2.1 Out of national territory/EU28, (options 5, 6)

In case the point falls out of the national territory or into marine sea, the surveyor does not have to reach the point. He selects option 5 or 6. In this case the survey for this point is concluded, once the type of observation has been filled in and the end time has been added.

Remark needed:

If the duration of the survey is <10min or > 1h15min a remark is needed.

9.3.2.2 The point is visible (option 1 or 2)

In case the point is visible the distance to the point is to be noted (less or more than 100 m) by ticking the relevant box in the field form.

While the surveyor has to get as close as possible to the theoretical LUCAS point, if this is not possible but the surveyor is able to see the point from a distance, the regular land cover/land use observation can be done and the field form can be filled in. This holds true also if the point is located in a forbidden or inaccessible zone.

Photo needed:

If the point is visible but the distance to the point is >100m the reason for not getting closer needs to be documented through an additional photo: "Access to point" (fields 669 – 695).

Remark needed:

If the access to the point was difficult and/or the distance is >50 m this needs to be noted in the comments.

If the point is not visible from the closest reachable place to the point but is visible from further away (e.g. due to a very high crop), the observation should be done at the closest place to the point where the point is visible.

Photos needed:

If the LUCAS point is reached put the marker on the point.

Take the point (fields 602, 604) and landscape photos (fields 608 – 619).

Remark needed:

If there is a problem with the marker add a comment.

9.3.2.3 In situ photointerpretation (option 3)

If the surveyor is not able to see the point from his observation place he has to do an interpretation of the point based on the orthophoto.

Remark and photo needed:

Reasons for not observing the point are to be written down in the remarks field and an additional photo ("Access to point" (fields 669 – 695)) documenting why the LUCAS point was not reached has to be taken from the point reached.

In situ photointerpretation is an exception to the observation rule	LUCAS is an in-situ survey and the points have to be visited in the field. The in-situ photointerpretation can only be used in rare cases if the point is not visible at the closest accessible location nor at a location nearby.
In situ photointerpretation is only allowed in some situations. It requires good documentation by comments and pictures.	The in situ photointerpretation is only allowed on the condition that the surveyor documents the existence of at least one of the following circumstances by **comments and by an additional picture**: - Point is located in the water - Point is located in inaccessible wetland - Impenetrable vegetation blocks the way to the point from all directions (thick shrubs with spikes, impenetrable forest) - Fenced area with “no access” signs or with a no accessible fence (forbidden area) - Walled or hedged private areas (companies' premises, private gardens etc.) o In this case it is advisable to try to get a permission from the owner to enter if the owner is available (e.g. by contacting the gate guard in companies or if the house owner is available) - Landowner refuses the entrance to the property - Dangerous animals are present close or in the walking way to the point - Shortest possible walking time from the car to the point and back is more than 1 hour (excluding working time for the survey and for walking the transect) Only if the above mention conditions are found, the surveyor registers “photointerpretation” (PI) as type of observation in the field form.

Use the orthophoto to make the photointerpretation	The orthophoto and the visual assessment done from the point reached by the surveyor will possibly allow to identify the land cover on the LUCAS point. This is the case if the surveyor can see the parcel where the point is located (which can be confirmed by photointerpretation) although he cannot see the point itself, e.g. in large field with the point several hundred meters away)
Take landscape pictures from the reached location	L**andscape** photos have to be taken from the point reached (mark the GPS point coordinates in the field form). Point and crop photos are not needed in this case.
Use BX1 or BX2 if crops are not identifiable	If the crop is not recognisable in the orthophoto, the two main classes BX1 ”Temporary crops” covering the classes from B11 to B55 and BX2 “Permanent crops” covering the classes from B71 to B84 have to be used. BX1 and BX2 are only allowed in the photointerpretation.

9.3.2.4 Point not visible and photointerpretation not possible (option 4)

The survey ends, if the point is located in an inaccessible area or forbidden zone and the point is not visible or in the case of photointerpretation in the office and the orthophoto doesn't allow interpretation (bad quality of orthophoto, incomplete coverage). Then, the appropriate fields – option 4 - in the field form should be filled in.

Remark and photo needed:

The reasons for not observing the point has to be written down in the remarks field. In case of the in-situ survey also an additional photo ("Access to point" (fields 669 – 695)) documenting why the LUCAS point was not reached has to be taken from the point reached.

To finalise the survey of the point the end time has to be added (including a remark for the short survey duration).

9.3.2.5 Photointerpretation in the office (option 7)

This option applies only if field D or E are "Yes". This means the point is to be photointerpreted in the office. However photointerpretation in the office might not be possible because e.g. there is a cloud in the orthophoto, in which case option 4 is to be selected. If the orthophoto is fine and the surveyor can proceed with the photointerpretation in the office option 7 needs to be selected.

9.3.3 Field: Direction of observation (25)

If the point is located on the boundary of two parcels and it is ambiguous which parcel has to be observed, or if the point is located on a linear feature < 3 m wide (small hedge, small track, roadside verge) or a small object (e.g. a tool shed < 3 m wide in a garden) the criterion of point definition (minimum width of 3m) is not fulfilled.

In this case the “look to the North” rule applies, which means that the surveyor has to observe land cover and use north of the point and if this is not possible to the east (see detailed explanation below).

Photo and remark needed:

If the "Look to the north" or the "Look to the east" rule is applied an additional photo "Point observation (fields 669 – 695)" is needed to document the decision. Also a comment is needed to explain why the rue has been applied.

Remark needed:

If the decision on which rule to apply is different from the decision of the last campaign a comment is needed.

		
Point location clear, since it is entirely located in an agricultural field.	Point located on a border	Point located on a small linear feature (roadside verge)

Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0) Edited: addition of the EW of observation and LTN rule

Figure 5 *Figure 6* *Figure 7*

Look to the North	If the point is located on a boundary between two land cover types, or the point falls on a small linear feature and the criterion of point definition (minimum width of 3m) is not fulfilled" then the surveyor has to observe the land cover/land use north of the point.
Look to the East if feature is oriented N/S	In case the border between two parcels is exactly in North-South direction (=meridian) and even when applying the "look to the north" rule a clarification cannot be obtained, land cover/land use to the East of the point are to be observed. In the survey field form, the surveyor must note this "virtual" shift of the point. Moreover, he has to explain the decision under the remarks field.
Look to the East if more than one linear feature exist to the North	 (Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du

	cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0). Edited: addition of the EW of observation) *Figure 8* If the point is located on a linear entity (e.g. path) the surveyor applies the rule "look to the north". If when looking to the North a second linear entity is found (e.g. grass margin north of the road), then the surveyor looks to the East.
Where to place the flag/point marker	Following strictly the workflow, the point marker is put in place and the point picture taken BEFORE applying the "Look to the North" rule. Place the point marker on the border, and NOT on the shifted point.
Implications for land use	Land use is to be assessed on the same place as the land cover.
Implications for photos	The landscape photos are to be taken at the original point (not the shifted point). The point picture should be taken showing stable landmarks. Additional photos (type 2 – point observation) may be needed to show the land cover assessed (direction North or East).
Comparability	If the point has already been observed in a previous survey the same direction of observation should be used, unless the direction of observation was clearly wrong. In this case the correct direction is to be used an a remark on the reasons for changing the direction of observation needs to be added

9.3.4 Other remarks about point observation

Other remarks about the point observation (why observation not at the point, why different decision than last survey, ground document not clear, etc.) should be added as needed (500).

9.4 Section: Land cover and land use

9.4.1 Extended window of observation

Theoretically, a point has neither width nor length. Considering the subject of the survey – land cover and land use – there is a standard definition to be applied for the size of the point: in the LUCAS survey the point corresponds to a circle with a 1.5 m radius (or 3 m diameter), therefore representing an area of about $7m^2$.

Normally, the point falls in a homogenous area (e.g. arable land, top of a house etc.) and the above-mentioned point definition can be easily applied as well as the location of the point can be identified without any doubt.

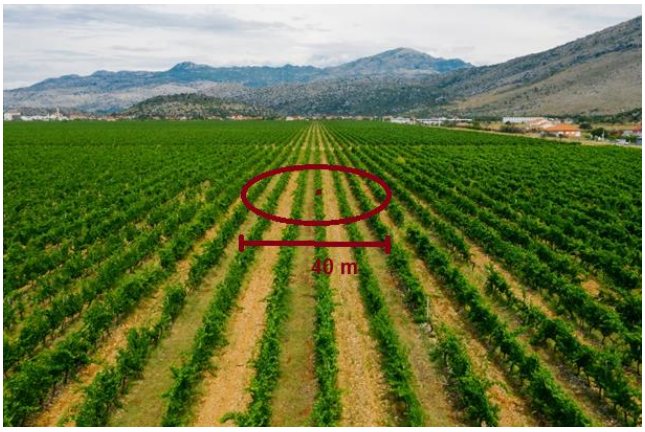
However, some cases might occur, where the location of the point and the observation of the land cover/land use are ambiguous:

- if the point falls on a boundary or small linear feature
- if there is heterogeneity in the land cover

The case where the point falls on a boundary or on a small linear feature has been discussed in chapter 9.3.3.

When the land cover is not homogeneous, for example when it is composed of trees or shrubs interspersed with grass, the scale of observation has to be changed to classify it. In these cases a systematic observation of the "environment" in the vicinity of the point, which in LUCAS is called the extended window of observation, has to be adopted.

The extended window of observation expands to a radius of 20 meters of distance (or 40 m diameter) from the point (representing an area of 0.13 ha).

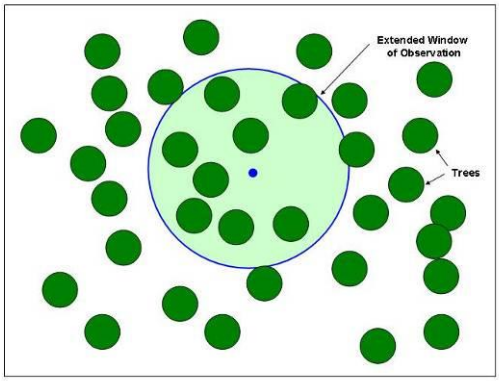


© 2019, Mikhail Nilov, Pexels License
Edited: addition of the EW of observation

Figure 9

© 2018, Carlos Aguilar (@zenderista), Pixabay License.
Edited: addition of the EW of observation

Figure 10

Using the extended window	 © European Union, CC BY 4.0 Figure 11 In the example above, the point is located in an area with a sparse tree coverage and grass. By means of the extended window of observation, the area share of the tree canopy can be estimated. If the extended window is not used and only the point with its 7m^2 is considered, it is not possible to obtain a reasonable estimation of the tree canopy. In this example, the area share of the tree's canopy is approximately 20%, so the point has to be recorded as woodland (minimum coverage of the tree crown 10%). If the tree coverage would range between 5 –10%, the corresponding land cover would be grassland

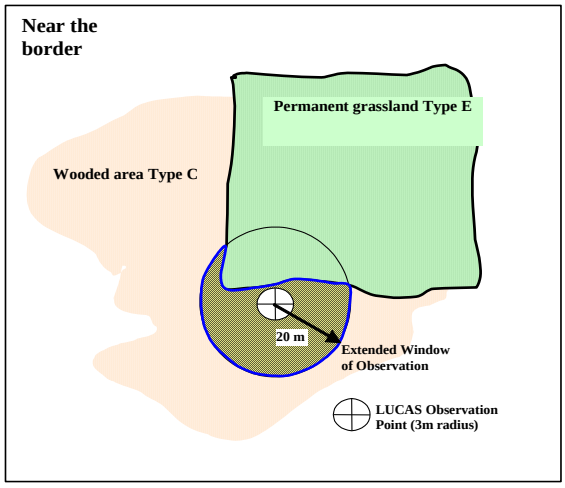
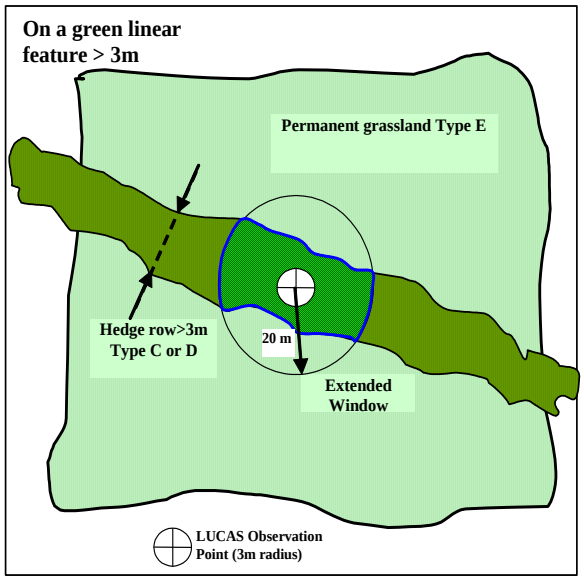
	with sparse tree coverage (depending on the land cover).
When to use the extended window	The window of observation has to be extended whenever the land cover at the point is heterogeneous. This occurs regularly in areas such as: - permanent crops (B7X, B8X, except nurseries B83): parcels of permanent crops where the trees or other plants alternate with bare soils and/or grassland or another crop - woodland (CXX) - shrub land (DXX): where a mix of e.g. shrubs and trees might occur - grassland (EXX), where land features may alternate (e.g. grassland with trees) - bare land (FXX) - wetland (HXX)
Example: an orchard	 (Source: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0) Edited: addition of the EW of observation) Figure 12 The orthophoto above shows a heterogeneous area with grassland and fruit trees (B7X). This is a situation where the extended window of observation is to be applied.

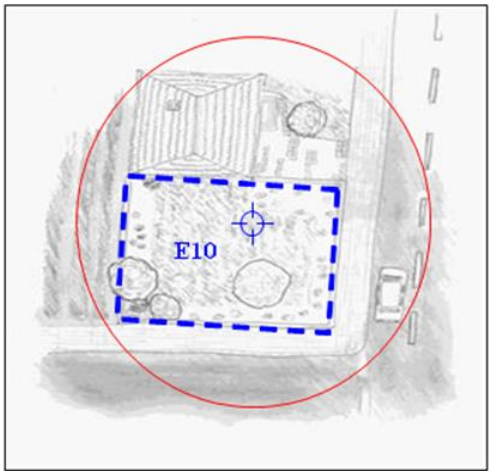
9.4.2 The homogeneous plot

Note that when the extended window of observation is applied, the surveyor has to observe the land cover **within the borders of the parcel where the point is located**. This means that in many cases not all the extended window will be observed, but only the **homogeneous plot** within it.

Generally speaking, for the LUCAS survey purposes, the extended window covers the maximum area within the 20 m radius circle having the same land cover and use.

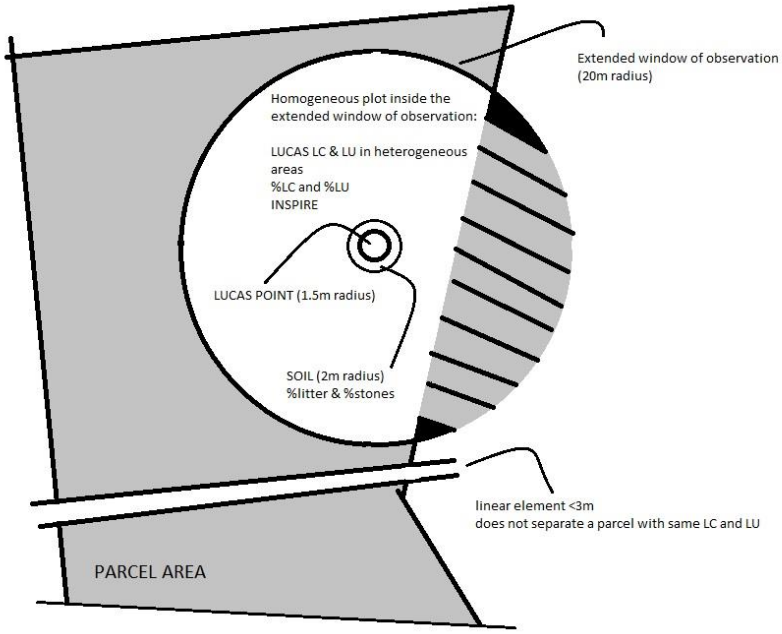
Three specific examples are presented below for clarification of the concept.

The extended window of a point spanning two adjacent parcels	 © European Union, CC BY 4.0 Figure 13 At the point, the cover being a wooded area, the observation has to be done **within** the extended window. The extended window has to be considered only **within the parcel** it belong to, so in this case the parcel defined by the border of the wooded area and the grassland, not considering the zone inside the grassland (which is a different parcel). The density of trees and or shrub is to be assessed in the hatched part of the circle to decide whether it is a shrub land (DXX) or a wooded area (CXX), and in the latter case whether it is coniferous (C2X), broad-leaved (C10) or mixed (C3X), and which forest type (CXX1 - CXXE).
The extended window of a point falling on a linear feature wider than 3 m	 © European Union, CC BY 4.0 Figure 14 A linear feature wider than 3 m is to be treated like any other parcel. The point is assigned to the existing land cover of the specific linear feature (road, river, wooded area). The assessment has to be made within the area defined by the linear feature (the parcel) in order to assess the density of trees and/or shrubs (but it is not extended

	into the adjacent parcels). In the example the density is to be assessed in the hatched part of the circle to define whether it is a shrub land (DXX) or a wooded area (CXX), and in the latter case whether it is coniferous or broad-leaved.
The extended window of a point falling on the grassy area of a garden belonging to a residential building	 © European Union, CC BY 4.0 Figure 15 Once again, the surveyor has to observe the parcel in which the point is located. In this example the grass zone enclosed by a wall (dashed square in the figure) defines the plot to be observed within the extended window of observation. As within this area shrubs and trees are growing, the point is to be classified as E10 because the tree crown (within the homogeneous plot) is below 10 %.

9.4.3 Schema: window of observation and homogenous plot

See below an image summarizing the concepts mentioned in this chapter.



© European Union, CC BY 4.0

Window of observation and homogeneous plot

Figure 16

9.4.4 General rules for classifying the land cover and the land use of the point

LAND COVER

For every point one or 2 land covers are to be recorded. The dominant land cover is recorded as first land cover (LC1).

Examples and special cases:

- A road covered with grass has heavily compacted soil (else it would be impossible to drive on), this is therefore the main characteristic: LC1=A22, LC2=E20,
- Wooded land is always considered a dominant land cover CXX=LC1)

In case of layered, competing (no clear dominance) land covers the classification starts from the top.

Examples and special cases:

- A bridge over a river is recorded as LC1=A30, LC2=G21).
- If both land covers belong to artificial (XX) only one land cover is recorded as it is in any case sealed (e.g. bridge over road LC1=A30, no LC2; bridge over square LC1=A30, no LC2).
- If a powerline over wooded land (or over shrubland or grassland) is <3m the powerline is not recorded: LC1=CXX

There is a difference between features superimposed (both are be registered, unless both are artificial) and features juxtaposed, the feature nearby is not registered.

Examples and special cases:

- When trees are near the road with the crowns covering the road but the stems of the trees being in another plot , the land cover of the road is only LC1=A22).

For structures with multiple layers (e.g. buildings), the rule is to attribute 100% land use to each layer (e.g. floor).

Examples and special cases:

- A building has a museum on the ground floor and bank offices in all the other 4 floors: LC1= A12, LU1 = U342 (400%), LU2 = U361 (100%)

LAND USE

The dominant land use is recorded as first land use (LU1)

Examples and special cases:

- The first land use LU1 for roads is always transport (U312)).

Associated areas get the land use from the main area they belong to

Examples and special cases:

- A gas station on the road side belongs to the road infrastructure: U312

- A lawn belonging to an industrial establishment has land use: U22X)

Abandoned and unused areas cannot have another land use.

COMBINATIONS OF LAND USE AND LAND COVER

It is possible to record 2 land covers and 1 land use.

Exception:

- For wooded land (LC1=CXX) a second land cover is recorded only if there is a second land use linked to it.

It is possible to record 1 land cover and 2 land uses.

Examples and special cases:

- Shrubland or wooded land may be used for forestry and for the feeding of cattle (agriculture). In this case 2 land uses are to be registered.

9.4.5 Field: LC1 land cover 1 and coverage (%) (28, 30)

Land cover refers to the bio-physical coverage of land (e.g. crops, grass, broad-leaved forest, or built-up area). Land cover (LC) will be noted for each point according to the classification mentioned in LUCAS reference document C3-Classification.

The land cover might not completely cover the ground, therefore the percentage of coverage within the homogeneous plot is evaluated in the observation radius of 1.5 m or within the extended window of observation.

This percentage is assessed in the homogenous plot, so will be 100% for all LC1 except: BXX.

For BXX the percentage for LC1 reflects the “true” coverage of the soil by the crop canopy to know about erosion risk and the phenological status of the crop at the time of the observation.

For LC2 on the other hand the percentage reflects the LC effectively occupied by LC2.

Photo needed:

If the point visible and LC1 is B, C, D or E take a crop photo (fields 605/607).

Remark needed:

If the decision on LC1 is different from the decision in the last campaign, add a comment explaining why.

9.4.6 Field: LC2 land cover 2 and coverage (%) - Multiple registration of land cover (31, 32)

When more than one land cover co-exists in the same area, a second land cover may be needed to describe the point.

This is common in specific landscapes such as for example in agro-forestry areas, where wooded land is combined with crops, but it can also happen in arable land, when different crops are intrinsically mixed in the same field.

This percentage is assessed in the homogenous plot.

While for LC1 the % will be 100% for all LC1 except: BXX, for LC2 the percentage reflects the LC effectively occupied by LC2.

The percentage of LC2 needs to be evaluated looking only at the second land cover.

The sum of the percentages of coverage of LC1 and LC2 can be >100%, when different land covers are covering each other, as for example when the tree canopy covers parts of the crops.

For possible combinations of LC1 and LC2 check the cross tables in the Annexes.

Note that the information recorded under (LC1 and LU1) and (LC2 and LU2) must correspond.

Photo needed:

If the point visible and LC2 is B, C, D or E take a crop photo (fields 605/607) or an additional photo (fields 660 – 695).

Remark needed:

If the decision on LC2 is different form the decision in the last campaign, add a comment explaining why.

A second land cover LC2 may be needed to describe the point	The need for a second land cover is normally the case in greenhouses, association of crops and crops under cover (e.g. under trees).
How to assess the % of LC2	The % has to be assessed on the whole area of reference.
Some classes include already a second land cover	For complex or heterogeneous areas, particularly in semi-natural areas, the double land cover classes are already coded in the main classification, as the classification is already referring to a mix of components. For example grassland with sparse shrub/tree cover (E10) or shrub land with sparse tree cover (D10). For these classes LC2 should not be recorded if there is no additional LC class. Likewise, if grass or shrubs appear in combination with permanent tree crops (B7X, B8X), or woodland (CXX) take into account that the tree component has already been assessed as LC1, therefore D20 and E20 are to be used as LC2.

Example: an orchard with grass between the rows	 © 2014, Gary Fisher (@gafisher), Pixabay License Figure 17 In the photo a mix of fruit trees (e.g. apple trees B71) and permanent grass can be seen. It is a heterogeneous area and the point falling in the orchard is evaluated using the extended window of observation. The main land cover consists of the fruit trees, as they determine the main use of the area. The resulting classification is LC1= B71 and LC2 = E20 In case of spontaneous grassland under the trees classify LC2 by using the corresponding code E30 (trees have been assessed in LC1).
Orchards with mixed species	Some orchards have different species (maybe in alternate rows or mixed within a given row). If two species have a significant presence in the orchard (at least 33% each), two types of land cover are noted. Otherwise, the major one is noted and the others are ignored.
Orchards and annual crops	Some orchards are organised in association with annual crops between the rows. If the annual crop has a significant presence (at least 33%) within the extended window of observation, two types of land cover are noted, the first is the permanent crop and the second is the annual crop.
LC2 in wooded areas (CXX) only if there is a different use	If the main land cover is wooded land (CXX), and the use is forestry (U120), a second land cover should only be given if it refers to another land use (e.g. U111 agriculture or U361 leisure).
Nurseries	For nurseries (B83) other than forest nurseries (B83f) the main type of plant/tree has to be noted as second land cover. The exception for forest nurseries (B83f) is due to the fact that CXX cannot be used as LC2.
Priorities	In case of multiple land cover combinations, there is some degree of prioritization of LC1 against LC2. For example, land cover with trees should always be recorded

	as LC1.
Be aware of impossible combinations of LC1 and LC2	For more details on impossible or unlikely combinations of LC1 and LC2 see the annexes to this document.

9.4.7 Field: LU1 land use 1 and coverage (%) (34, 36)

Land use indicates the socio-economic use of land (e.g. agriculture, forestry, recreation or residential use). Land use (LU) will be noted for each point according to the classification mentioned in LUCAS reference document C3-Classification.

To determine the main land use it is important to evaluate the context and to determine if the area analysed is associated to a neighbouring area that determines its use. Grassland for example can be part of a residential area, but it can also be part of a commercial building or to the road network (e.g. a green island in the middle of a highway crossing).

The LC1 and LU1 information need to correspond to each other. If the land use of two land cover types is the same, only one land use class is to be assigned.

Possible combinations of LC and LU are presented in the annexes.

The percentage of land use on the observation unit is to be assessed in the homogenous plot.

Each floor of a building counts as 100%.

It is possible that a certain land use is present only in part of the observation unit and not in all.

Remark needed:

If the decision on LU1 is different form the decision in the last campaign, add a comment explaining why.

9.4.8 Field: LU2 land use 2 and coverage (%) - Multiple registration of land use (37, 39))

As for land cover, also for land use a second land use can be registered.

In case of more than one land use being present it is also possible that the sum of land uses in the observation unit is more than 100% (e.g. a building with several floors holding residential and commercial use).

Remark needed:

If the decision on LU2 is different form the decision in the last campaign, add a comment explaining why.

In case of multiple use register the dominant use first	Typically buildings are often used for multi-functional purposes. The dominant land use – that is the most important land use - is to be recorded as LC1.
Example: multiple uses in urban area	The point falls on an office building with 20 floors and there is a museum downstairs. For buildings, the rule is to attribute 100% land use to each floor. The

	dominant land use relates to the offices (U342). LC1= A12 (Buildings with more than 3 floors) LU1=U342 (Business) LU2=U361 (Museums)
Multiple use in roads	In case of roads, the first land use has to be always transport (U312). A second land use might be added for final socio-economic use of the road, e.g. agriculture (U111) if it is for agricultural machines, forestry (U120) if it is used for forestry and so on.
Another example of multiple use (a gas station with retail in an area associated to a road)	The point falls on the building of a gas station. Inside there is a bakery. LC1= A11 (Buildings with one to three floors) LU1=U312 (Road transport is the first land use, since road transport includes the relevant associated areas) LU2=U341 (The second most important land use is the gas station, so a retail shop. As there is no third land cover recorded, the bakery is not registered)
Abandoned and unused areas cannot have another land use.	The land use classes abandoned (U410) and unused (U420) cannot be registered in combination with another land use codes, neither can both of these classes (U410, U420) be recorded at the same time).
Grazing in forest areas	Shrubland or wooded land may be used for forestry and for the feeding of cattle (agriculture). In this case 2 land uses are to be registered. LU1=U120 (forestry) LU2=U111 (agriculture)
Water areas can have many uses	Where a dam has been built for the production of electricity, the lake may also be used for water-skiing. The lake would be simultaneously classified as energy production and leisure-recreation.
Register a use when there are visible signs	Some other areas may have also several uses. In general, a second land use code is justified if there is a visible sign of this use, e.g. a fence around the shrub land or wooded land to prevent cattle from outbreak, a landing stage for boats at the lakeside, a special track for persons to walk on or for horse-riding etc.

9.4.9 Land cover x Land use

If for two land covers (LC1 and LC2) the land use is the same, (e.g. “U111” Agriculture for different species of fruit trees), only one land use is to be registered.

It is also possible to record one land cover and two land use categories (e.g. river: transport, fishing). A list of possible LC1 & LC2 and LC & LU combinations is provided in the annexes.

Within the possibilities, LU codes are to be associated with the respective LC code, thus LC1 -> LU1 and LC2 -> LU2 if the LC and LU are related

Forest (cover) and energy production (use)	Trees can be found below power lines. The correct classification is LC1=A30 LC2=CXX LU1=U319 LU2=U120 The classification is made from the highest layer to the lowest layer.
Be aware of impossible combinations of LC and LU	Check the Annexes for impossible (or unlikely) combinations of land cover and land use.

9.4.10 Changes in land cover between campaigns

LUCAS sample points may be visited in more than one campaign (see also 9.2.4). This allows identifying whether changes in land cover or land use have occurred at the point. However, a thorough review of point data collected in the 2009 and 2012 campaigns revealed that in some points changes had been registered but no real change had occurred at the point. This could be found especially in case of unlikely changes registered.

Unlikely changes are changes that do not occur very often, such as e.g. a building becoming a forest.

The causes of changes registered that where not real changes were:

- Shifts in points surveyed on the ground:
    - Due to a shift of the point in the ground document,
    - Ground document in previous campaign not detailed enough to locate the point with precision,
    - The new structure is not on the orthophoto and therefore it is difficult to say exactly where the LUCAS point is,
    - A wrong positioning of the point in the field in one of the campaigns;
- Differences in classifying the same point:
    - Linear feature rules not applied consistently (e.g. a small road is considered as small linear feature in one campaign and not in the other),
    - Linear feature rule applied inconsistently according to the feature type (e.g. a grass strip is considered a linear feature, but a similar sized side walk is not),
    - The same road is classified as A22 in one year and F00 in the other;
- Border problem:
    - The point is at the border between 2 areas and the look to the north rule has not been applied in the same way in different years.

The evaluation of land cover changes is an important result of the LUCAS survey, therefore the surveyor should carefully document changes between the present and past campaigns, and avoid classifying the point differently if no real change is present.

While errors that may be found in the data of the previous campaigns cannot be corrected by the surveyor, it is of uttermost importance that the surveyor inserts a structured comment to document the fact that the classification of the previous campaign differs from his classification but there is not real

change at the point. The surveyor also has to insert a comment to support his/her decision on how to correctly classify that point.

These rules apply also to evaluation of Land Use. See a list of unlikely changes in Annex 9.

9.4.11 Examples of classification by land cover

9.4.11.1 Artificial land (A00)

Built-up areas (A10) include roofed constructions (buildings) distinguished in 3 categories

- <= 3 floors (A11)
- > 3 floors or higher than 10m (A12)
- Greenhouses (A13)

Non-built-up areas with artificial cover (A20) include area features (A21) or linear features wider than 3 meters (A22).

In 2015 a new class (A30) was introduced to cover for other artificial areas.

For this class it is very important to identify the correct position of the point in residential areas, especially those where houses are mixed with small parcels of gardens, yards and parkings. Remember to use the "Look to the North/East" rule on linear features (those less than 3m wide) and to apply correctly the extended window if needed. With very small constructions (e.g. a tool shed less than 3m wide) the look to the North/East rule is also to be used.

See below some examples of classification

Parking lot	The point is located on a parking area of a supermarket. LC1 = A21 (non built-up area feature) LU1 = U341 (commerce)
Building (>10m)	The point is located in a building hosting offices with more than 3 floors, and hosts a textile products' manufacturer. LC1 = A12 (buildings with more than three floors) LU1 = U222X (textile products can be coded as U222R (raw) or U222L (light end industry, depending on the specific activity))
Road (>3m)	The point is located on a sealed road wider than 3m. LC1 = A22 (non-built-up linear feature) LU1 = U312 (road transport)
Road (<3m)	The point is located on a sealed road not wider than 3m. The point is located on a linear feature (<3m) and the surveyor has to apply the "Look to the North/East" rule, i.e. observe the land cover and land use in the northern direction (or eastern direction if the limit or the linear feature follows the N-S direction).
Agricultural road,	The point is located on an agricultural road more than 3 m wide. The road is

sealed	sealed. LC1 = A22 (non-built-up linear feature) LU1 = U312 (road transport) LU2 = U111 (agriculture)
Unsealed roads and parking lots	If a parcel can be recognized as a road or parking lot, it is an artificial construction so LC1 should reflect the fact, and these areas are classified as LC1 = A2X. If the roads or parking lots is not sealed, it is important to register the secondary land cover, which can be sand (F20), gravel (F40) or even permanent (E20) or spontaneous grass (E30). The first land use of a road is always U312. In case of agricultural unsealed road with permanent grass coverage: LC1 = A22 (non-built-up linear feature) LC2 = E20 LU1 = U312 (road transport) LU2 = U111 (agriculture)
Unsealed roads with only some vegetation	Such roads are also commonly a mix of bare and vegetated patches. To decide on whether to code the LC2 as bare (FXX) or as grass (EXX), use the 10% rule: if the amount of vegetation is negligible (less than 10%) then an A22+FXX is to be selected. It is more important though, that even if we are speaking of a natural area (the road was not strictly "built" but has been formed by the successive passage of vehicles and the soil has been compacted) that it is recognized as an A22 and the use is U312 (road transport). The secondary land cover is additional information.
Greenhouse	The point is located in a greenhouse (an installation of glass, plastic or any material which is translucent but impervious to water) dedicated to agricultural production. The type of crop inside the greenhouse will be noted as second land cover. LC1 = A13 LC2 = BXX (code of the crop) LU1 = U111 (agriculture) (If the greenhouses are not dedicated to agricultural production, the land use may be different)
Greenhouses are raised structures	If only the ground is covered by plastic for protecting the plants against frost without a raised structure, this is not considered a greenhouse. The land cover to be assessed is the crop. Therefore only the crop code has to be provided.
Small constructions	If the point falls on a small tool shed (<3m wide) in a garden, use the Look to the North/East rule.
Bridges and other	For *artificial* superimposed features take the feature on top only. This means that

superimposed features	if there is a bridge over a dam, only the bridge is classified. However, in case the second land cover is not artificial land (e.g. a bridge over a river, or overlapping a crop, the second land cover is to be taken. A point falling on a bridge over a field of sunflower is to be classified: LC1 = A30 (other artificial area) LC2 = B31 (sunflower) LU1 = U312 (road transport) LU2 = U111 (agriculture)
Be aware of exceptions: superimposed is different from juxtaposed	There is a difference between the treatment of features that are superimposed and features that are juxtaposed. In case of a point falling on a road that is covered by tree canopy, do NOT take the tree into consideration (unless, of course, we are on a road less than 3m wide, where the Look to the North rule would have to be observed). This is a case of a juxtaposed feature, where the trees are “next to” the road, not “on top” of the road.
Be aware of exceptions: power lines and other "non sealed" artificial features over (e.g.) buildings	In case of a point falling on a road (or parking lot, or building…) that is crossed by a power line, do not take the power line and give priority to the feature which is sealing the soil. Check the cross tables for impossible combinations of LC1 x LC2 LC1 = A22 (or A21 or A1X)
Be aware of exceptions: green rooftops and bridges for animal crossings	 © 2017, René Boinski (@ReneBoinski), Pixabay License Figure 18 In these cases, the grass (or other vegetation) is used as part of the construction, so the AXX code prevails (as these are sealed areas). Do not use a second land cover (LC2) in these cases.
Artificial grass	Artificial grass (e.g. football field with artificial grass) is to be classified as A21 or A22, depending on the shape.

9.4.11.2 Cropland (B00)

Cropland means there is crop production on a parcel. The most recent crop must be recorded according to the LUCAS LC 2018 classification. Note that if the surveyor is visiting the point too soon and the crop cannot be recognized, a second visit is needed at a later date.

See below some examples of classification

Cropland	The point is located in a common wheat field. LC1=B11 (wheat) LU1=U111 (agriculture)
Crop not yet emerged in a tilled and sown field but seeds are visible	A point falls in arable land that does not yet have a growing crop at the time of the survey. If seeds are visible, and the crop can be identified, take a crop photo of the seeds on the ground. The point does not need to be revisited when the crop can be identified. If only seeds are visible on the field, mark the percentage of land cover as less than 5% as it is the current status of the field that has to be described not the coverage which is expected at harvest time.
Revisit is needed when it is impossible to identify a crop	A point falls in arable land (e.g. tilled) that does not have a growing crop at the time of the survey, or the land is covered with snow. The point can be fallow (U112), and then the existing cover (E30, F40…) has to be taken. But if the point is not fallow (U112) then the point has to be revisited in order to identify the crop.
Usage of Bx1 and Bx2	When photo interpreting a point, if the crop is not recognisable in the orthophoto, the two main classes BX1 ”Temporary crops” covering the classes from B11 to B55 and BX2 “Permanent crops” covering the classes from B71 to B84 have to be used. BX1 and BX2 are only allowed in the photointerpretation. In case the crop (e.g. an olive grove (B81) or a vineyard (B82)) can be identified by photointerpretation, the specific codes can be collected by the surveyor.
Crop already harvested but identifiable by residuals	The point falls in a field which is already harvested. The surveyor has to try to recognize the crop from crop residuals in the field and use the code for that crop.
Crop already harvested not identifiable by residuals	The point falls in a field which is already harvested and it is not possible to identify the crop by the residuals. LC1=F40 (bare soil) or E30 (spontaneous vegetation) LU1=U111 (agriculture)

	Special remarks (harvested field) are needed
Inclusion of plant species	The point is located in a jute field. LC1=B35 (other fibre and oleaginous crops) LU1=U111 (agriculture) LC1 plant species = B35h
Mixed crops	A point falls in a field with alternating rows of potatoes and sugar beet LC1=B21 (potatoes) LC2=B22 (sugar beet) LU1=U111 (agriculture)
Mix of two cereals	A point falls in a field with common wheat and rye. LC1=B11 (wheat) LC2=B14 (rye) LU1=U111 (agriculture)
Mixes of more than two cereals	A point falls in a field of mixed cereals with more than 2 species. LC1=B54 (mix of cereals) LU1=U111 (agriculture)
Bare areas between the rows of an orchard	A point falls on a field with stripes of bare ground between and around the rows of apple-trees. These areas are considered as belonging to the orchard (the extended window of observation was used). LC1=B71 (apple) LC2=F40 (bare soil) LU1=U111 (agriculture) The second land cover is used here to provide environmentally important information. In case of grass instead of bare land, LC2 could be E30 (spontaneous vegetation).
Grassy areas between the rows of a vineyard	A point falls on a vineyard with stripes of grass between and around the rows. These areas are considered as belonging to the vineyard (the extended window of observation was used). LC1=B82 (vineyards) LC2=E30 (spontaneous vegetation) LU1=U111 (agriculture) The second land cover (E20 or E30) is used here to provide environmentally important information.
Fruit trees in kitchen gardens	A point falls in a kitchen garden with fruit trees from several (3 or more) species. LC1=B7X (according to the dominant species)

	LU1=U113 (kitchen garden)
Isolated fruit trees	A point falls on the crown of an isolated fruit tree. The zone is considered heterogeneous and the extended window has to be used. The land cover of the surroundings is assessed as grassland. The tree covers between 5 and 10% of the extended window. Note that an isolated fruit tree is not an orchard, but the use can still be agriculture (U111). LC1=E10 (grassland with trees)
Chestnuts, cherries, walnuts, and other forest trees that also bear fruit	It may happen that trees that are known as forest trees can also be grown as an orchard. This is common for chestnuts, walnuts or cherry trees. Note however that the tree density is expected to be different in both cases. In the case of orchards the land cover will be B7X and not CXX and the use will be agriculture (U111) and not forestry (U120).
Abandoned crop areas	A point falls on an abandoned olive grove. LC1=B81 (olive) LU1=U410 (abandoned) Crop areas, which are no longer cultivated, must be classified by observing the present cover: - If the cover is grass then LC1=E10 or E20 - If the cover is spontaneous vegetation (weeds) then LC1=E30 - If the cover has bushes, criteria to classify between grassland and shrub land will be applied

9.4.11.3 Woodland (C00)

Woodland refers to areas covered by trees with a canopy of at least 10% of the extended window of observation.

When broadleaved and coniferous trees are mixed, the criterion to respect is that 75% or more of the surface is occupied by the canopy of one group. Otherwise the forest is considered as mixed. The canopy is the aerial volume occupied by boughs and leaves.

In the past the following errors occurred frequently:

- on one hand, it was common to forget to assess the 10% cover of the canopy in shruband with trees or grassland with trees on the extended window
- on the other hand the surveyor used the CXX class when the canopy was less than 10% due to ambiguous instructions on the LUCAS 2012 documentation

See below some examples to help clarify the correct classification of woodland areas

Example: Young stands and	The “FAO forest” definition includes areas of young stands and plantations yet to reach 10% crown coverage. However in LUCAS land cover assessment these areas

plantations yet to reach a density of trees of 10%	should be coded with the existing land cover, and not a potential future land cover. This means that such areas are coded with D10 (shrub land with trees) or E10 (grassland with trees), and in some extreme cases even E20 (grassland without trees) or FXX. For young stands and plantations, even if less than 10% crown cover, land use will always be forestry. Do not forget to assess the height of trees at maturity. A forest type is not added in these areas. LC1=D10 (shrub land with trees) or E10 (grassland with trees) LU1=U120
Example: Mixed stands of uneven age	The breakdown between broadleaved and coniferous may be difficult when broadleaved trees have been planted under the coniferous trees they will replace. During the first few years the point will be coded coniferous until the broadleaved trees dominate the canopy.
Example: Urban parks	A point is located in a big urban park with mainly broadleaved trees (e.g. a beech grove), used for recreation. The extended window of observation is to be used. The point is classified as C10, therefore a forest type has to be added in the field LC1 plant species. LC1=C10 (broadleaved woodland) LU1=U361 (leisure) LC1 plant species=C10-6 (beech forest)
Example: Trees bordering roads or railways.	Roadside (or rail side) trees that can be considered as associated areas to the road or railway will still be classified as woodland (CXX) if the density is above 10%. Accordingly, on what concerns use, they have to be classified as U312 (or 311) as LU1. LC1=CXX (woodland) LU1=U312 (roads and associated areas)
Example: Burnt areas	A point is located in a burnt forest area. There are still more than 10% (living) trees in the homogeneous plot within the extended window, so it can be classified as woodland. LC1=CXX (woodland) LU1=U120 (forestry) Special remarks=burnt areas Note that burnt areas are coded according to their present cover (e.g. shrub land (DXX) or bare land (FXX)). Also land use will be coded according to the actual land use (e.g. U111 (agriculture) or U120 (forestry) or U4XX (abandoned/unused)).
Example: Clear cuts	A point is located in a zone where a clear cut was made. The point will be classified according to the actual existing land cover at the moment of the survey. LC1=EXX or DXX or FXX LU1=U120 (forestry) Special remark=Clear cut

Example: Fire breaks	A point falls in a fire break completely bare, within a forest area (wider than 3m; otherwise the look to the north rule would have to be used). LC1=F40 (bare soil) LU1=U120 (forestry) Note that following the general rule, codification is made according to the existing land cover (CXX, DXX, EXX or FXX). In areas with frequent forest fires, fire breaks are often found in forests, but they can also be found on agricultural areas or other. Use is to be registered accordingly.
Example: Grassland x Woodland	A point falls on a forest area dominated by pine trees (density of trees is above 10% on the extended window of observation, more than 75% of the trees are pines). There is grass under the trees, but according to the rules this is only to be coded as LC2 if there is a different use (e.g. animals are grazing). Use E20 as LC2, since the trees have already been assessed at LC1 LC1=C22 (pine dominated forest) LC2=E20 (as LC2 it provides environmental interest information) LU1=U120 (forestry) LU2=U111 (agriculture) See also example on Cropland x Woodland below
Example: Cropland x Woodland	A point falls on a “dehesa” or “montado”, with more than 10% of cork oak trees, but with a crop (e.g. oats) underneath (it is common to find this landscape in southern countries, where cereals, dry pulses, potatoes or even fresh vegetables may grow under the trees). LC1=C10 (broadleaved forest) LC2=B15 (oats) LU1=U120 (forestry) LU2=U111 (agriculture)
Example: Hedges and Coppices	A point falls on a hedge composed of broadleaved tree species. The hedge is wider than 3 m (else the look to the North rule would have to be applied), and the tree coverage is above 10% on the homogeneous plot within the extended window. The area has no signs of use. LC1=C10 LU1=U420 Areas which are composed by young or coppiced trees, which can reach more than 5 m of height are not to be classified under shrub land (DXX) but as woodland (CXX) if the tree cover is >10%.
Example: Wet forests	Regardless of the water content of the soil, wooded areas that comply with the general rule of having a canopy of at least 10% are to be coded as CXX and not as

	wetland.

9.4.11.4 Shrubland (D00)

Areas dominated (more than 10% of the surface) by shrubs and low woody plants are classified as shrub land (DXX).

Be aware that for shrub land included in woodland areas, or surrounded by trees, it is not always easy to define if a point falls on a separate parcel covered only by shrubs or if the parcel includes the trees. This occurs mainly in the Mediterranean area where the cover is a mix of shrubs and trees. If a point was visited in the past assess carefully whether a change is due to a real evolution of the landscape or simply a case of different interpretation of a situation (and therefore not a real change), an information that should be noted down on the field form .

Hedges	Hedges composed only of shrubby species (e.g. by ornamental plants or dwarf shrub, heathland or Mediterranean shrub species) are considered as shrub land (DX0).
Grazing on shrub land	If the point falls in a shrub area (without trees) that is used for pasture. LC1=D20 (shrubs without trees) LU1=U111 (agriculture) for regular grazing, U420 for very occasional grazing
Shrubland with trees	Shrubland may include sparsely occurring trees within a limit of a tree-crown density of 10% (D10). This can be encountered in two cases: - Permanent vegetation in regions where soil and climate conditions are poor; - Temporary covers evolving from a cultivated state to woodland in regions with better conditions. For the LC class D10, the height of trees (below or above 5m) at the moment of the survey and at maturity as well as the width of the feature (larger or smaller than 20m) have to be assessed in the field form.

9.4.11.5 Grassland (E00)

Land predominantly covered by grass or communities of grass like plants is classified as grassland (EXX). In case of existence of trees and/or shrubs, the density of tree-crown is less than 10% and the density of tree+shrub-crown is less than 20%. Note however that LUCAS also separates from this class the communities of grass corresponding to wetlands that are classified under (HXX).

Pastures	The point falls in a pasture under trees. The density of trees is less than 10%, or else the point would have to be classified as woodland (CXX). LC1=E10 LU1=U111

Grassland under permanent crops	As mentioned before, grass under permanent crops like fruit trees or olive trees is to be classified as LC2=E20. The usage of EXX as land cover 2 is restricted to E20 or E30, since normally the tree component is assessed at LC1.
Spontaneous herbaceous vegetation	Spontaneous, herb or tall fringe vegetation is coded under E30.
Campsite	The point is located in the lawn of a campsite with less than 10% of trees. LC1=E10 LU1=U341 (holiday camp)

9.4.11.6 Bare land and lichens/moss (F00)

This class includes areas covered by lichens or moss or with hardly any vegetation cover (where at least 90% of the ground or more is bare).

Note that to classify an area as lichens or moss these can cover more than 10% of the ground, but no other vegetation can be present in a density higher than 10%.

Crop not yet emerged	If the survey is being carried out before the planting period of certain crops, a second visit has to be organised for those fields found bare in arable land, if no seeds or young plants could be found which unambiguously refer to the sown crop.
Fallow land	In case of fallow land (U112) that is not sown during the current season, the land cover is to be noted (e.g. F40 Other bare soil, E30 Spontaneous vegetation, etc.) and a comment needs to be provided.
Use of FXX as LC2 in unsealed roads and parking lots	It is common to find roads or parking lots which are not sealed but have clearly compacted soil. If a parcel can be recognized as a road or parking lot, it is an artificial construction so LC1 should reflect the fact, and these areas are classified as LC1 = A2X. In an unsealed area, it is important to register also the secondary land cover, which can be sand (F20), gravel (F40) or even permanent (E20) or spontaneous grass (E30). The first land use of a road is always U312.

9.4.11.7 Water (G00)

This class includes Inland or coastal areas without vegetation and covered by water and flooded surfaces, or likely to be so over a large part of the year.. The average water level of a river defines the delimitation

of the inland running water. The definition of lakes refers to permanent water surfaces. Islands in lakes are to be included in the land surface area.

Man-made lakes and lakes regulated at a dam may have water levels shifting very much up and down depending on the need to store or use water e.g. for hydroelectric purposes. The area of such reservoirs should be defined at the maximum filling. On the other hand specific meteorological conditions can cause a considerable increase of the water level of a lake and cause flooding.

The LUCAS definition takes these fluctuations into account:

1) by defining the water areas as "areas without vegetation and covered by water and flooded surfaces or likely to be so for a large part of the year".

2) by providing a comment on "temporarily dry" areas that is to be used in case a water feature is observed at a lower level than usual

3) by providing a comment on "temporarily flooded" for areas exceptionally covered with water.

In the past, the problems identified were mainly related to the correct classification of sandbanks in the river bed and irrigation canals in arable land.

Separating fresh and salt water	Due to the need of mapping LUCAS classes to INSPIRE, a separation of fresh and salty water features was needed. Although normally expected at the coastal areas, salty water lakes can also occur inland in volcanic regions or where evaporation is important.
Rice fields are not GXX	This class **excludes** rice fields which are classified as cropland (B17).
Stagnating water with vegetation is not GXX	This class also **excludes** brackish or stagnating water bearing vegetation cover of grass, shrubs or trees. The appropriate classes will either be wetland (HXX), shrub land (DXX) or woodland (CXX).
Varying water levels in sandbanks, margins of artificial lakes and islands within water features.	Temporarily submerged areas and sandbanks are to be assigned in FXX classes. On the other hand, a temporarily exposed sandbank inside the mean bed of the river is to be considered as water (GXX). A similar rule is to be used for margins of artificial lakes (where the water level can vary considerably): if the point falls on the temporarily dry area (normally bare land), code it anyway as water (GXX) and use the relevant remark “temporarily dry”. Always use the relevant comment temporarily flooded/temporarily dry to complement the information collected.
Tidal areas	In the rare case a point falls on a tidal area, use the normal high tide mark as a reference to use the "temporarily flooded/temporarily dry" comment.
Non-permanent snow cover is not	The areas permanently covered by snow (G50) **do not include** those under snow

G50	for only a certain period of the year. It is therefore necessary to dig a little to find the bare soil or the grass, or to organise a second visit for these points that were found under snow cover during the survey to assess the actual land cover.

9.4.11.8 Wetland (H00)

Wetlands are areas that fall between land and water. They are areas that are wet for long enough periods that the plants and animals living in or near them are adapted to, and often dependent on, wet conditions for at least part of their life cycle.

Wetlands are defined as land that is inundated on a temporary or permanent basis, with water usually slow moving or stationary and that can be shallow, fresh, brackish or saline.

9.4.12 Examples of classification by land use

In general, land use is easy to define, if signs of use can be seen. It is more difficult when there is no visible proof of the use.

See below some examples.

Agricultural use	An orchard (B7X) is trimmed, traces of work are visible in the fields. In such case there is no ambiguity about the use. LU1=U111 (agriculture)
Why is landscape care and maintenance no longer under agricultural activities (U111)?	Landscape care and maintenance includes the planting, care and maintenance of parks and gardens, greenery (e.g. sport grounds) and plants for protection against noise, wind, erosion, visibility and dazzling. It is seen as a service, not as primary production.
Set-aside	Agricultural land which has been set-aside, will be classified as fallow land (U112).
Can fallow land be ploughed?	In some southern countries fallow land (U112) is ploughed in summer (to kill the weeds). If the surveyor find a ploughed field and his local knowledge allows him to determine that this field is fallow land he has to add the relevant comment (Local Knowledge) else quality control will ask to revisit to determine what is growing on the field.
How to distinguish between fallow and abandoned agricultural land?	In principle abandoned agricultural land is expected to have more woody growth than a fallow land, which has been out of use for a short time. Local knowledge and contact with the land owner may be needed to determine the use.

Forests (also known as LUCAS woodland or CXX) can have many uses	Parts of forest may also be exploited for the leisure of people during weekends (recreation, leisure, sport), or be part of a nature protection area (indicated by signs). It can happen that a woodland area is not used for forestry: a camping site in a wooded area could be classified as LC1=CXX (woodland) LU1=U341 (commercial activities)
How to distinguish between professional hunting or sport?	Professional hunting is defined under NACE activity A01.70 as "hunting and trapping on a commercial basis" as opposed to the recreational or sport activity. It also includes "taking of animals dead or alive for food, fur, skin or for use in research, zoos or pets" and "production of fur skins, reptile or bird skins from hunting and trapping activities", "land based catching of sea mammals as walrus or seal". It excludes the same type of activities for sport or recreation (and related service activities) and service activities that promote hunting and trapping.
Is it other primary production (U150) when the hunter pays for the hunting activity?	If there is a company profiting from the hunting or the selling of the hunted meat and this is the main use of the land, then U150 is LU1. Else it is sport (U362) – see also NACE 93.2
Military zones	Military zones are to be included in community services (U350).
Use of grassland in urban areas	For the grassland in urban areas, the assigned land use needs to be in relation to the use of the area. Grassland may belong to a hotel (U341) or to a residential house (U370), or to a museum or botanical garden (U361).
Abandoned areas	An area is considered abandoned when it is not used but traces of their former use are still evident.
Abandoned vs. non abandoned agricultural areas	Agricultural areas can be out of use as part of the field rotation or because of a long-term set aside. This area is to be classified as U112 Fallow land. It might not be possible to distinguish a recently abandoned agricultural area from a fallow land. In case of doubt it is to be classified as U112 Fallow Land.
Abandoned or unused *"natural areas"*	Forest that has no signs of intervention (no recent tracks, no cuttings) can be abandoned (U410) or a protected area subject to a non-intervention management regime (U420). If a reed-bed does not have any signs of being regularly cut, use will either be unused (U420) or abandoned (U410) (if signs of former use are visible).

9.4.13 LC plant species (29, 32)

This field allows to register more detailed information on the land cover previously assessed:

For crops (LC1=BXX) classified as “other” in LC the species is to be registered. The relevant species are listed in the document C3 – Classification under the relevant class and chapter 10.2.2 Code list for species.

For nurseries the type of nursery is to be registered. The relevant types are listed in the document C3 – Classification under the relevant class and chapter 10.2.2 Code list for species.

If definitely none of the existing codes applies select "Exotic forest" and add a structured comment: BD06 ”Woodland does not correspond to any EEA Forest type".

As in previous campaigns wooded land in urban parks is classified according to its composition.

9.4.14 LU land use type (35, 38)

This field is used to further differentiate some activities to allow to compare the information collected to the INSPIRE land use classification.

Some industrial activities are further classified in_

- Raw industry (R)

- Heavy end industry (H)

- Light end industry (L)

Transport via pipelines is subdivided in:

- Transport of water via pipelines (W)

- Transport of other material via pipelines (O)

The full overview of codes can be found in chapter 10.2.4 Code list for land use types.

9.4.15 Parcel area (ha) (40)

The surveyor needs to roughly estimate the area of the parcel (in ha) to which the point belongs. This has to be done for all points regardless of their land cover. The size is graded according to area classes.

The area calculation takes into account the whole parcel having the same land cover and land use as the observation point, except for wooded land.

PLEASE NOTE: As an exception, for wooded land the total extent of wooded land (C00) is to be assessed:

This means that the total extend of wooded land (C00) is to be assessed regardless of the fact that there might be a part of broadleaved woodland (C10), coniferous woodland (C2X) and or mixed woodland (C3X) and the same use. This because the total C00 area is needed to calculate the FAO Forest area.

Note that this is <u>not</u> the “homogeneous plot” mentioned in chapter 9.4.2!

Evaluating parcel areas in the field	In order to assess an area of 0.1 ha in the field, the surveyor has to have in mind that a circle of 18 m radius (a bit less than the extended window of observation) around the point represents an area of 0.1 ha. In order to assess an area of 0.5 ha in the field, the surveyor has to have in mind that a circle of 40 m radius (twice the extended window of observation) around the point represents an area of 0.5027 ha. A circle of around 56 m radius represents an area of almost 1 ha. In case of quite large parcels (greater than 1 ha), the assessment of the size should be done with the help of the orthophoto.
Parcels cut by linear features less than 3m wide	If land is cut by linear features (fences, ditches, roads, railways, rivers etc.) narrower than 3m, consider all the area with the same LC & LU as homogeneous for assessing the area of the parcel.
"Linear parcels"	For points in water courses, roads, rivers and railways wider than 3 m, mark the area of the parcel always as bigger than 10 ha. For hedges wider than 3m, the orthophoto can be used as base for the area estimation.
Different uses indicate different parcels, except for wooded land	For example, if two vineyards are adjacent to each other, one is in use and the other is abandoned, consider only the one where the point is located for the area estimation.
Parcel area for wooded land	For wooded land the total extent of the wooded land – broadleaved, coniferous and mixed - is assessed. This assessment does not take into account the lower level classification (CXX).

9.5 Section: FAO parameters

Parameters collected under this heading are needed to determine:

- points that fall under the definition of "FAO Forest" and "FAO Other Wooded Land", as specified in "FRA 2015 – Terms and Definitions, 2012" (Forest Resources Assessment Working Paper 180) from FAO (http://www.fao.org/docrep/017/ap862e/ap862e00.pdf),

- the height of permanent crops (B70 and B80).

9.5.1 Fields: Height of trees/crops at survey and at maturity (42, 43)

For points with trees in CX0, D10, E10 and for points with crops in B70 or B80 (whatever the size of the parcel), the height of the trees/crops (below or above 5m) at the moment of the survey and at maturity has to be assessed and noted in the field form.

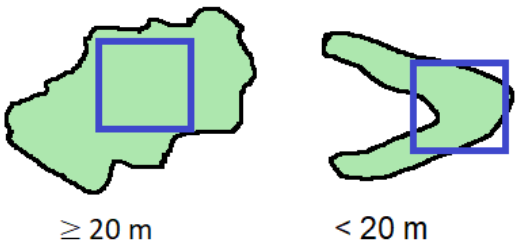
The height to be taken is the height of the highest plants.

9.5.2 Field: Width of feature (44)

For points with trees in CX0, D10, E10 and for points with crops in B70 or B80 (whatever the size of the parcel and whatever the height of trees at maturity), the width of the feature has to be assessed and noted in the field form.

The height to be taken is the height of the potentially highest plants.

This information is needed to evaluate the compactness of areas. A quadrant of 20*20 m^2 needs to be covered by forest (or by the relevant crop) somewhere within the parcel. This means that the parcel should not be narrower than 20 m for at least 20 m length.

Assess the width of features for trees and for crops in B70/B80	 Figure 19 The width of features (wider or narrower than 20 m) needs to be assessed only if the LC is CX0, D10, E10, B70, B80. Both the orthophoto and measurements in the field can be used to estimate the area.

9.6 Section: Land management

Different land management activities can have an impact – among others - on erosion and are to be registered. This information is to be collected for points with the following land cover: BXX, CXX, DXX, EXX, FXX, HXX.

The first aspect to be assessed is ploughing (46, 47, 48):

- are there signs of ploughing in the field?

- if so, the slope of the ploughed field is to be assessed.

- if the field is not flat, then the direction of the ploughing (plough direction) is to be assessed.

Signs of ploughing and the type of ploughing are assessed to determine the risk of erosion; therefore all signs of ploughing are to be registered, i.e. spurs of the ploughing by tractor, even if the crops are already grown.

The other aspects to be assessed are: presence of stone walls and their maintenance (49), presence of crop residues (50) and presence and width of grass margins (51).

The reference area is the field, as far as visible from the point reached by the surveyor. There is no need for major walks to assess these parameters.

The following pictures illustrate these concepts.

Slope of ploughed field	Gently sloping = no effort when walking up the slope Steeply sloping = requires effort to walk up the slope Undulating = land slopes in more than one direction
Plough direction across the slope	image placeholder In this field, plough is across the slope as evidence by the channel (flowing downslope) that cuts across. Ploughing along constant elevations (contours) is a good way to reduce erosion.
Plough direction across the slope	image placeholder In the second example ploughing has been done up and down the slope.

Not maintained stone walls	 © 2016, Roger Templeman, CC BY-SA 2.0 Figure 20  © 2007, John S Turner, CC BY-SA 2.0 Figure 21  © 2020, Pijarn Jangsawang Pxhere.com, CC0 1.0 Universal Figure 22

	 © 2009, Andy Stott, CC BY-SA 2.0 Figure 23  © 2009, Trevor Littlewood, CC BY-SA 2.0 Figure 24
Well maintained stone walls	 © 2007, John S Turner, CC BY-SA 2.0 *Figure 25*

© 2004, Pollinator, CC BY-SA 3.0

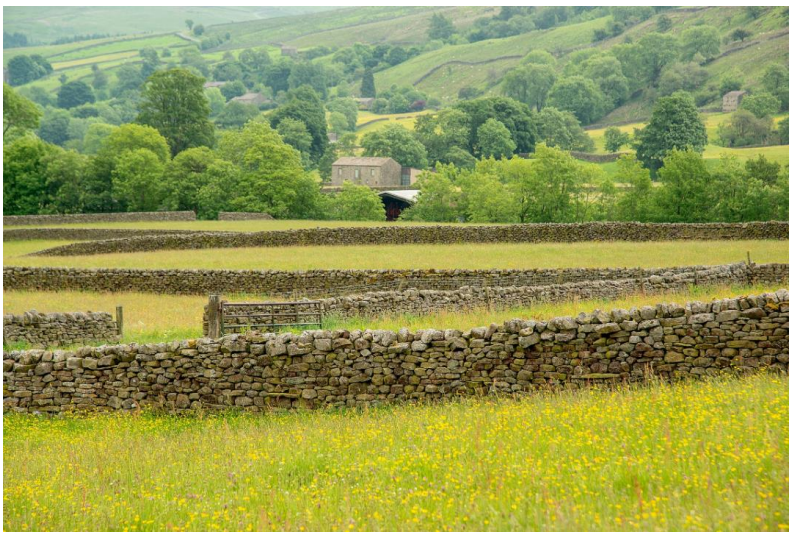
Figure 26

© 2019, Pacopac, CC BY-SA 4.0 Int.

Figure 27

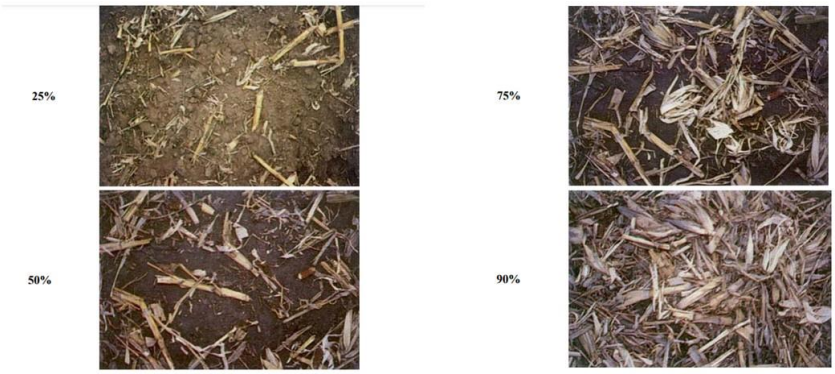
© 2019, Jacqueline Macou (@Jackmac34), Pixabay License

Figure 28



© 2018, Peter K Burian, CC BY-SA 4.0 Int.

Figure 29

Presence of crop residues	Photographs of Corn Residue Cover  Adapted from Shelton, David P. and Jasa, Paul J., "G95-1134 Estimating Percent Residue Cover Using the PhotoComparison Method" (1995). Historical Materials from University of Nebraska-Lincoln Extension. 782. https://digitalcommons.unl.edu/extensionhist/782 https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1780&context=extensionhist Figure 30
Grass margins	 © 2007, Keith Edkins, CC BY-SA 2.0 Figure 31.  © 2011, Michael Trolove, CC BY-SA 2.0 Figure 32

© 2011, Nigel Mykura, CC BY-SA 2.0

Figure 33

© 2013, Michael Trolove, CC BY-SA 2.0

Figure 34

© 2015, Richard Humphrey, CC BY-SA 2.0

Figure 35

9.7 Section: Special remarks

Photo needed:

If any special signs are found, they can be documented with an additional photo "Other" (fields 669 – 695).

9.7.1 Field: Signs of grazing in the field (53)

Information on grazing is to be collected for points with the following land cover: BXX, CXX, DXX, EXX, FXX, HXX. The surveyor has to observe whether the field to which the point belongs shows signs of grazing.

The reference area is the field, or if there are no field borders the area up to a distance of some 500 m. There is no need for major walks, only the area visible from the point reached in the field is to be assessed.

The classification (C3) at the start of the survey stated that signs of grazing cannot be found on U112 "Fallow land" nor in U420 "semi-natural and natural areas not in use". This meant that in principle if there were signs of grazing, the use had to be U111 "Agriculture". Reality shows that grazing can happen in a variety of different areas. Therefore the grazing rule has been extended on 4.6.2018 and grazing can be assessed whatever the land use.

Mostly this concerns:

U112 + Grazing: Grazing on revegetated fallow land (or crop residues from previous years)

U420/415 + Grazing: Wild grazing in remote semi-natural or abandoned areas

Actually the DMT already allows these combinations.

Intensive grazing is expected to happen on agricultural land: U111.

Practically this rule will cause LU changes (U111 -> U420/U415) for some points that must be commented with BP11 (“Different decision than in previous survey/visit: rules changed”).

Signs of grazing	Grazed areas are mostly on grassland, with visible signs for grazing management: pastures, where cattle are out at feed and/or infrastructure is seen (fences, stables, drinking troughs) dung and/or cattle trampling can be observed. If there is nothing to be grazed select "Not relevant".
Check for visible impacts	The impacts of poaching by livestock/trampling (destruction of grass layer, compaction etc.) might be visible. As grazed grassland is more susceptible to erosion than mown areas, various measures might be in place which are controlling or minimising erosion (fencing off trampled areas, re-seeding bare ground, prevention of bank erosion by livestock etc.).
Take location into account	Grazed areas are also found on hilly or mountainous land, which is difficult to access and to manage (steep slopes), or on poor soils, and might bear grass species of lower nutritional values.
Transhumance areas are covered too	Areas grazed during summer (transhumance) are covered by this land management category as well. Its land cover is mostly marked by grassland with trees or shrub, bare land (if with rock outcrops or covered by lichens only), shrub

	land or young forest land.
Crop areas can be grazed	Cereal fields might be grazed after harvesting (e.g. grazing of residuals), if the harvest is not expected to be satisfying or if cereal mixtures have been sown as fodder crops.
Forest and shrub areas can be grazed	In some regions, forests are traditionally grazed (permanently or not). This can be observed by the special species composition of the forest, its structure or simply by the presence of cattle and their residues or fences and stables.
Suitable areas might not be grazed	If the land cover is suitable for grazing but no signs of grazing are visible, the surveyor should mark "no signs of grazing".
Artificial (AXX) and water (GXX) are not grazed	If the LUCAS point has a LC = AXX or GXX, the land management doesn't apply (not relevant in the field form).

9.7.2 Field: Special status (54)

Check for signs of special status or use local knowledge	The surveyor shall note if the point is in a protected area (meaning inside an area for nature conservation) or a hunting area (e.g. hunting signs, hunting towers). Application of local knowledge may be needed.
Is the special status "hunting" needed when use is U150 Other primary production?	Yes, if it is relevant. Hunting is a part of U150, but U150 also includes activities other than hunting.

Both statuses – hunting and protected area - can exist simultaneously. If none exists, select "no special status".

9.7.3 Field: Special remarks on land cover / land use (55)

The surveyor shall note special remarks concerning land cover/use as follows:

If the field is tilled and/or sowed the surveyor must visit it again to identify the crop	The "tilled or sowed" remark is to inform the Central/Regional office that the point has to be re-visited. **If the field is tilled and /or sowed and the crop cannot be recognised the surveyor has to re-visit the point!** This field is needed only if the crop is not recognizable. Use of local knowledge may be needed to identify that a tilled field is to be left fallow.
In a harvested field	If the field has been harvested during the current season and the **crop is not**

the crop may not be recognized by the residuals	**recognisable** by residuals then the point should be classified LC1: F40 (or E30 if spontaneous vegetation is present) LU1: U111 This remark is needed only if the crop cannot be recognized
Clear cuts and windthrows	For windthrows please select "clear cut" and add a structured comment BD07 “Windthrow”.
Clear cut in forest areas is considered to have forestry use	If most of trees have been cut down uniformly the point should be classified according to the cover present on the ground: LC1: DXX or EXX or FXX LU1: U120
Burnt areas can occur in any cover	A burnt area can occur in any LC, but signs of fire need to be observed. The point will be classified according to the land cover observed.
Fire breaks	Fire breaks are man-made gaps in vegetation in order to stop fires. They can occur in cropland, woodland/forests, grassland or shrub land.
Nurseries	A distinction needs to be made between Nurseries (trees are to be transplanted) and Re- or Afforestation (trees are planned to stay at the location). Indications for a nursery that is no longer in use, and therefore to be considered as ordinary forest (LU1: U120), is the size of the trees and the absence of signs of management. As trees over approx. 5m can no longer be transplanted, the presence of a majority of trees over 5 m is an indication for abandonment of the nursery.
Nursery is used for forest nurseries (wildings)	This special remark is used for nurseries having forestry use (i.e. to produce forest trees). Unlike the specialized forest nurseries (B83f) this comment refers to forest nurseries normally found inside the forest (to differentiate these areas from plantations). The point will also be classified as: LC1: CXX LU1: U120
Dump site	This special remark is used in the case the surveyor observes an area which is used as a dump site. Open dump site LC1: A30
Temporarily dry river bed/lake	This special remark is used in case the surveyor observes an area which is part of a river bed or lake, but is temporarily dry. Land cover would still be classified as water. Note that the limits of the lake/river are normally visible. LC1: GXX

Temporarily flooded	This special remark is used in case the surveyor observes an area which is temporarily flooded. A temporarily flooded sandbank which normally would be above the mean river level should still be classified as FXX.

If there is no remark, check the option "No remark".

9.8 Section: Copernicus

LUCAS data is used as in-situ data for the Copernicus products, be it for the calibration and the training during the production process, be it for the validation of the products. To allow for a better use of LUCAS for Copernicus 2 aspects are particularly relevant:

- photos suited for an automated analysis

- information on the extension of the land cover at the point and on the surroundings of the point

Information to be collected, in addition to the core LUCAS data therefore concerns the actual spatial extent and the direction into which the LC class of the point expands, as well as the next land cover.

Therefore the Copernicus survey module has been introduced to collect information on the spatial **LC dimension around the LUCAS observation, together with a simplified description of the surrounding environment.** As such it will improve the compatibility between the LUCAS data and the Copernicus data.

Additionally the LUCAS photos (N, E, S, W) will be subject to Copernicus analysis. It is therefore important to register the observation in compliance with what will be visible in the photos.

The Copernicus data is to be assessed if the point is part of the Copernicus module (Copernicus point, G) (pre-filled) and if the observation type (field 24) is (1) "field survey, point visible, 0-100m to point".

The assessment is to be based on the in-situ observation with the help of the orthophoto.

9.8.1 Field: Copernicus LC (58), Can you do the Copernicus survey [57]?

The surveyor has to register the land cover on the position he has reached using the LUCAS LC classification at level 2. No second land cover is registered for Copernicus. The position reached is the **position of observation** [fields 17 – 19], which can coincide with the **LUCAS point or not but it cannot be more than 100 m away from the LUCAS point**.

To successfully observe the Copernicus module it is necessary that the extent of the Copernicus LC is at least 5m in any possible direction. If this is not the case the Copernicus assessment cannot be done: select "No" for field 57: "Can you do the Copernicus module?" and skip the remaining questions of this module.

9.8.2 Fields: Extension of Copernicus LC, new land cover and its breadth (in 4 cardinal directions) (60 – 63, 65 - 68, 70 - 73)

There are 3 key observations of the Copernicus module to be done:

- the extent of the Copernicus land cover (LUCAS LC classification at level 2) registered at the point reached in the field;
- the next land cover (up to 50 m);
- the breath of the next land cover.

These observations are to be done for each of the following 4 sectors:
- north west – north east (abbreviated with: northern cardinal direction, North, N);

- north east – south east (abbreviated with eastern cardinal direction, East, E);
- south east – south west (abbreviated with southern cardinal direction, South, S);
- south west – north west (abbreviated with western cardinal direction, West, W).

The LUCAS landscape photos are used to document this assessment, therefore the assessment of land cover change concentrates on the part of the landscape covered by the photos. Changes in land cover in this part of the landscape are to be registered and it has to be indicated if they are visible on the photos or not.

If there is a change in the land cover not in the field of view of the camera (= photo) (because the camera is not able to cover 90°), this is considered a special case. How to tackle this case is explained in the section "Special cases".

Extent of Copernicus land cover

For each sector the visible extent (or spatial dimension) of the Copernicus land cover (LUCAS LC classification level 2) is recorded as the radial distance in meters [fields 60 – 63] from the observation position up to 50 m. If the land cover extends beyond 50 m a value of "51" is to be inserted.

Please note:

As specified above the extent of the Copernicus land cover has to be at least 5m in any direction; else Copernicus cannot be assessed (Field 57: "Can you do the Copernicus survey?" = NO). If this is not the case from the position closest to the LUCAS point (e.g. observation position on the border of a parcel), the surveyor should move a few meters in any possible direction, but only if this does not have a negative impact on the assessment of the other LUCAS data.

Next Copernicus land cover

For each sector the next land cover is recorded if a land cover change (LUCAS land cover level 2) occurs within 50m, regardless of the fact that the next land cover is visible on the landscape photo or not. Any feature less than 3m wide is not taken into account and is not considered a land cover change.

If two or more new land cover objects appear within one sector then only the most important one is registered.

The most important next land cover is determined using the following rules:

I) Closest land cover change is to be recorded, or in case of same distance
II) Widest next land cover is to be recorded, or in case if same distance and width
III) First land cover change in a clockwise order is to be recorded.

Breadth of next land cover

In the final step the *horizontal breadth* [b] of the identified *new Copernicus LC object* at the identified *radial distance* [d] is to be recorded by assessing the % of the width of the land cover in this sector, as visible on the photo. This means that the breadth is 100% if the next LC is seen all over the photo from one side to the other. If the next land cover is not visible on the photo because it is completely behind a linear feature (e.g. hedge) or because it is completely hidden by the terrain, then the next land cover is to be recorded but the breadth is 0%.

VISIBILITY

If the next land cover is only partially visible on the photo because it is partially hidden behind a linear feature (e.g. hedge) or by the terrain, then only the visible extent of the next land cover is considered for assessing the breadth.

SPECIAL CASE I

If there is no land cover change but in one or more sectors a feature like a hedge (<3m wide) or the terrain completely hides the landscape behind, then the extent of the Copernicus land cover from the observation point up to the hedge/hill/bump is to be registered in the field form as extent. The next land cover is to be registered as -1 and the breadth is 0%.

SPECIAL CASE II

If there is a next land cover starting within 50m, the full breadth of this feature as visible in the photo is to be assessed, regardless of the fact that the feature might partly extend beyond the 50 m radius.

SPECIAL CASE III

Relevant LC change (>3m width, visible or not visible) within 50 m <u>not located</u> in the field of view of the camera (= photo). In this case a comment is needed:

- Comment code: PA02 “LC change existing but not located in an area covered by a photo”
- Comment detail: Free text comment: “XX YYm ZZ; xx yym zz" (multiple entries to be separated by semicolons)

  where XX = relevant direction (NE, SE, SW, NW), YY = distance from standing point, ZZ = next land cover.

In case that there are several land cover features not visible in different sectors, the comment shall look for example: “NE 10m A1; SW 20m B1; NW 20m C2”.

In any case only the closest change in each direction is to be registered. The order of registration suggested is based on the order of the directions NE, SE, SW, NW.

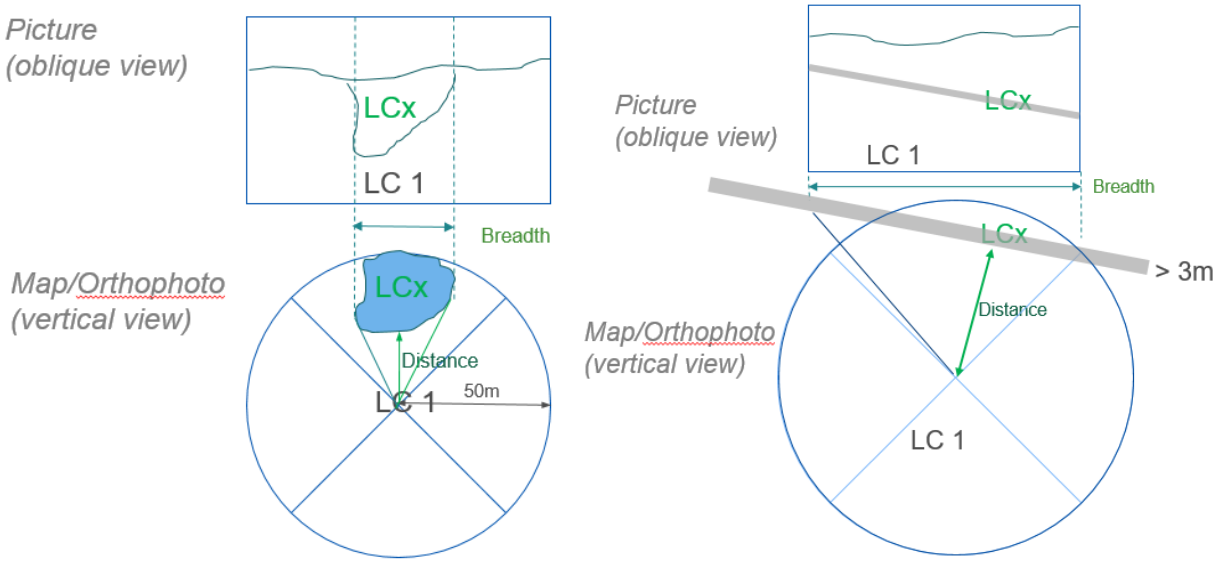


Figure 36

<u>Photo needed:</u>

A photo of the point, where the surveyor stands when taking the landscape photos, needs to be taken (fields 620, 622).

Indicate the point with an object. Step back some 5m and make a photo of the point (not a landscape photo). The photo should show as much as possible the surface found on the point.

Some examples:

Example 1: Copernicus point is inside a plot with E20

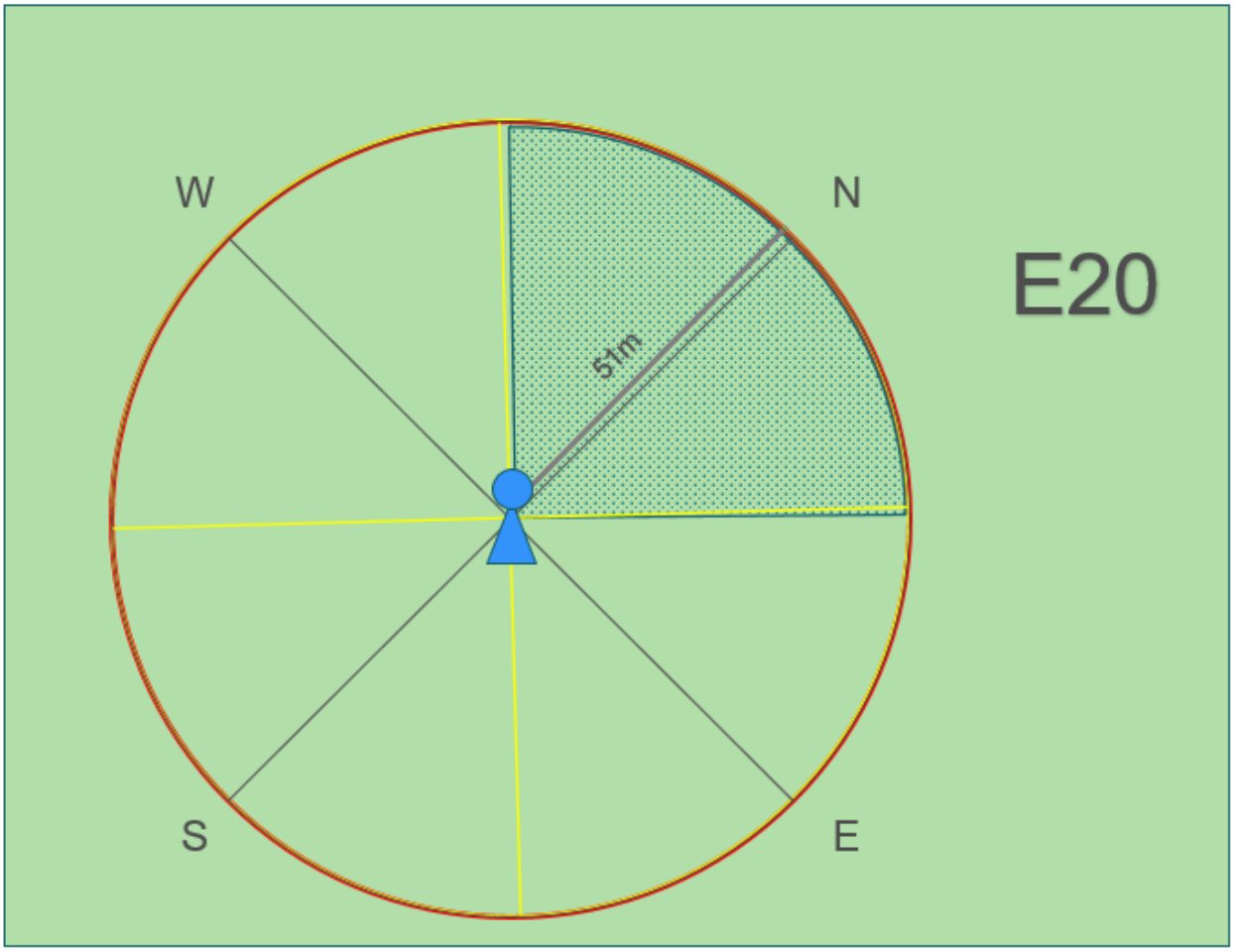


Figure 37

There is no LC change within the 50 meter within any of the sectors/cardinal directions.

	Copernicus LC: **E2**		
	Extension (d) of Copernicus LC in cardinal direction in **m**	Breadth of next LC in (%), if d <= 50m	Next LC, if d <= 50m
N	**51**		
E	**51**		

S	**51**		
W	**51**		

Example 2: LC change within 50m from the position of observation, distance, breadth and LUCAS LC level 2 code of the LC in the relevant sector have to be recorded.

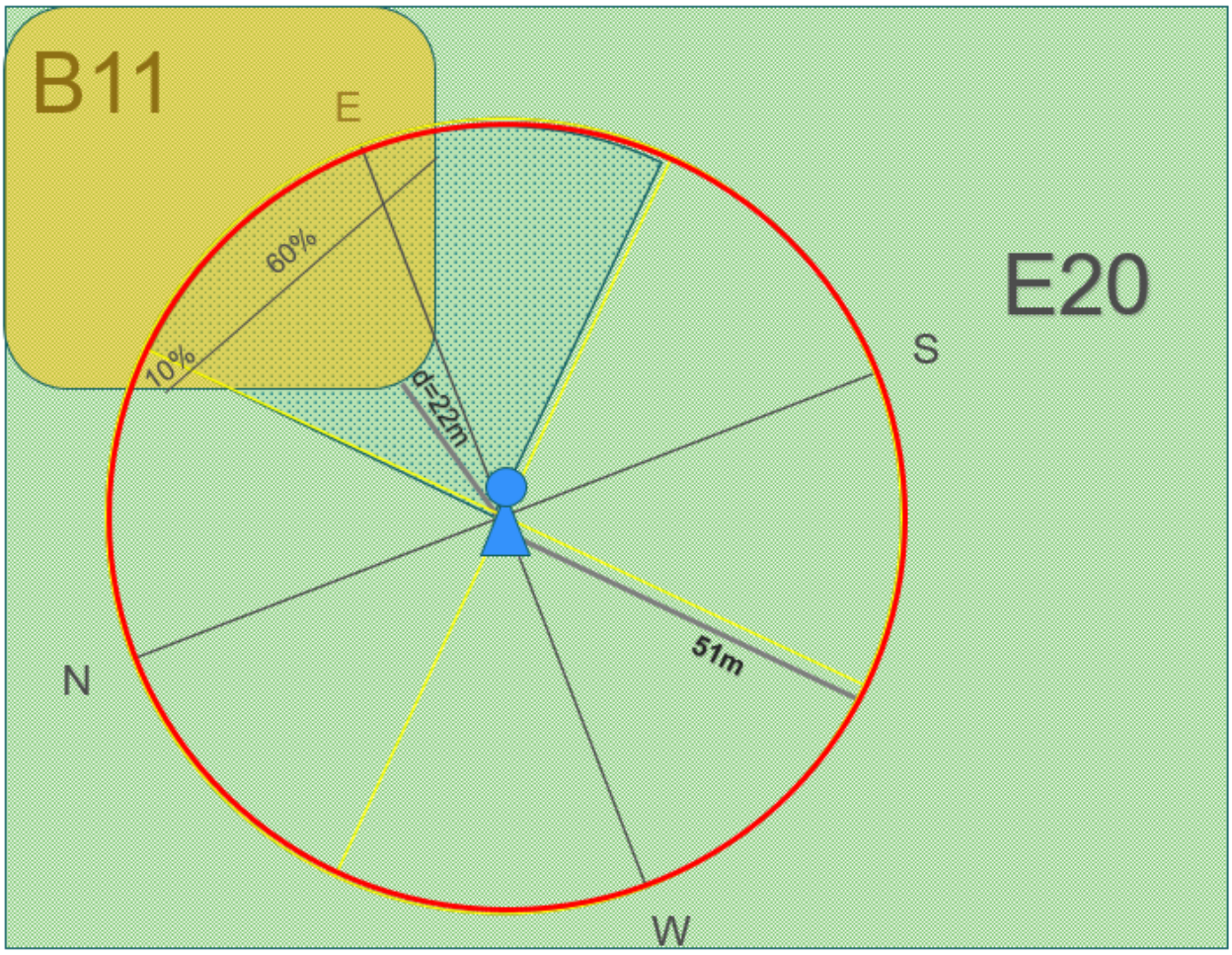


Figure 38

Identify the distance (d) towards the next different LC feature within the 50 m in each sector, in this case 22m towards B1 in the sector to the East and 40m in the sector to the North.
Estimate the breadth of the feature by recording the percentage of coverage of the feature in the sector by considering the horizontal view – only the visible part of the feature is to be assessed. In this case 60% in the East sector and 10% in the North sector.

	Copernicus LC: **E2**		
	Extension (d) of Copernicus LC in cardinal directions in **m**	Breadth of next LC in (%), if d <= 50m	Next LC, if d <= 50m
N	**40**	**10**	**B1**
E	**22**	**60**	**B1**

S	**51**		
W	**51**		

Example 3: Another example with LC change within 50 meter from the position of observation, the distance, breadth and LC level 2 code of the LC in the relevant sector have to be recorded.

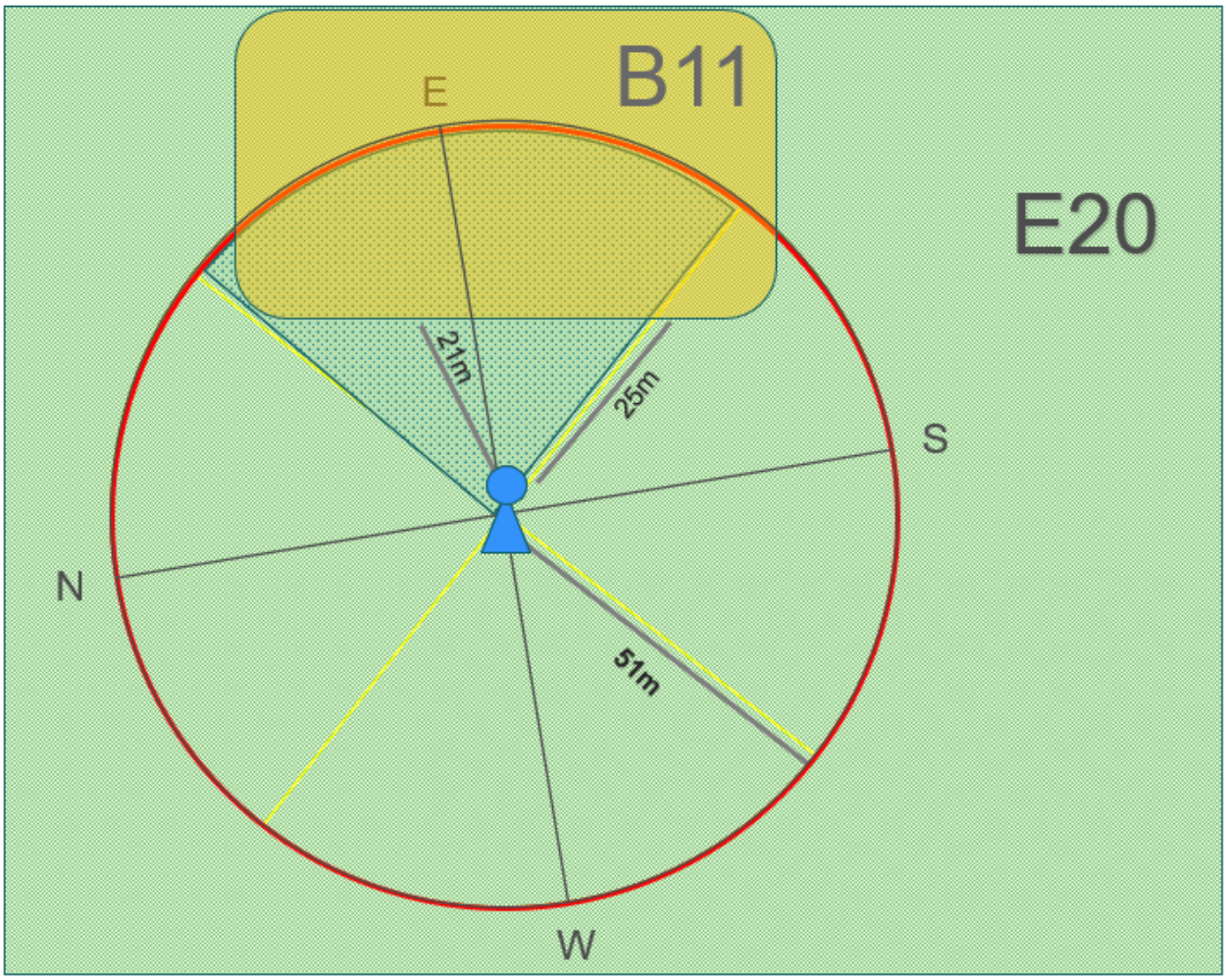


Figure 39

In this case the extent from the Copernicus point towards the B11 in the East and South sector and its breadth is recorded in each sector.

	Copernicus LC: **E2**		
	Extension (d) of Copernicus LC in cardinal directions in **m**	Breadth of next LC in (%), if d <= 50m	Next LC, if d <= 50m

N	**51**		
E	**21**	**100**	**B1**
S	**25**	**20**	**B1**
W	**51**		

Example 4: Two different LC changes within one cardinal sector

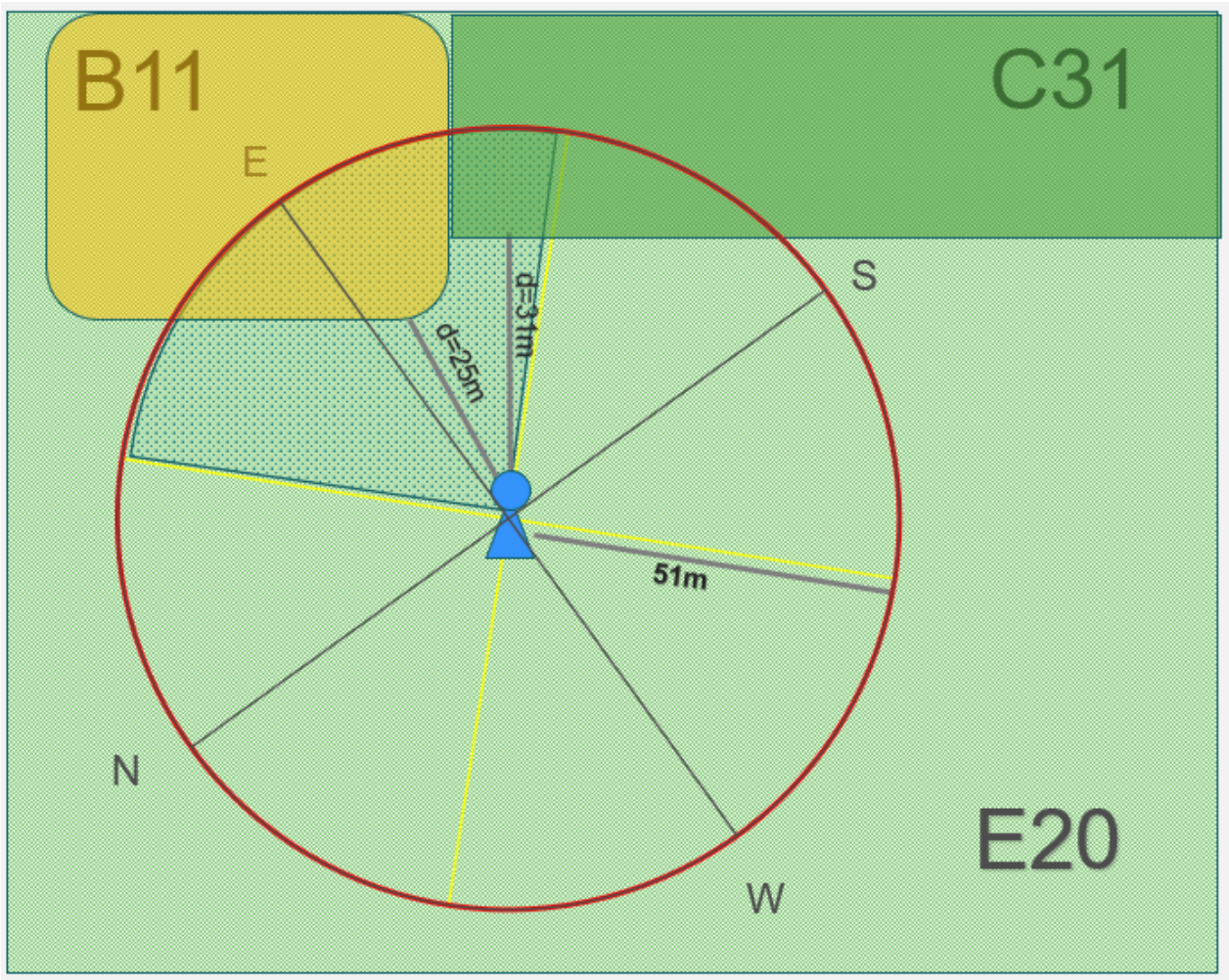


Figure 40

The closest LC change in the cardinal sector has to be registered. In this example only B1 is considered in the East sector, the C3 is ignored in this section. In the South sector C3 is recorded.

	Copernicus LC: **E2**

	Extension (d) of Copernicus LC in cardinal directions in **m**	Breadth of next LC in (%), if d <= 50m	Next LC, if d <= 50m
N	**51**		
E	**25**	**60%**	**B1**
S	**31**	**45%**	**C3**
W	**51**		

Example 5: Linear feature with less than 3m width within a cardinal sector are not considered a LC change. However if the linear feature is completely hiding the area behind the extent from the observation point to this feature and the "Next LC" ("-1") are registered.

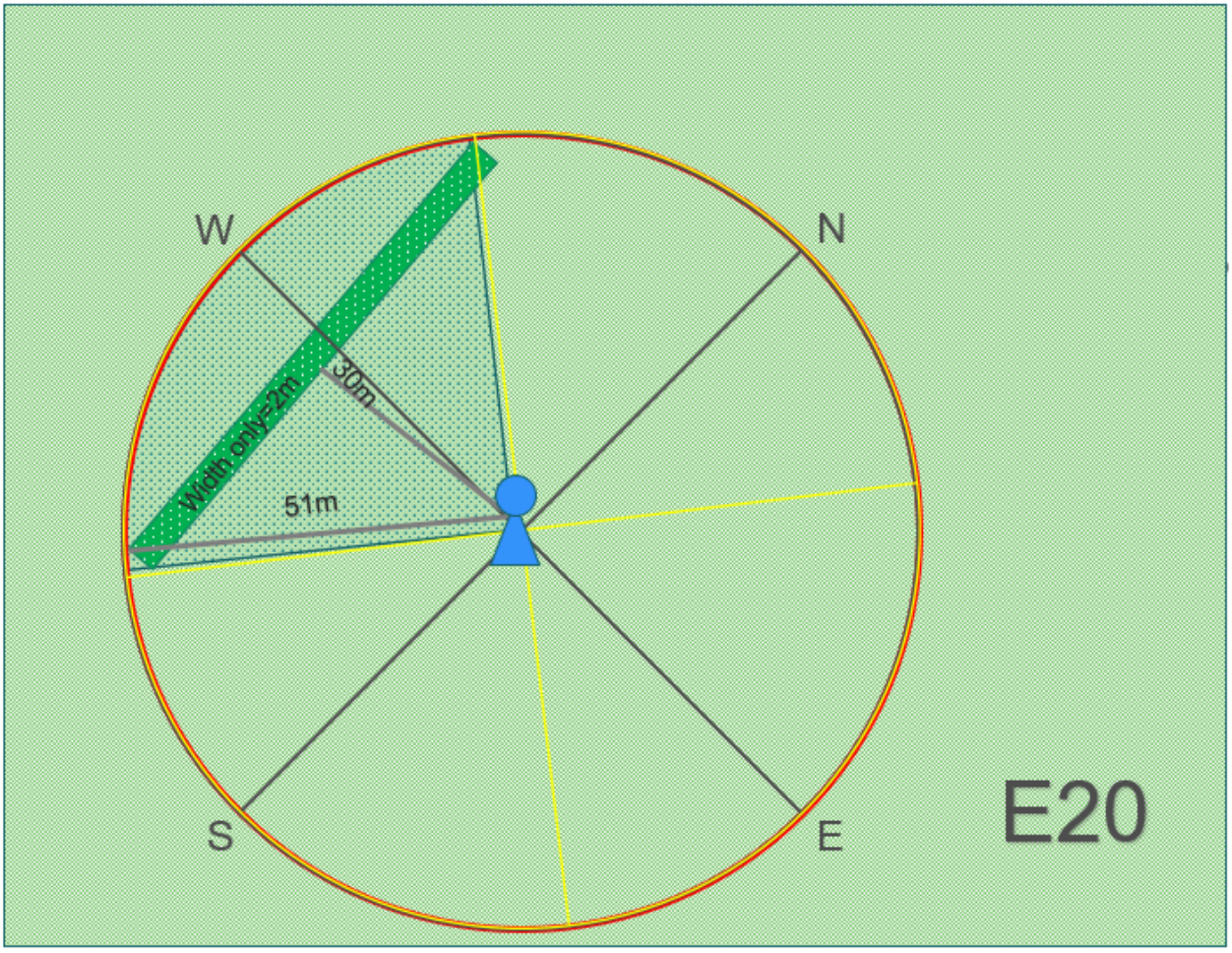


Figure 41

Linear features with width < 3m are not considered a land cover change. However, in the special case in which the linear feature completely hides the landscape behind the extent of the Copernicus land cover to the linear feature is recorded ("how far can you see" principle) and -1 is registered as next land cover,

to indicate that there is no change. As the land cover behind the feature is not visible, the breadth is 0.

	Copernicus LC: **E2**		
	Extension (d) of Copernicus LC in cardinal directions in **m**	Breadth of next LC in (%), if d <= 50m	Next LC, if d <= 50m
N	**51**		
E	**51**		
S	**51**		
W	**30**	**0**	**-1**

Example 6: Land cover change is more important than a small linear feature

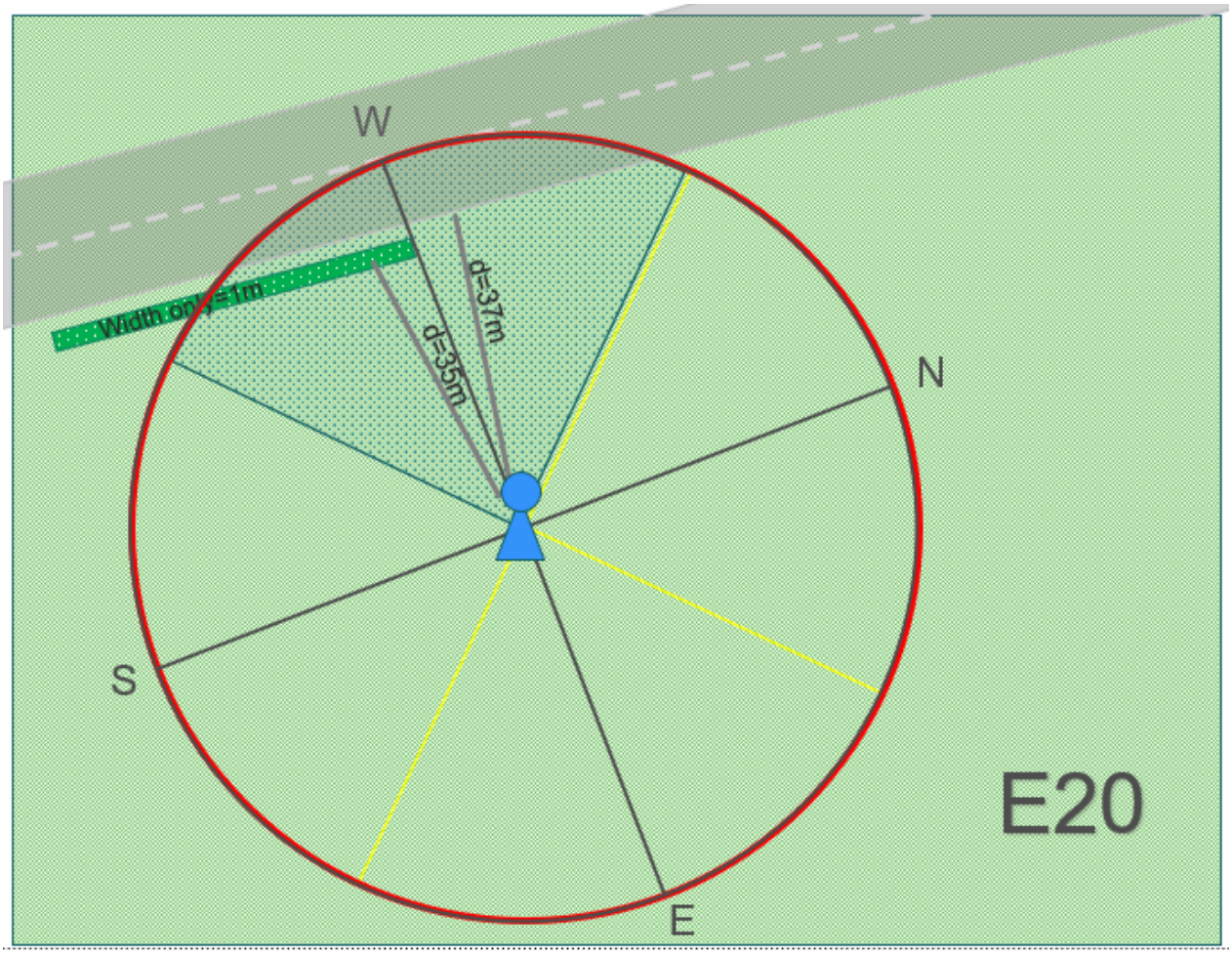


Figure 42

Linear features with width < 3m are not considered a land cover change. A land cover change is visible next to it, therefore the visible landcover change is recorded.

	Copernicus LC: **E2**		
	Extension (d) of Copernicus LC in cardinal directions in **m**	Breadth of next LC in (%), if d <= 50m	Next LC, if d <= 50m
N	**51**		
E	**51**		
S	**51**		
W	**37**	**50%**	**A1**

Example 7: Point of observation is on a border or feature with less than 5m width

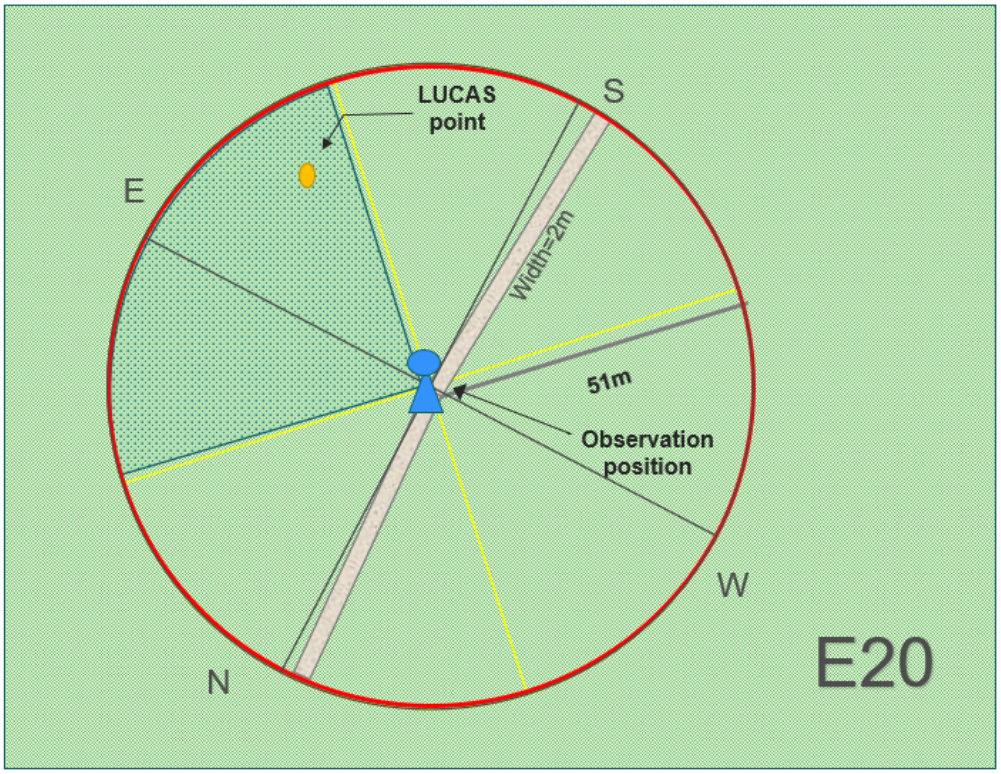


Figure 43

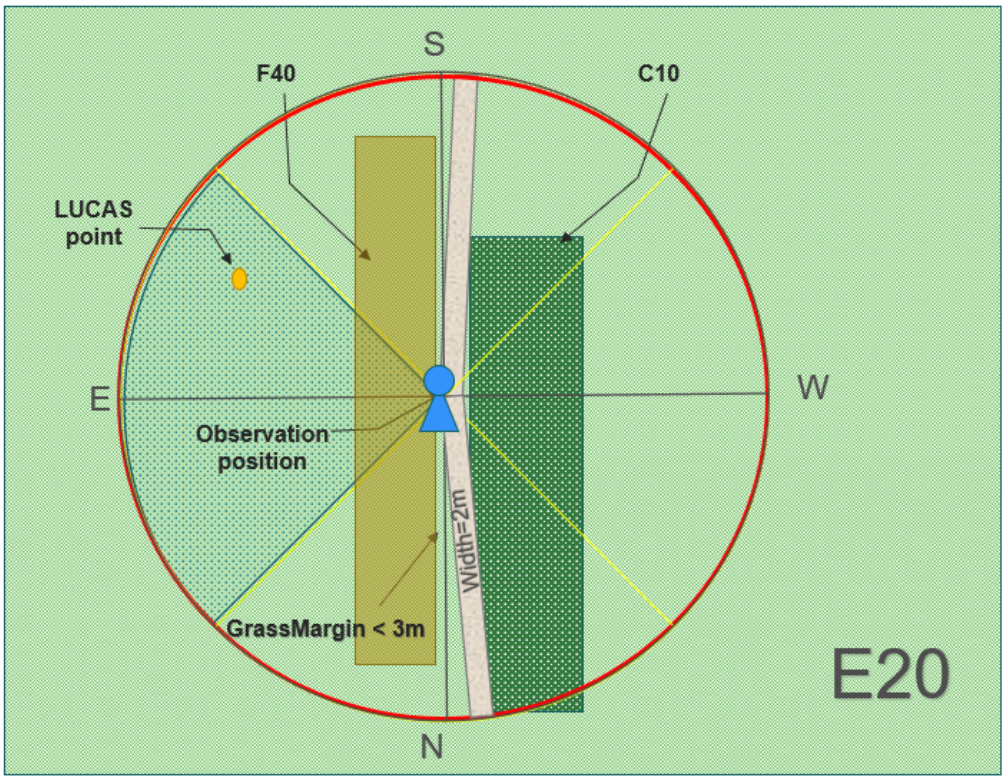


Figure 44

In such complex cases the Copernicus survey module is not applicable.

9.9 INSPIRE

9.9.1 Field: Point in urban area? (80)

In order to assure the mapping to Corine Land Cover it is important to determine if the LUCAS point is located in an urban area or not.

A good way to identify the “urban area” is to use the orthophoto, checking that it corresponds to reality. In general, the boundaries of an “urban area” are easily recognisable on an orthophoto and are marked by, for example, fences or walls around kitchen or allotment gardens, graveyards, residential areas or dwellings.

9.9.2 Field: Imperviousness (%) (81)

Imperviousness is assessed in order to support the classification and the validation of the Copernicus HRL "Imperviousness". This layer is based on the assumption that the more vegetation appears on the ground, the less sealed/impervious an area is. Therefore the definition used is the same as the one for this Copernicus HRL, that is all areas that are not vegetated are considered impervious.

The degree of imperviousness is to be assessed on the LUCAS point inside the extended window of observation (20m radius) and is based on birds eye view. The observation is not restricted to the homogenous plot.

The degree of imperviousness is the percentage (0 – 100%) of the area within the extended window that does not show vegetation.

E.g. bare soil = non-vegetated = 100% "impervious";

E.g. water = non-vegetated = 100% "impervious";

9.9.3 INSPIRE PLCC (fields 83 – 90)

Data on INSPIRE Pure Land Cover Components (PLCC) will only be collected for the points where LC (LC1 or LC2) is either woodland (CXX), shrub land (DXX), grassland (EXX) or bare land (FXX) and is to be 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%, the sum of PLCC must be 100%. Assessment of these percentages is made using the "birds-eye" view.

Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0)

Figure 45

9.10Section: EUNIS Habitat complex (92)

The interest here is to assess if there is agro-forestry taking place at the LUCAS point. To this end evaluate the homogenous plot within the extended window for points that have trees (permanent crops included) to assess if any of the 2 habitat complexes described below is present (92).

Remark needed:

If relevant add a comment (500).

Agro-forestry: "A land-use system that involves deliberate retention, introduction, or mixture of trees or other woody perennials in crop and animal production systems to take advantage of economic or ecological interactions among the components" (Dictionary of Forestry, Helms, 1998, Society of American Foresters, quoted from Vol 4, Forest land, 2006 IPCC Guidelines for national GHG inventories).

Therefore 2 specific EUNIS habitat complexes are to be assessed here:X06 or X09. If none of them is present select NR.

Strictly speaking X06 includes combinations that are not agro-forestry (when the trees are not forest trees). However both types of trees are of interest and the land cover information of the point allows to separate forest trees from non-forest trees. So no further information needs to be collected here.

X06	Crops shaded by trees	Crops, meadows or pastures developed under orchards or other cultivated tree plantations. The component habitat types may include elements of I1, E2.6 and FB.	ILE SAS	2005c	Revision of habitat descriptions originating from Davies, Moss & Hill, M.O. (2004)

X09	Pasture woods (with a tree layer overlying pasture)	Pasture woods are the products of historic land management systems, and represent a vegetation structure rather than being a particular plant community. Typically this structure consists of large, open-grown or high forest trees (often pollards) at various densities, in a matrix of grazed grassland, heathland and/or woodland floras. This habitat is most common in southern Britain, but scattered examples occur throughout the UK. Outgrown wood-pasture and mature high forest remnants occur in northern and central Europe, but the number and continuity of ancient (veteran) trees with their associated distinctive saproxylic (wood-eating) fauna and epiphytic flora are more abundant in Britain than elsewhere. Component habitat types include beech and yew woodland (G1.6 and G3.97), heathland (F4) and dry acid grassland (E1.7). A range of native species usually predominates amongst the old trees but there may be non-native species which have been planted or regenerated naturally.	Hill, M.O., Moss, D. & Davies, C.E.	2004b	EUNIS habitat classification descriptions

Habitat complexes: The listed habitat complexes represent preliminary draft proposals. They have not been subjected to rigorous scrutiny to ensure consistency. Some complex habitats have been listed above (e.g. valley mires D2.1). Hill, M.O., Moss, D. & Davies, C.E., 2004b EUNIS habitat classification descriptions

E.g. Dehesas are to be assigned X06, as the trees are cultivated. So even if it is forest species, as they are cultivated the habitat complex is X06.

9.11Specific module: Grassland

The new grassland module is a test module. LUCAS 2018 will assess the practical and technical feasibility of this module. A careful evaluation of the point is therefore important.

The record will be done either on a transect (20*2.5m), on an enlarged transect (20*10m) or on field.

9.11.1 GRASS point and region (H, I), survey possible: Can you do the grassland survey? (98)

Points that are part of the grassland survey have been selected based on the land cover information available in the LUCAS survey 2015. To qualify for the grassland survey a point had to have at least 50% of grass cover in the INSPIRE Pure Land Cover Component assessment in 2015 and the point was reached in 2015.

If the point has been selected fields H and I of the form will be prefilled as follows:

- Point is part of grassland module: Yes

- Grassland region of the point: Prefilled with relevant value

If the point has been selected for the grassland module this is because in 2015 the point was a grassland point and at that time the point could be reached. However conditions can change over time, the point might no longer be a grassland point, it might not be accessible or there might be other reasons that prevent the grassland survey. If the point is part of the grassland module and has been reached (same field, less than 100 m distance = observation type = 1) it is necessary to assess if the point still qualifies for the grassland survey, e.g., if there is at least 50% of grass cover, also it is necessary that a transect can be placed in the same field the point is in.

If these conditions are not fulfilled, the grassland survey is NOT to be done and "No" has to be selected in the relevant field 96: Grassland survey possible?

Remark needed:

In this case a comment explaining why the survey is not possible is mandatory (500).

9.11.2 EUNIS GRASS Habitat Type (98) (enlarged transect)

EUNIS is an EU-wide habitat classification system. Please indicate the level 2 EUNIS habitat type according to the habitat identification key given in Annex 10.8 (98).

The most important habitat types for the grassland survey are E1 – E7, for their identification and description see Annex 10.8.

E1 Dry grasslands
E2 Mesic grasslands
E3 Seasonally wet and wet grasslands
E4 Alpine and subalpine grasslands
E5 Woodland fringes and clearings and tall forb stands
E6 Inland salt steppes
E7 Sparsely wooded grasslands

There are, however, other EUNIS types and some LUCAS points may lie e.g. in forest (e.g. wooded meadows), fen or heathland. In this case LUCAS will not classify them as grassland but as C = Woodland, D = Shrubland or H = Wetland.

Overview on possible EUNIS habitat types

Broad habitat categories	**Potential habitat types**	
	EUNIS	**LUCAS**
Grassland main types	E1-E7, FA, FB	**E10, E20, E30, B55, B70-B77**
Grassland-relevant habitats other than lowland agricultural or semi-natural grassland		
Seashore	A2, B1	**H20**
Lakeshore	**C3**	**H10**
Mires, bogs and swamps	**D1-D6, F9**	**H10**
Riverbanks	**C3, E3, E5, F9**	**E10, E20, E30, H10**
Subalpine and alpine	**E4, E5, F2**	**B55, D10, D20, E10, E20, E30**
Heath and scrub	**F2- F9**	**D10, D20, E10**
Woodland/scattered trees	**E5, E7, G1-G5**	**B70, B80, C10, C20, C30, D10, E10**
Anthropogenic	**I1, I2**	**A30, B50, B55, E10, E20, E30**
Steppe	**E1, E6, E7**	**C10, E10, E20**

For the correct classification please use the habitat identification key given in this annex 9.8.

Remark needed:

A specific comment can be added to field n. 500.

9.11.3 Section: Grassland site (enlarged transect)

9.11.3.1 Field: Site orientation (100)

Orientation can be either “Flat” with no slope or indicate the direction of the slope: N = North, E = East, S = South, W = West; further differentiation: NE (Northeast), SE Southeast), SW (Southwest), NW (Northwest);

9.11.3.2 Field: Site slope (101)

Values between 0 and 90 degrees are to be recorded. However when analysing the data (after the survey) the values will be classified.

The final classification is as follows: 0, <3, <8, <15, <25, <35, >=35.

This means that the surveyor does not have to worry if the slope is 10, or 11, or 14, any of these numbers will be treated the same way in the data analysis.

9.11.3.3 Field: Site moisture (102)

There are six categories to judge the moisture of a site; please note that this refers to the **moisture of the soil** and not the moisture through current rainfall or the moisture of the vegetation.

Wet: Permanently wet through ground- or surface water or numerous floods per year with the water partly remaining on the surface. Reeds, sedges or rushes often dominate.

Moist: The grassland is frequently wet or moist throughout the year; reeds, sedges or rushes may occur frequently.

Mesic:	The site has a regular water supply but it doesn't suffer heavily from flooding or permanently high ground water. Reeds, sedges, rushes do not dominate.
Semi-dry:	The site is partly dry during the growing season. This often occurs on south-facing slopes and free-draining calcareous or rocky soils.
Dry:	The site is permanently dry or, depending on the biogeographical region, in some seasons of the year (e.g. summer in the Mediterranean region).
Mixed:	There are also sites where both dryness and moisture occur. For example, some south-facing slopes (which tend to be dry) may contain soil layers that frequently carry water, which can be accessed by some plants but not others; thus, indicators of wet conditions (e.g. sedges like *Carex effusus*) may occur alongside indicators of dry conditions (e.g. *Carlina acaulis*).

Figure 46

Figure 47

The moisture of a site is an important characteristic; good indicators are for example the Juncus species (photo of Swabian Jura, 05.05.2016).

Figure 48

Here three types of moisture can be seen: in the middle the flooded plain comprise wet sites (throughout a large part of the year), in the plain but not under water are the moist sites and in the foreground at the edge of the plain there are mesic sites.

(a), (b), (c), (d)

a-d (upper row) and e-f (bottom row):

- *(a) Moist site with sedges and rushes on the pasture,*
- *(b) and (c) mesic sites without specific characteristics*
- *(d) semi-dry site on the slope,*
- *(e) another semi-dry site on the rocks and shallow soil,*
- *(f) dry site (dry throughout almost the whole year.*

(e)

(f)

Figure 49 a, b, c, d, e and f

Site moisture – Examples (© Rainer Oppermann, 2016)

9.11.3.4 Field: Soil surface (103)

- very **even** (smooth)
- somewhat **heterogeneous** or rugged (humps and depressions of 5-10 cm height / depth scattered over the transect)
- **very heterogeneous** or rugged (humps and depressions of >10 cm height / depth scattered over the grassland transect).

9.11.3.5 Field: Presence of animal paths (104)

Animal tracks should be noted; normally they don't cause erosion and they may even play a positive role in preventing erosion and supporting biodiversity; however, in case of overgrazing they may be problematic. Tick the box if animal tracks are present.

9.11.4 Section: Grassland fertilisation (enlarged transect / field)

9.11.4.1 Field: Fertilisation (106)

Fertilisation is not always easy to see. However, in some cases it is clear that there is fertilisation because you see for example the active spreading fertiliser or it lying on the surface. Please tick the boxes as follows:

- no: no fertilisation can be seen and the grassland seems to be unfertilised (sparse growth, grass is yellowish or olive colour and not dark green;
- probably: the grass is lush and dark green but there are no signs of fertilisation (no slurry, no injection tracks, no solid manure, no mineral fertiliser visible) and the sward consists only of few species – thus it seems probable that the grassland is fertilised even if you don't see any direct signs of fertilisation.
- sure: you see direct signs of fertilisation (slurry, injection tracks for slurry, solid manure, pasture dung, or mineral fertiliser visible)
- unclear: there are neither positive signs nor negative signs of grassland fertilisation.

9.11.4.2 Field: Type of fertilisation (107)

In those cases where you have clear signs of fertilisation you often can see the kind of fertilisation. Tick one of the following boxes:

- mineral: you see mineral fertiliser granules on the ground or powder (common in the case of liming) or you see the farmer spreading the mineral fertiliser.
- slurry: you see the slurry on the leaves or you see injection tracks in the ground.
- solid manure: solid manure can easily be seen also many weeks after fertilisation.
- pasture dung: pasture dung of grazing animals can also be observed easily and also many weeks after the pasturing.
- unclear: even if you are sure that there is a fertilisation you might not be able to say what kind of fertilisation has taken place (e.g. when mineral fertiliser or slurry distribution have been applied several weeks before and it has rained considerably in the meantime).

9.11.5 Section: Grassland type (enlarged transect / field)

9.11.5.1 Grassland type (109)

Select the grassland type (meadow, pasture, other grassland) in field 109. Complete fields 109 – 124 as appropriate, based on the indications below.

Add comments in field 500 as needed.

9.11.5.2 Meadows: growth, recently mown (110, 111)

Meadows are grasslands that are cut one or more times per year for harvesting hay, silage or biomass (e.g. for biogas). There is a very broad range of meadow types and uses. For example, in some meadows only the first spring growth is cut after which it is grazed, whilst others are mown only in autumn for harvesting litter (animal bedding) or are mown only every second year.

The optimal time for carrying out the survey is before the first cut or grazing period. It is important to note if the vegetation is first growth (i.e. before the 1st cut), second growth (after the 1st cut and before the 2nd cut) or if it has been recently mown.

During first growth, the grass species and many forb species develop flowers, in the second growth the grass species mainly develop leaves. If the grassland has recently been mown, please indicate according

to your own judgment if this happened less than one week ago (sward is very low, hardly any new shoots have developed), more than one week ago (grass and forbs have new shoots but they are still fresh) or > 3 weeks ago (vegetation / second growth of the grassland is well developed).
Please indicate also if the meadow is fallow; this is the case if old vegetation from the previous year(s) can be seen (e.g. large amounts of dead leaves, tall and dry forbs or small woody plants).

If you find your LUCAS point on a recently mown parcel, please check if you can do the transect record on some unmown part of the meadow. However, this should only be done if site conditions are homogeneous and should be noted on the survey form!

If this is not possible, some information cannot be collected.

9.11.5.3 Pasture: grazing, freshly grazed (112, 113)

Pastures can usually be easily distinguished from meadows by the presence of fences, by animals on the pasture, by animal tracks, by animal dung, by a water supply or shelters for animals etc.
As in meadows, the optimal time for carrying out the survey is the first growth of the vegetation during the year (before 1st grazing). It is important to note if the pasture is in its first growth or in its second growth (after 1st grazing) or if it is freshly grazed.
Please indicate also if the pasture is fallow; this is the case when old vegetation from the previous year(s) can be seen (however, note that in contrast to meadows, regularly grazed pastures may have many tall forbs and small woody plants that are avoided by the livestock!).

If you find your LUCAS-point on a recently grazed parcel, please check if you can do the vegetation record by checking the species on some ungrazed patches (e.g. under or adjacent to a fence). However, this should only be done if site conditions are homogeneous and should be noted on the survey form!

If this is not possible, some information cannot be collected.

Please note the following characteristics of the pasture:

Type of grazing (if freshly grazed pasture)(113):

- rough grazing: very low-intensity grazing, whereby the animals do not graze for long in a single location and constantly wander. Often this kind of grazing is done without fences or on very large areas.
- seasonal grazing: the animals graze the parcel 1-5 times a year. Normally these pastures are fenced.
- strip grazing: the animals are fenced on small strips of a pasture and are moved every 1-5 days or every week. The biomass is grazed intensively and normally there are no ungrazed patches left after the animals are moved on.
- if the kind of grazing is unclear, do not tick any of the boxes.

Type of livestock (animals if grazed)(115 – 123): the most frequent type of grazing livestock are cattle, horses, sheep and goats. Please tick the box if either the animals are observed directly or if you can judge it from the dung left by the animals or from the animal tracks.
Other grazing animals could for example be geese and /or ducks, deer, donkeys etc.

9.11.5.4 Other grassland (124, 500)

If it is difficult to judge if the grassland is a meadow or a pasture, or it serves both purposes, tick the box meadow or pasture.
For fallow grassland it may be not possible to judge how it was used before management ceased; then classify it as “other grassland” and tick the box “fallow” (Field 124, option 5) and indicate the length of fallow status (up to 2 years or > 2 years, see below)(125).

Further special types of “other grassland” are:

- pastured woodland: animals regularly graze the parcel and there is a tree cover;
- amenity grassland: all kind of grasslands in and around cities, villages and human settlements (in parks, at the side of roads, football pitches, gardens etc.);
- ruderal grassland: mainly self-seeded grassland with grasses and forbs – it may look similar to extensive used pastures or meadows;
- other grassland not included in the categories above should be noted and described in a few words.

Remark needed:
If "Other type of grassland n.e.s." is selected a comment is needed.

In the case of fallow grassland you should note if the grassland has been fallow for up to 2 years (only old grass and forbs occur but no bushes and the soil surface is still even) or longer than 2 years (possibly with bushes and a heterogeneous surface due to growth of grass tufts and ant hills.

9.11.6 Section: Grassland age (enlarged transect / field)

9.11.6.1 Field: Grassland age (126)

It is not easy to judge grassland age (i.e. the length of time that the current vegetation has been growing without interruption by ploughing etc.). However, there are several signs that indicate if a grassland is more than or less than 5 years old:

Grassland older than 5 years (> 5 years):

- species-rich composition (normally more than 10* herb and grass species present), **and**
- no seeding rows from a seeding drill visible, the sward is rather dense and the composition / distribution of the grass and herb species on the ground is balanced.

* Please note: very intensively managed meadows, with high slurry inputs after each of several cuts per year show less than 10 plant species and still are old in the sense of same use and no ploughing for many years.

Grassland 5 years old or younger (≤ 5 years):

- seeding rows of grassland are visible and / or
- only few grass and forb species occur (< 10 species)
- small patches of open ground

Remark and photo needed:

Unclear age: If it is unclear whether the grassland is ≤ 5 or > 5 years old, this should be indicated by the surveyor and explained which signs are visible and which not (comments in field 500). A photo is to be taken to document these aspects (fields 653/655).

9.11.6.2 Field: Grassland installation (128)

Further it should be indicated if a young grassland (≤ 5 years) is

- seeded (see signs above under grassland (≤ 5 years) or if it has
- spontaneously revegetated, e.g. by regularly mowing former set aside areas.

Photo and remark needed:
If none of the obvious signs occur and other signs for judgment are present, please take a photo (fields 669 – 695) and describe other relevant signs in one line of explanation (comment in field 500).

Figure 50 a, b and c (from left to right): Seeded grassland can be *identified for example when the sward consists only of a few species (here* Lolium perennis *and* Trifolium repens *in (a) and (b)) and is partly open (Photos from 05.05.2016, Swabian Jura) or when the grassland is monostructured and the seed rows can be seen ((c), Photo from 10.05.2016, Luxemburg).*

9.11.7 Section: Grassland transect (130 – 140)

The grassland survey is based on a transect of 20 m length and 2.5 m width. Walking alongside the transect line, the surveyor should survey the vegetation 1.25 m to the left and 1.25 m to the right. In a few cases the observation window is a bit wider: these cases are indicated separately below (e.g. for orchards).

The starting point and the transect should be at least 5 m inside the grassland field (not at the edge bordering e.g. on another parcel a road, a forest, or a ditch, etc., as the information collected on the transect should be representative for the grassland type of the parcel and not that of the edge.

Please indicate if the transect starts directly on the point or if it has to be shifted (as the point falls on the edge). If a shift is necessary, please indicate the direction (N, NE, E, SE, S …) and the distance of the shift (1-5 m).

Remark needed:

If there is a shift a comment on the reason for the shift is needed.

From the starting point, the transect should proceed in a strictly eastern direction. If it is not possible to walk a transect of at least 20 m to the east without coming within 5 m of the parcel edge, walk southeast. If this is not possible, walk south, and if neither of these options is possible take the direction southwest, west etc. Finally, if none of these directions are possible take the direction of the longest possible transect walk within the parcel and indicate the direction of the transect.

If the longest possible transect is < 20 m length (extending until 1 m from the parcel edge) please indicate the length of the transect (e.g. 14 m).

Photos needed:

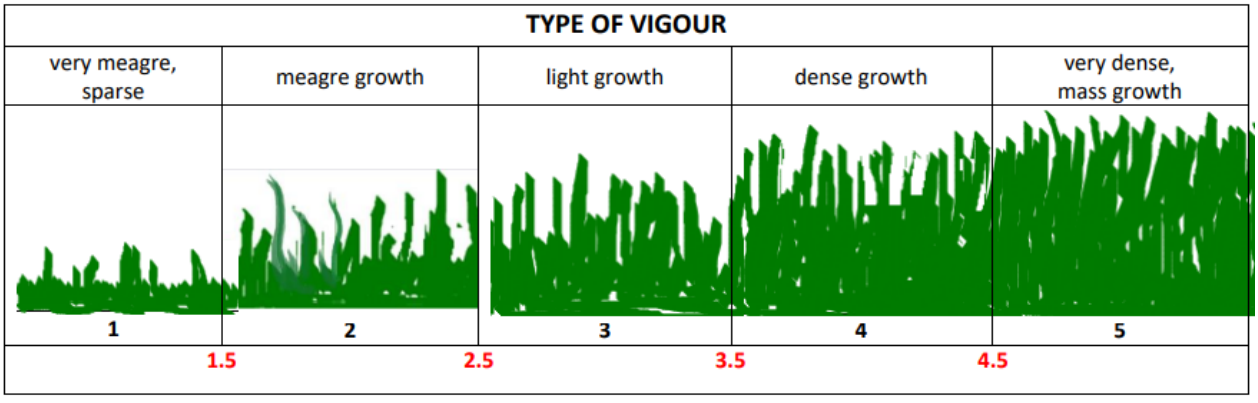
Take a photo from the starting point of the transect in the direction of the end point of the transect (fields 659/661).
Take one photo from 1.5 m height pointing the camera vertically downwards to a typical patch of vegetation for the transect (fields 662/664).

Take a photo from the end of transect point in the direction of the starting point of the transect (fields 665/667).
Mark the transect on the ground document and provide a photo of the marked transect on the map (fields 656/658).
Register the coordinates of the starting point and of the end point.
Remark needed:
If there is a problem with the GPS make a comment explaining the reason.

9.11.8 Section: Grassland vegetation layers (transect)

9.11.8.1 Field: Vigour of vegetation (142)

Grassland types often are characterised by quite different types of vegetation height and density (vigour), ranging from very dense (naturally or artificially fertilised) to very sparse (nutrient-poor and/or dry).
The vegetation on the transect should be assessed as one of five main categories of **vigour**. Intermediate stages (1.5, 2.5 etc.) should be assigned when the vigour is between two main categories. The height is not relevant for the type of vigour as the height depends mainly on the dominant species. The main characteristic is the density of the vegetation, especially to what extent sunlight can reach the low plant species near the ground. The type of vigour is assessed by looking vertical to the ground and checking to what extent the view (sunlight) can reach the different plant layers and the low plant species. Type 1 is a very meagre vegetation where the low plant species can be fully seen, type 3 is a light growth vegetation where the sunlight can reach almost all layers but with medium shadow effects given through higher plants and type 5 is very dense vegetation where only the highest plants receive sunlight.



Vigour of vegetation Figure 51

However, difficulties may occur when the grassland is pastured or has already been mown. The type of vigour is indicated to show the full potential of the vegetation in spring; thus grazed pastures may be judged with the help of ungrazed patches remaining on the pasture. Meadows before the first cut should be judged according to the density that will be reached when most of the grass species are flowering. For example, a score of 4 or 5 can be expected if one or few highly productive species dominate, whilst the grassland will probably be 1, 2 or 3 if there is space between the tall grasses and forbs and sunlight reaches the ground.

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Figure 52. a, b and c: These three pictures show three types of vigour: (a) type 1.5 sparse, (b) type 3 (light/medium growth, sun light can still reach the ground) and (c) type 4.5 very dense growth

9.11.8.2 Fields: Percentage of herbaceous, bare and woody layer on grass transect (143 – 145)

First of all the horizontal coverage of the main layers (graminoid-herb layer, woody layer, open soil layer) is estimated in % and the sum of all three layers may sum up to over 100 % as, for example, in an orchard there may be 30 % coverage of the fruit tree canopy, then there may be a dense pasture with 90-100 % coverage and there may be even open soil from animal tracks etc. over 10 % of the transect.

While the information collected by the surveyor is a percentage and any integer value is a possible value, the surveyor should be aware that the percentages collected will be re-grouped into the following categories when the results will be analysed:

0
<3
<8
<15
<25
<35
…
<85

86 – 100

The coverage of the herb layer comprises all areas covered by non-woody vegetation (grasses and broad-leaved plants) when looking downwards from about 1.5 m height.

The coverage of bare ground comprises all areas not covered by vegetation (the % bare ground visible when looking downwards from about 1.5 m height).
The coverage of the lignified plant layer (woody plants) comprises all types of woody material (bushes, orchards, dead wood) as a percentage of ground covered by these.

9.11.8.3 Fields: Herb layer components (147 – 151)

- graminoid layer: all graminoid species including grass, sedges, rushes, reed;
- forb layer: all forb species (i.e. non-woody plants that are not grasses, sedges or rushes), as well as fern species;
- moss layer: this layer comprises all mosses in the herb layer and on the ground;
- lichen layer: this layer comprises lichens in the herb layer (not on rocks and stones, as these are included in the layer open soil);

The sum of all layers (graminoid layer+forb layer+moss+lichen-layer) can exceed 100 % as for example there may be a grass layer with 60 % coverage and also the forb layer may cover 60 %.

9.11.8.4 Fields: Bare layer components (153 – 155)

- bare soil: this category comprises open / uncovered earth, sand and mud;
- rock / stones: rocks, stones, boulders and gravel;
- litter: dead leaves and vegetation from the previous year(s) are still present on the ground during the survey;

Bare ground normally covers only a small proportion of grasslands; however, under extreme conditions this category can reach up to values of > 50 %.

On this photo, all main types and many sub-types of layers occur: There is a woody plants layer (45%) with old trees (10%), with shrub (30%) and with dead wood (5%). Also a graminoid-herb layer with graminoids and forbs (ratio 40:60) can be seen.

The estimated percentage of the woody layer refers to the enlarged transect (20 m transect, 5m left and 5 m right), the herbaceous layer refers to the transect of 20m x 2,5 m.

Figure. 53: *On this photo all main types and many sub-types of layers occur:*

There is a woody plants layer (40%) with old trees (10%), with shrub (30%) and with dead wood (5%), there is a graminoid-herb layer (60%) with graminoids (30%), forbs (40%) and legumes (5%, and there is a bare ground layer (10%) with open open soil (10%) and litter (5%).
The estimated percentage refers to a strip of 10m X 20m (20 m transect, 5m left and 5 m right).

9.11.8.5 Fields: Woody layer components (lignified plants) (157 – 162)

This layer requires a wider observation window (5m left and 5m right of the transect line – (thus normally 20m*10m = 200 m^2) as judging the tree canopy coverage requires a larger area to be considered than just the normal 2.5 m transect width.

- orchard: all kind of fruit and nut trees (e.g. apple, pear, cherry, plum, walnut);
- old trees: trees older than 20 years or higher than 5 m are considered, often found in wood pastures, olive groves and dehesas;
- shrub: all woody plants > 1 m and < 5 m height;
- dwarf shrub: small woody plants normally < 1 m in height, e.g. heath (the woody species of *Calluna* and *Erica*), blueberry or the hairy alpenrose in the Alps or the Phrygana and Garrigue vegetation in the Mediterranean countries (comprising woody plants with thorns or spines).
- other woody species: all woody species not classified as shrub, dwarf shrub or heath, e.g. woody species like *Rubus* spec.;
- dead wood: dead wood lying on the ground is characteristic for semi-natural conditions and should be recorded, e.g. lying tree trunks or branches. Standing dead wood, or dead branches still attached to the tree should not be counted.

When estimating the percentage of the different woody layers, always consider the whole plant: for a shrub of 4 m height, also include the parts of the shrub lower than 1 m in the layer estimate; if there is dwarf shrub that is mainly below 1 m in height, also include the parts of the plants greater than 1 m in height.

The sum of all woody layers can in extreme situations reach 100 % or even more, e.g. in a dense wood pasture where further woody species occur on the ground.

9.11.9 Section: Grassland herb layer: number, height and heterogeneity (transect)

9.11.9.1 Number of herb layers and height (165 – 169)

The herbaceous vegetation can often be divided into separate layers formed by different species or groups of species. The height, measured in cm, is determined by looking against the horizon; for example, the upper layer might be 140 cm in height built mainly by the grass *Arrhenatherum elatius*, even if a few individual grass stalks are 160 cm in height (i.e. not the maximum, but the average height of the top of the layer!). There may be multiple lower layers comprised of other grasses (often at about 100 cm height) or herbs like *Centaurea jacea* or *Salvia pratensis* (often at about 60 cm height), and perhaps a lowest layer of creeping speci currently flowering forbs es such as white clover (*Trifolium repens*) at about 25 cm or even 10 cm height. There may thus be up to five layers in the grass-herb vegetation, although many meadows and pastures only have 2-3 layers, and seeded grassland sometimes only has one visible layer (formed by the dominating / seeded species).
Please indicate the height of the different layers in descending direction (e.g. 120 / 80 / 50 / 20) and note the number of layers (in this example 4).

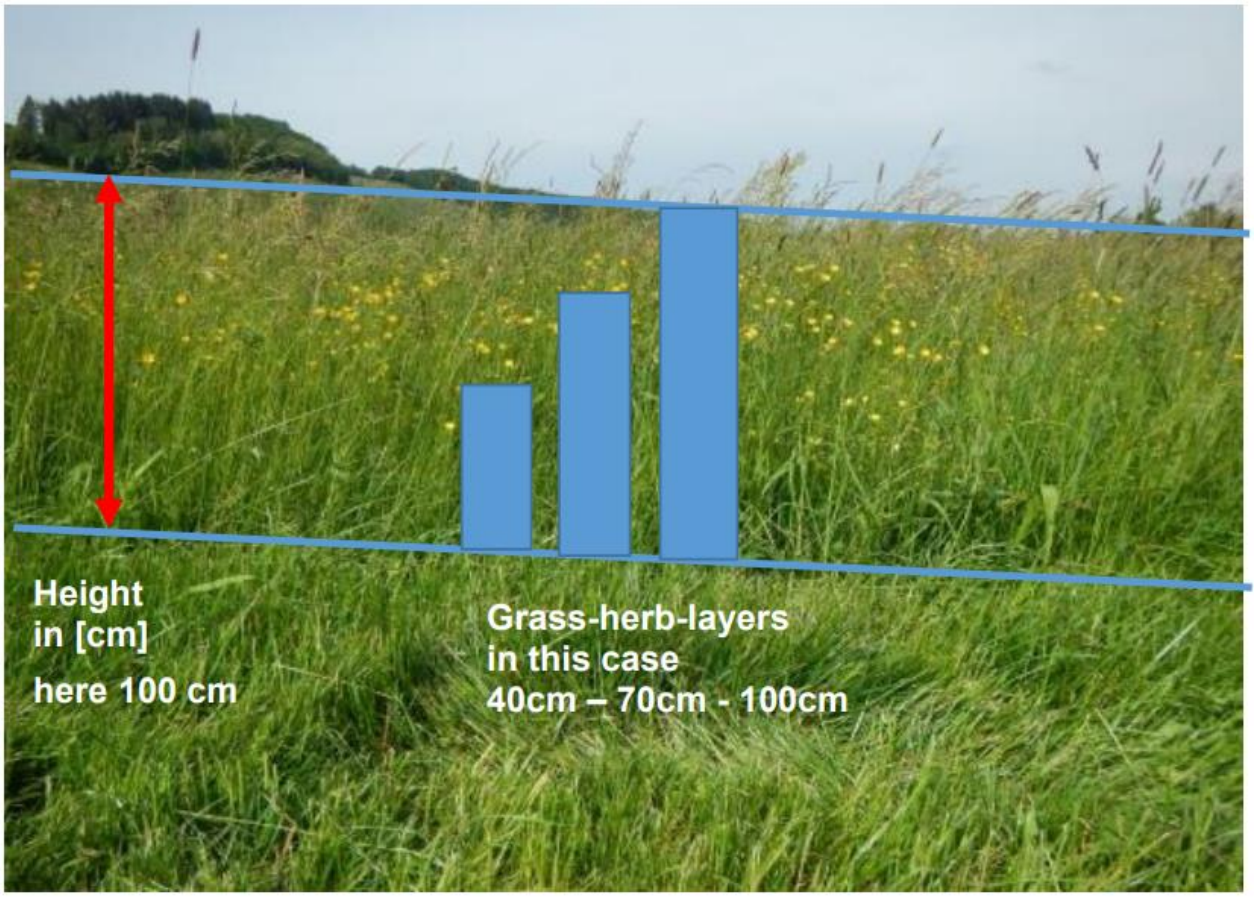

Photo of a grassland with the upper layer marked with the blue line. This can also be done on slopes as demonstrated on the photo (the foreground on the photo is mown). In this case there are three layers: the dense grass layer on the ground, the middle layer with yellow flowering Ranunculus, and the upper grass layer. Please note: the total height and the upper layer are not measured with the highest blades of grass but with the average height of the upper grass layer (can be seen by looking against the horizon).

Figure 54

9.11.9.2 Herb layer heterogeneity and heterogeneity reason (170, 171)

In addition to the indication of the height and number of layers, please indicate if the vegetation as a whole is more or less homogeneous, or if it is heterogeneous (patchy) or even very heterogeneous.
Please also indicate the reasons for heterogeneity / patchiness.

Remark needed:

If "other reasons" is selected please explain these reasons.

9.11.10 Section: Grassland flower (transect)

9.11.10.1 Number of species of flowering forbs (173)

Please count the number of currently flowering forb species (also the species which have well developed flower buds almost ready to flower, and species which have just finished flowering and the dead flowerheads can be seen). This applies only to insect-pollinated plant species (species with +/- coloured flowers, no grasses/sedges, no plants with inconspicuous flowers like Plantago spec.) but it applies to all flowering plants and not only to those indicated on the key species list.

Please count these flowering species exactly up to 10 species and write down the number. Please assess if there are <=15, <=20, >20 flowering forbs.

9.11.10.2 Flower density (174)

Please indicate the flower density according to the following scale:

There are five main categories of flower density; however, it often occurs that it is difficult to decide whether to take the one or the other category especially in direct comparison of meadows; therefore also the intermediate boxes shall / can be ticked.

1. none — no flowers in the transect
2. very few — hardly any flowers in the transect
3. very few to few — between hardly any and a few scattered flowers
4. few — a few scattered flowers
5. few to medium — between a few scattered and regular flowers
6. medium — regular flowering in the transect but not a dense flowering
7. medium to dense — between regular and many flowers
8. dense — many flowers occur, but not a dense “flower carpet”
9. dense to very dense — between many flowers and dense “flower carpet”
10. very dense — dense “flower carpet”

All flowers are to be considered.

10 – very dense	8 – dense	6 – medium	4 – few	2 – very few	1 – none

Figure 55 *a, b and c: The flower density in these three pictures reaches from (a) very few (almost no), over (b) few-medium (“between-category”) to (c) dense.*

9.11.11 Section: Key species/species group richness (177 – 218)

There are 20 key species for each European subregion. The key species are species that indicate species-rich or semi-natural grassland, as well as being easy to spot / identify, and neither too rare nor too common.
The presence of these species should be recorded on the transect walk of 20 m length and 2.5 m width. While walking slowly along the transect line please tick the boxes of the key species that are present. While walking back on the transect, please indicate the abundance of the species, from 1 to 10 or >10:

For final analysis the values will be regrouped as follows:
- only 1-2 individual plants were seen within the transect;
- 3 – 10 individual plants were seen within the transect;
- more than 10 individual plants were seen within the transect.

If there are several species of one group (e.g. two *Campanula* species, for example *C. rotundifolia* and *C. patula*) the box is only ticked once and the abundance refers to all the plants in the group together.

9.11.12 Section: Grassland structural characterisation (enlarged transect)

9.11.12.1 Structural species / species group: presence and % (221 – 233)

Certain species tend to dominate under certain conditions. These may indicate positive conditions for grassland nature value (signs of extensive use) or negative conditions (e.g. abandonment).
Please tick the boxes if the species listed are present in the transect and record the percentage coverage (not the number of plants).

While the information collected by the surveyor is a percentage and any integer value is a possible value, the surveyor should be aware that the percentages collected will be re-grouped into the following categories when the results will be analysed:

0, <3, <8, <15, <25, <40, <60, <80, <=100,

Always indicate the coverage you estimate over the whole enlarged transect of 20m x 10m (200 m2).
All species of one species group are counted together (e.g. all Juncus species, both large and small species).

A few species groups are present in this and in the previous section. While they indicate species richness in the previous section (depending on the survey region – differing across Europe) they indicate a structural characteristic in this section (here they are listed with their coverage in %).

9.11.12.2 Number of other structural species (234)

Further dominant structural species that are not listed among the structural species (in the previous chapter) may occur. These species are also considered as structural species and need to be assessed.
Other dominant structural species are other woody plants and tall herb species that form distinct patches in the enlarged transect (≥ 20 %). Thus they form a considerable proportion of the transect and/or occur in clusters, and that are significantly more common than most other species.

Examples of these species are the wild grapevine (Vitis vinifera), broom (Cytisus scoparius) or Canadian goldenrod (Solidago canadensis).

Register the number of these additional structural species in the table on structural species.

Photo and remark needed:

Please take a photo (additional photo "Grassland dominant species", fields 669 – 695), note the photo number and estimate the percentage of coverage. If you know the species name, please add it (500).

9.11.13 Section: Total cover of legumes (%) (transect) (236)

Record the total coverage of all herbaceous legume species.
Consider those in the list of key species **plus additional other legumes** like white clover species and blue lucerne).

Legumes are the following species groups:
Astragalus spec., Coronilla spec. Onobrychis spec., Hedysarum coronaria
Medicago spec., Lotus spec., Coronilla spec. – all species
Trifolium spec. – all species (red, yellow and white flowering)
Vicia spec., Lathyrus spec., Astragalus spec. – all species
other herbaceous species in the pea and bean family (Fabaceae; e.g. lucerne, lupin)

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Figure 56 a and b: Legumes may form a considerable part of the herb layer as in (a) the sain foin (Onobrychis viciifolia); also legume species not listed in the key species list like white clover (b) have to be considered during the estimate of the coverage of the legume layer.

9.12Water management (251 – 254)

Data for water management is collected if a point falls in an area where the use is agriculture or fallow land (LU=U111 or U112) or if the grassland module has been assessed.

Determine the presence of water management in the field you are in, as far as visible form your point of observation. If present, determine the type of irrigation, the source and the delivery system.

Record source and delivery if visible	The source of the water and the delivery from the source (only relevant for irrigation) should be recorded if visible.
Mark the dominant source or delivery	If more than one source or delivery systems are present, mark the dominant one.

It is not always possible to identify a source	Sometimes it will not be possible to see the source of irrigation, as the water is distributed over a long distance.
Identify watering devices in the field	The surveyor should take the supplying devices in the visible surroundings of the point, either on the same field parcel or at the edge of it, or if within walking distance (≤ 100 m), of the neighbouring field parcel if the water device is covering the survey point as well.

Source and delivery systems can be found in various combinations. See below some examples

Type: gravity irrigation	Irrigation water is delivered to the field through an irrigation ditch. Water is siphoned from the ditch and allowed to gravity flow down the furrows.
Type: gravity / pressure	Irrigation water is delivered to the field through an irrigation ditch. A side roll sprinkler irrigation system picks up water from the ditch and irrigates the field.
Type: pressure (sprinkle irrigation)	Irrigation water is delivered to the field through a pressure pipeline. The field is irrigated with a centre pivot irrigation system.
Type: pressure: (micro-irrigation)	Irrigation water is delivered to the field through a pressure pipeline. The field is irrigated with a drop-by-drop irrigation system, which is partly buried in the ground.
Source: Well	Examination of surroundings reveals a well house with photovoltaic panels or power lines entering it.
Delivery: canal	Examination of surroundings reveals a canal along the side of the field.

Photo needed:

If there is irrigation, take a photo showing the irrigation present (fields 623/625).

Take additional photos as needed (additional photo "Water management", fields 669 – 695).

9.13 Specific module on soil (in DMT after erosion)

This chapter is based on the Joint Research Center Technical Report "LUCAS 2018 Soil Component technical reference document – instructions for surveyors" (version dated 28.04.2017) by Oihane Fernández-Ugalde, Alberto Orgiazzi, Arwyn Jones, Emanuele Lugato, and Panos Panagos.

9.13.1 Purpose of the soil sampling in the LUCAS Survey

The soil component has been incorporated in the LUCAS survey in order to create a harmonised and comparable dataset of soil properties and to improve the quality of soil modelling in Europe. The

outcome of the soil component of the LUCAS is used for assessing the state and change of soil characteristics over time, updating the European soil database and supporting the development and implementation of EU land based policies.

In the LUCAS 2009/2012 and LUCAS 2015, soil samples were collected across Europe following a standardized sampling procedure and several physical and chemical properties were analysed in them. In LUCAS 2018, sampling will be adapted in order to collect samples for the assessment of new properties: erosion, soil biodiversity, bulk density and thickness of organic horizon in peat soils.

9.13.2 Availability of results

Results of the various analysis and measurements will be published trough the European Soil Data Centre (http://esdac.jrc.ec.europa.eu/). Should the land owner/land user ask to obtain a copy of the results of the soil analysis, it will be possible to do so, provided that full contact details are recorded in the Field Form.

9.13.3 The soil sampling process

9.13.3.1 Different soil modules apply to different points

The present document is separated in chapters which relate to different soil collection modules. Only a selection of all LUCAS points is subject to soil collection (max. 26014). In the majority of soil points the soil collection will be identical to the method followed in previous campaigns (see chapter 9.13.4 on how to collect the standard sample).

In a subsample of 9000 soil points the standard sample will be collected using a different methodology in order to allow also for the determination of bulk density (see chapter 9.13.5 on how to collect the bulk density sample).

In 1000 of these bulk sample points an additional sample for the determination of biodiversity will be collected. The explanation on how to collect the biodiversity sample is integrated in the same chapter of the bulk sample as all the soil biodiversity points are also bulk density points. Special measures however are needed for points where the biodiversity sample is to be collected (including careful cleaning of material and usage of gloves by the surveyor).

An additional collection of the depth of the organic horizon will be requested for previously identified points (1470 points) (see chapter 9.13.5.3 on how to measure the organic horizon).

In some cases it will not be possible to collect the soil samples strictly according to the standard instructions. Guidelines are given on how to collect the sample in different special circumstances and in case of difficult access (see chapter 9.13.6 and chapter 9.13.7).

9.13.3.2 When to collect soil samples?

Soil samples are to be collected only in points with observation type 1 (the point is observed at less than 100m) and when the location reached by the surveyor is in the same land cover as the LUCAS point (ideally also in the same field).

9.13.3.3 Which soil samples to collect? (K, L, M, N, O, P)

If one or more specific modules on soil are to be assessed on the point this will be indicated with "yes" in the fields K – P:

- Soil point (K): standard soil sample is to be taken
- Organic horizon point (L): assessment of the organic layer
- Bulk point (M, N, O): collect (and assess) bulk density
- BIO point (P): collect biodiversity sample

Remarks and photos needed:

If it is not possible to take any one of these sub-modules a remark is needed. In case of the basic soil assessment or the bulk density also a photo is needed (additional photo "soil", fields 669 – 695).

If the relevant sub-modules are assessed a photo of the sampled area (soil photo: fields 626/628, organic horizon photo: fields 638-652) and a photo of each label is needed (biodiversity label: fields 635/637, bulk label photo: 632/634, soil label photo: fields 629/631).

Further remarks can be added

When samples are collected this needs to be noted as well as the number of the label and the expedition date. The detailed process, including photos to be taken, is presented below.

Labels will be provided by the JRC. If labels are lost and there is a need to create own labels by the contractor or the surveyor, please use the point id as label code, but enter 00000 as the label code in the DMT.

9.13.3.4 Soil site (341)

In any case the percentage of stones on the surface has to be assessed.

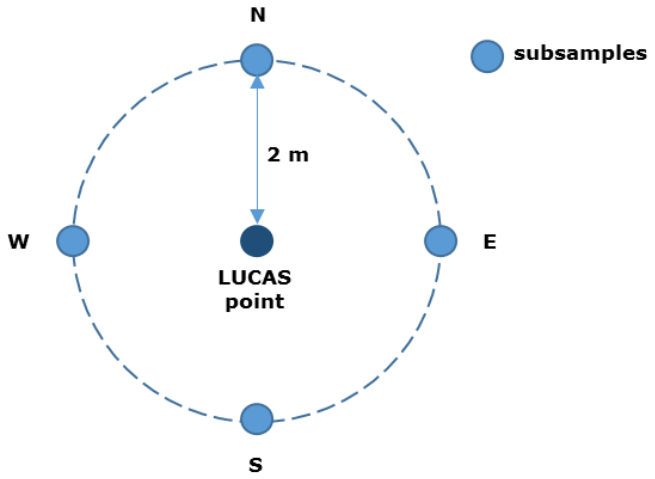
9.13.3.5 Subsequent treatment

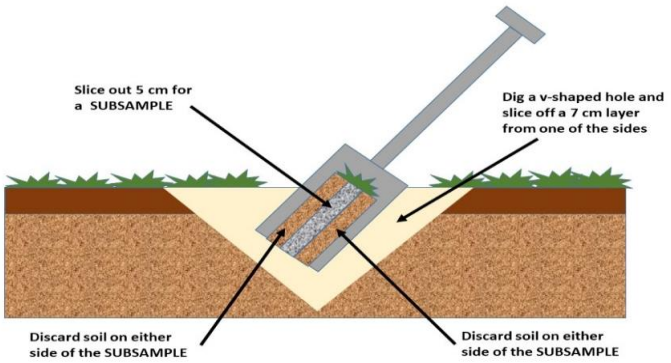
A number of subsequent steps are needed after the soil collection for the proper shipment, eventually drying and weighing of the sample. The treatments depend on the type of sample and are described in the respective chapters.

9.13.4 Standard soil sampling (without determination of bulk density)

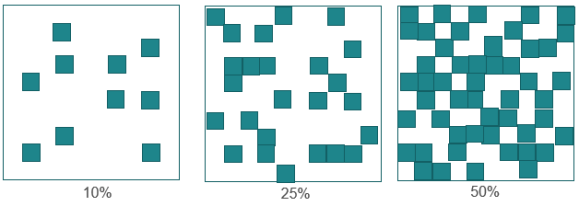
9.13.4.1 Collecting the soil sample in the field

1 *The sample is collected only if the point is reached!*	Go to one of the LUCAS points of the list provided. For the soil survey you need to be able to reach the exact point (observation distance ≤100m) in contrast to the rest of the survey where you can also make observations from a certain distance. Avoid taking soil samples on the edge of or in between parcels. If "look to the North/East rule" applies, then move a maximum of 100 m distance from the LUCAS point to the north or east respectively. Note that soil samples are to be taken within a maximum of 100 m distance from the LUCAS point and, if possible, in the same field where the LUCAS point is located. Soil samples have to be taken always from the same land cover class as observed at the LUCAS point. If it is not possible to take the soil sample in one LUCAS point due to inaccessibility problems (e.g. forbidden zone, wetland, impenetrable forest, barriers, access denied by landowner), then no soil sample will be collected for that point.

2 *Collect a composite sample of at least 500g of soil*	 © European Union, CC BY 4.0 Figure 57 A minimum of 500 gr (≥ 0.5kg) of topsoil has to be collected. This quantity should be representative of a larger area. For this reason, the soil sample has to be a composite one, resulting from the mixture of 5 subsamples. The first subsample will be collected in the LUCAS point, the other 4 subsamples will be collected at a distance of 2 meters following the cardinal directions (North, East, South, West).
3 *Remove residues from the surface*	 © 2017, European Union, CC BY 4.0 Figure 58  © 2017, European Union, CC BY 4.0 Figure 59 Remove vegetation residues, grass and litter, if any, from the surface. Some fine roots and brownish organic material from the upper part of the soil can remain in the sample as it is difficult to remove it completely.

4 *Cut a slice of soil, and trim the sides*	 Figure 60 Using the spade, dig a (V shaped) hole in the central point to a depth of approximately 15-20 cm (the depth of the spade) as shown in the image. Take a slice of soil with the spade. This slice is approximately 3 cm thick. Remove any remaining vegetation residues, stones, and litter. Now trim the sides of the sample, leaving a 3cm sample on the spade.
5 *Put soil in the bucket*	 Figure 61 Put the soil in the bucket. Clean soil in excess from the spade.
6 *Repeat the process in the other 4 locations (N, E, S, W)*	From the central point, walk 2 meters to North, take a subsample (with the same procedure as before) and put the sample to the bucket. Clean excess soil from the spade and walk back to the central point. From the central point, walk 2 meters to East, take a subsample (with the same procedure as before) and put the sample to the bucket. Clean excess soil from the spade and walk back to the central point. From the central point, walk 2 meters to South, take a subsample (with the same procedure as before), and put the sample to the bucket, clean excess soil from the spade and walk back to the central point.

	From the central point, walk 2 meters to West, take a subsample (with the same procedure as before) and put the sample to the bucket. Clean excess soil from the spade and walk back to the central point.
7 *Use the trowel to mix the 5 sub-samples in the bucket*	Use the trowel to mix the 5 soil subsamples together. By mixing the five subsamples you get the required composite soil sample. Also clods and lumps are broken up. Remove any extra vegetation residues, stones, and litter.
8 *Take at least 500g of soil and put it in the smaller plastic bag. Tag it and tie it.*	 © 2017, European Union, CC BY 4.0 Figure 62 Take minimum 500 grams (about 5 heaped trowels full) of soil; place it in the plastic bag. Put the first available plastic label with a progressive number and an "A" sign printed on it inside this bag (white label). Close the bag using a tie.
9 *500g of dry soil are needed for the analysis*	In case the soil is too wet, collect more than 500 g to compensate for weight loss during the drying process.
10 *Put the smaller plastic bag into the larger one. Tag again and tie it.*	 © 2017, European Union, CC BY 4.0 Figure 63 Put the plastic bag in a second one. Put a label with the same progressive number as in step 8, but with a "B" sign on it inside the outer bag (white label). Close the bag using a tie. This is the sample to be shipped.
11 *Register the label number in the Field Form*	Record the progressive label number in the appropriate Field Form.

***12** Take the soil photo*	Put the bag next to the LUCAS point. Take a photo of the LUCAS point with the bag (keep the label visible) and as many as possible of the 5 holes clearly visible.
***13** Take additional photo of the label*	The label has to be clearly readable.
***14** Complete the questionnaire on soil*	Complete the questions on the Field Form related to stones on the surface.
***15** Percentage of stones are evaluated on the 2m radius area that serves as base for soil collection.*	 Figure 64 The surveyor has to estimate the percentage <u>of the surface</u> that is covered with stones. This assessment is made on the 2m radius area that serves as base for the soil collection. The presence of stones <u>in the soil</u> does not need to be estimated. As explained above, stones should be taken out of the subsamples before making a composite sample.
***16** Take additional pictures if needed*	If appropriate take any additional pictures (e.g. to justify that a subsample was not taken due to excessive amount of thorny shrubs).
***17** Make any necessary remarks*	If the procedure was not followed strictly, report any changes in the comments, explaining the reason (e.g. superficial sample as underground rock, hard due to tree roots). For free text remarks the use of English is mandatory. Special characters are to be avoided.
***18** If applicable take note of the land owner contacts*	If the land owner/land user asks to obtain a copy of the results of the soil analysis, include his/her contact details (at least name, postal address and telephone number; if available, also e-mail address) in the Field Form.

Add a remark if relevant.

9.13.4.2 Measuring thickness of organic horizon in peat soils

If the point is part of the organic soil sample selection, you will have to measure the depth of the organic soil before leaving the point. Otherwise you can skip this part.

1 *Reuse the holes already dug for the soil sampling*	Thickness of organic horizon will be measured in 3 out of the 5 holes already dug for soil sampling. One of the measurements has to be done in the central LUCAS point. The other 2 measurements preferably should be done in the holes following North and South directions. If it is impossible to measure the organic horizon in the appropriate locations (i.e. because the soil is too wet), move to the hole following East and/or West direction. Measure there the thickness of the organic horizon. Location of each measurement has to be recorded in the Field Form. Start from the central LUCAS point.
2 *Dig to 40 cm the opposite face to where you have taken the bulk density sample*	Digging a hole in peat should be easy. Dig to 40 cm the opposite face to where you have taken the bulk density sample. Make sure that the face is vertical to the soil surface. If the bottom of the organic horizon is above 40 cm, you do not need to dig to the 40 cm depth (see step 3 to identify the organic horizon).
3 *Identify the organic horizon*	Organic horizon is formed from the accumulation of organic material deposited on the soil surface. They must have at least 20% of organic carbon and a thickness of 10 cm. The intense dark colour of organic horizon, compared to mineral horizons, make easy to recognize them. Examples of sections through peats showing deep organic soils: image placeholder image placeholder A soil profile showing organic horizon (dark layer) overlaying mineral layers (brown/orange layer): image placeholder We are looking to see if the dark layer is at least 40 cm thick.
4 *Measure the thickness of organic horizon*	Using a meter stick, measure the thickness of organic horizon from the top to the bottom of the horizon on the face of the hole. Record the thickness in the Field Form.
5 *Take a picture*	Take a picture of the face of the hole with the meter stick showing the scale and indicating the label number of the point.
6 *Measure the thickness of organic horizon at the other 2 locations*	The other 2 measurements should be done at a distance of 2 m from the central LUCAS point following North and South directions. Repeat steps 1 to 5 to do the measurements at each location. **REMEMBER:** If it is impossible to measure the organic horizon in the appropriate locations (i.e. because the soil is too wet), move to the hole following East and/or West direction. Measure there the thickness of the organic horizon.

	Location of each measurement has to be recorded in the Field Form.

Add a remark, if relevant.

9.13.4.3 Leaving the point

Before leaving the point

Close the holes	Using the soil in excess, close the 5 holes you did.
Clean and store the material	Remove by hand the soil that could remain on the spade, the trowel and the bucket from the former sample. This is important in order to prevent cross-contamination.
Don't forget to take all material and samples with you	Be aware that you do not forget material or samples collected on the field before leaving the point. Put the closed bag in the box used for shipping the samples and put the box in the trunk of the car.
If applicable take note of the land owner contacts	If the land owner/land user asks to obtain a copy of the results of the soil analysis, include his/her contact details (at least name, postal address and telephone number; if available, also e-mail address) in the Field Form.

9.13.4.4 Air drying and shipping the standard soil sample

Before the shipment, soil sample need to be air-dried. Wet or damp samples may give unreliable results, if inappropriately stored.

NOT FOR ORGANIC SAMPLES!

Do not dry samples collected for soil biodiversity assessment! These samples need to be kept fresh and shipped to the JRC-Ispra refrigerated.

***1** Air-drying the sample, except organic samples.*	Air-dry the soil sample at the end of the day's work, when you have reached your night's location, except organic samples. Roll down the sides of both bags and open as much as possible to dry the soil sample by exposure to the air in a well-ventilated room. **Do not** use an oven or exposure to heat source to dry the sample!
***2** Handle the sample with care*	Make sure that the soil sample do not fall over and contaminate other sample.
***3** Make sure that the sample is well air-dried*	Crumble samples into small clods/peds by hand. Let the sample stay to dry the time needed and inspect whether the samples have already dried. During air-drying, the soil sample will become gradually lighter. At a certain

	point, no more moisture will evaporate from the soil and the weight of the sample will be constant. This can take several days.
***4** Close the bags carefully*	Close the inside bag with a tie (check the label A is still inside). Close the second bag with a tie (check the label B is still in between the two bags and has the same progressive number as the other). Make sure all bags are properly closed in order to prevent contamination during transport when the boxes may not be kept upright all the time.
***5** Ship the samples to the supervisor*	When 5 to 10 samples were collected (total weight around 2,5 to 5kg), they should be shipped to the supervisor (e.g. via mail). Tape the sides of the box for extra security. Buy a new box that you will use for storing the samples to be collected until you will come again to a post office and that you will use for the next shipment.

9.13.5 Soil bulk density sampling (with or without determination of biodiversity)

This chapter describes the sampling procedure for the determination of bulk density, analysis of core physical and chemical properties, and assessment of soil biodiversity. In 9,000 LUCAS points, soil samples will be taken for the determination of bulk density and analysis of core physical and chemical properties. Unlike the standard sampling, surveyors have to collect separate soil samples from the 0-10 cm and 10-20 cm depth increments in these points.

Only in points located in Portugal, surveyors have to take soil samples also from the 20-30 cm depth increment.

In addition, in 1,000 out of the 9,000 points, soil samples for biodiversity assessment will also be collected. Surveyors will receive from their coordinators the list of the specific points, indicating the samples that have to be collected in each one, before the survey.

If the LUCAS points are located in peat soils, surveyors will also need to measure the thickness of the organic horizon. Surveyors will receive from their coordinators the list of the points located in peat soils before the survey.

Further aspects described concern measures to be taken before leaving the point and instructions for drying and shipping the sample.

Surveyors will need to tag 2 small plastic bags per point with the following labels: Bag A 0-10 cm, Bag B 10-20 cm. Surveyors in Portugal have to prepare another small plastic bag with the label Bag C 20-30 cm.

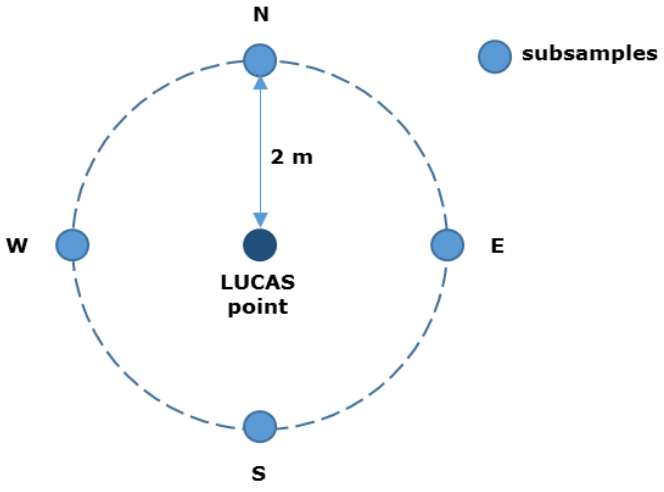
9.13.5.1 Before going to the field

For the points where samples for the assessment of soil biodiversity will be taken, surveyors will need to:

***1.** Freeze freezer packs 24/48h in advance*	Put the freezer packs required into a freezer at least 24/48 hours before the sampling. Per point 4 freezer packs are needed.
***2.** Prepare the material at*	In the morning before going to the field place 4 freezer packs

home	into each of the polystyrene boxes needed that day.
***3.** Take water for cleaning all the material*	Fill up the water bottles that you will need that day (a 1 l bottle of water per point).

9.13.5.2 Collecting soil samples in the field

***1** Samples are collected only if the point is reached*	Go to one of the LUCAS points of the list provided. For the soil survey you need to be able to reach the exact point (observation distance ≤100m) in contrast to the rest of the survey where you can also make observations from a certain distance. Avoid taking soil samples on the edge of or in between parcels. If "look to the North rule" applies, then move a maximum of 100 m distance from the LUCAS point to the north. Note that soil samples should be taken within a maximum of 100 m distance from the LUCAS point and, if possible, in the same field where the LUCAS point is located. Soil samples have to be taken always from the same land cover class as observed at the LUCAS point. Collected samples have to be representative of a larger area than the LUCAS point. For this reason, composite samples, resulting from the mixture of 5 subsamples, will be collected per depth.  Figure 65 The first subsample will be collected in the LUCAS point, the other 4 subsamples will be collected at a distance of 2 meters following the cardinal directions (North, East, South, West).
ATTENTION 1: *In case of problems to take one of the subsamples*	Note that 5 subsamples per depth have to be taken for the 0-10-cm and 10-20-cm depths at each point. For the 20-30-cm depth in Portugal, only 3 subsamples have to be taken. If, for any reason beyond your control, you cannot take one of the subsamples with the metallic ring, indicate the reason and the number of subsamples finally taken by depth in the Field Form (see related

	questions in the Field Form). At each depth, a minimum of 3 subsamples have to be taken.
ATTENTION 2: *Do not collect a sample in saturated peat soils*	Soil samples can only be taken in the mature surface layer of the peat soil under unsaturated conditions. If the peat soil is saturated with water do not take samples.
Move to step 2 if you have to take a sample for assessment of soil biodiversity. **Move to step 4** if you do not have to take a sample for assessment of soil biodiversity.	
2 *Use gloves if a sample for biodiversity assessment have to be taken*	Wear plastic gloves if you are in one of the 1,000 points where a sample for the assessment of soil biodiversity will be taken. Ensure that the material for the sampling (spades, the bucket and the knife) do not have soil residues from previous sampling. Quickly wash them first with alcohol and then with water.
3 Clean the sampling material	Ensure that the material for the sampling (spades, bucket and knife) do not have soil residues from previous sampling. First, clean the material using water to remove soil from previous sampling. Second, clean the material using the alcohol wipes provided. This is very important in order to prevent cross-contamination among samples. Collect the used napkins in a garbage bag. Do not forget to take the bag with you when leaving the point.
4 *Remove residues from the surface*	Remove vegetation residues, grass and litter, if any, from the surface. Some fine roots and brownish organic material from the upper part of the soil can remain in the sample as it is difficult to remove it completely.  © 2017, European Union, CC BY 4.0 Figure 66  © 2017, European Union, CC BY 4.0 Figure 67
5 *Drive the ring into soil*	Gently press the metallic ring, bevelled edge down, into the soil with the help of a mallet. Use a block of wood to push the ring with the mallet, in order to avoid compaction of soil and protect the ring.

	Avoid pushing the ring in too far or the soil will compact.  © 2017, European Union, CC BY 4.0 Figure 68  © 2017, European Union, CC BY 4.0 Figure 69 Excavate a little bit around the outside edge of the ring with a small, flat-bladed knife. Put the plastic cap to the ring.  © 2017, European Union, CC BY 4.0 Figure 70  © 2017, European Union, CC BY 4.0 Figure 71
6 *Dig a square hole to a depth of 20 cm*	Dig a hole at a distance of 2-3 cm from the metallic ring. Make 4 cuts with the spade to dig the hole, avoiding to stand/step where the ring is hammed.  © 2017, European Union, CC BY 4.0 Figure 72  © 2017, European Union, CC BY 4.0 Figure 73 Extract the resulting clump of soil with the spade. Take care that the hole remains clean.

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Figure 74

Keep the extracted soil close to the hole. Once the samples are collected, the extracted soil will be use later to close the hole.

Move to step 7 if you have to take a sample for assessment of soil biodiversity.

Move to step 9 if you do not have to take a sample for assessment of soil biodiversity.

7 *Cut a slice of soil and trim the sides if a sample for biodiversity assessment have to be taken,*

Take a slice of soil with the spade from the face of the hole opposite to the ring. Remove any remaining vegetation residues, stones, and litter.

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Figure 75

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Figure 76

Trim the sides of the slice, leaving a 5 cm segment on the spade. Take care that the hole remains clean and that the trimmed material does not end up again in the hole.

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Figure 77

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Figure 78

8 *Put collected soil in the bucket*	Put collected soil in the bucket. Clean soil residues from the spade.  © 2017, European Union, CC BY 4.0 Figure 79
9 *Remove the metallic ring*	Make 3 cuts with the spade in the remaining sides around the ring, at a distance of 2-3 cm from the metallic ring. Place the spade (or the trowel) underneath the ring and carefully remove the clump of soil with the ring intact.  a  b  c Figure 80 a, b and c © 2017, European Union, CC BY 4. Remove excess soil from the bottom of the ring and around the outside edge of the ring with the knife.

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Figure 81 a

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Figure 81 b

If the metallic ring is not completely filled with soil (less than 10% missing due to a stone or lost material when removing from soil), you can fill the ring with removed soil.

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Figure 82 a

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Figure 82 b

If the missing part in the ring is greater, discard the soil core and take other on one of the other faces of the hole following steps 4 to 9.

10 *Put the soil core in the plastic bag tagged as "Bag A 0-10 cm"*	Push out the soil core into the small plastic bag labelled as "Bag A 0-10 cm" using the knife. Make sure the entire core is placed in the plastic bag.

	 © 2017, European Union, CC BY 4.0 Figure 83  © 2017, European Union, CC BY 4.0 Figure 84
11 *Repeat the process at the other 4 locations (N, E, S, W)*	From the central LUCAS point, walk 2 m to North and repeat steps 2 to 10. When finished, walk back to the LUCAS point. From the central LUCAS point, walk 2 m to East and repeat steps 2 to 10. When finished, walk back to the LUCAS point. From the central LUCAS point, walk 2 m to South and repeat steps 2 to 10. When finished, walk back to the LUCAS point. From the central LUCAS point, walk 2 m to West and repeat steps 2 to 10. When finished, walk back to the LUCAS point. Be aware that you take all material and samples with you when you move to a new location.
12 *Label the small plastic bag containing the 5 soil cores collected in 0-10 cm depth increment*	Insert the first available **orange plastic label** with a progressive number and **"BULK 0-10"** sign printed on it inside the small bag containing the 5 soil cores collected from 0-10 cm depth increment. Close the bag with a tie.  © 2017, European Union, CC BY 4.0 Figure 85
13 *Place the sample in the big plastic bag and label it again*	Put the plastic bag containing the sample inside the big plastic bag. Insert the **orange plastic label** with the same progressive number as in step 12, and with **"BULK"** sign printed on it, inside the big bag.  © 2017, European Union, CC BY 4.0 Figure 86
Move to step 14 if you have to take a sample for assessment of soil biodiversity. **Move to step 20** if you do not have to take a sample for assessment of soil biodiversity.	

14 *Mix the 5 subsamples in the bucket if a sample for biodiversity has to be taken*	Use the trowel to mix the 5 subsamples in the bucket and to get a homogeneous composite sample. Clods and lumps have to be also broken up. Remove any extra vegetation residues, stones, and litter.  © 2017, European Union, CC BY 4.0 Figure 87
15 *Transfer 500 g of soil to the plastic jar and label it*	Take 500 g (about 5 handfuls) of the composite sample and place it in the plastic jar. Clean the first available **green plastic label** with the same progressive number as in steps 12 and 13 and with **"BIO A"** sign printed on it with alcohol and insert it in the jar and close it.  ©2017, European Union, CC BY 4.0 Figure 88 This will be the sample for soil biodiversity assessment. It has to be shipped fresh to the JRC as soon as possible.
16 Take a picture of the sample	Take a photo of the plastic jar (open) with the green label inside. The label has to be readable. Close the plastic jar.

17 *Prepare the polystyrene box for shipping*	Place the plastic jar in the polystyrene box. Place the 4 freezer packs at the sides of the bag.  ©2017, European Union, CC BY 4.0 Figure 89 Insert the **green plastic label** with the same progressive number as in step 16 and with **"BIO B"** sign printed on it in the box. Close the box and seal it with the packaging tape to ensure the cover is secured. Attached the address label on the box.
18 Ship the polystyrene box to the JRC-Ispra	The box must be shipped to the JRC-Ispra within the 24h after the sampling (maximum 48h after the sampling). The box with the sample must arrive to the JRC-Ispra within 48/72h of the sampling. The box needs to be stored in a fridge overnight until its shipment. If needed, open the box, store the sample in the fridge and the freezer packs in the freezer. In the morning, prepare again the box as explained in step 17 and ship it. The surveyor should contact the JRC-Ispra by email to inform when the sample is send and when is expected to arrive to the JRC-Ispra. The email shall be sent on the day the sample is shipped.
19 *Move again to the central LUCAS point*	Be aware that you take all material and samples with you when you move to a new location.
20 *Drive the ring into soil from 10-20 cm depth increment*	Measure the depth of the hole where the first soil core was taken. If the depth of the hole is less than 10 cm, dig to reach at least 10 cm depth. Gently press the metallic ring, bevelled edge down, into the soil with the help of a mallet. Use a block of wood to push the ring with the mallet, in order to avoid compaction of soil and protect the ring. Avoid pushing the ring in too far or the soil will compact. Excavate a little bit around the outside edge of the ring with a small, flat-bladed knife. Put the plastic cap to the ring. 

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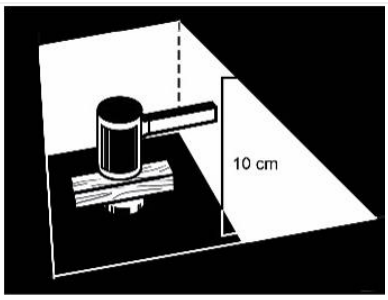
Figure 90



a

b

c

d

Figure 91 a,b,c,d, ©2017, European Union, CC BY 4.0

21 *Remove the metallic ring*

Excavate more around the outside edge of the ring with a small, flat-bladed knife.

Place the spade (or the trowel) underneath the ring and carefully remove it intact.

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Figure 92 a

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Figure 92 b

Remove excess soil from the bottom of the ring and around the outside edge of the ring with the knife.

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Figure 93

If the metallic ring is not completely filled with soil (less than 10% missing due to a stone or lost material when removing from soil), you can fill the ring with removed soil.

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Figure 94 a

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Figure 94 b

If the missing part in the ring is greater, discard the soil core and take other on the opposite face of the hole. Dig at least to 10 cm depth and follow steps 20-21. Take note that the core was discarded (re-done) on the field form.

22 *Put the soil core in the small plastic bag tagged as "Bag B 10-20 cm"*

Push out the soil core into the plastic bag labelled as "Bag B 10-20 cm" using the knife. Make sure the entire core is placed in the plastic bag.

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Figure 95

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Figure 96

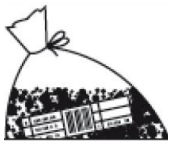
23 *Repeat the process at the other 4 locations (N, E, S, W)*	From the central LUCAS point, walk 2 m to North and repeat steps 20 to 22. When finished, walk back to the LUCAS point. From the central LUCAS point, walk 2 m to East and repeat steps 20 to 22. When finished, walk back to the LUCAS point. From the central LUCAS point, walk 2 m to South and repeat steps 20 to 22. When finished, walk back to the LUCAS point. From the central LUCAS point, walk 2 m to West and repeat steps 20 to 22. When finished, walk back to the LUCAS point. Be aware that you take all material and samples with you when you move to a new location.
24 *Label the small plastic bag containing the 5 soil cores*	Insert the **orange plastic label** with the same progressive number as in steps 12 and 13 and with **"BULK 10-20"** sign printed on it inside the small bag containing the 5 soil cores collected from 10-20 cm depth increment. Close the bag with a tie.  © 2017, European Union, CC BY 4.0 Figure 97
25 *Place the sample in the big plastic bag*	Put the plastic bag containing the sample inside the big plastic bag (the same bag in which you put the first sample from 0-10 cm depth). Make sure that the **orange plastic label** from step 13 is still inside. Close the bag with a tie if you do not have to take soil cores from 20-30 cm depth increment (taken only in Portugal).  © 2017, European Union, CC BY 4.0 Figure 98
Move to step 26 *if you have to collect soil cores from 20-30 cm depth increment (only for Portugal).* ***Move to step 33*** *if you do not have to collect soil cores from 20-30 cm depth increment.*	
26 *Move again to the central LUCAS point*	Be aware that you take all material and samples with you when you move to a new location.
27 *Drive the ring into soil from 20-30 depth increment*	Make sure that the depth of the hole, where the previous two soil cores were taken, is at least 20 cm. 

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Figure 99

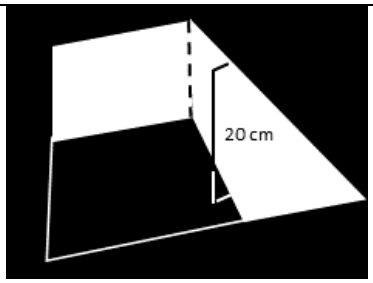

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Figure 100 a

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Figure 100 b

Gently press the metallic ring, bevelled edge down, into the soil with the help of a mallet. Use a block of wood to push the ring with the mallet, in order to avoid compaction of soil and protect the ring. Avoid pushing the ring in too far or the soil will compact.

Excavate a little bit around the outside edge of the ring with a small, flat-bladed knife. Put the plastic cap to the ring.

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Figure 101 a

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Figure 101 b

28 *Remove the metallic ring*	Excavate more around the outside edge of the ring with a small, flat-bladed knife. Place the spade (or the trowel) underneath the ring and carefully remove it intact.

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Figure 102 a

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Figure 102 b

Remove excess soil from the bottom of the ring and around the outside edge of the ring with the knife.

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Figure 103

If the metallic ring is not completely filled with soil (less than 10% missing due to a stone or lost material when removing from soil), you can fill the ring with removed soil.

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Figure 104 a

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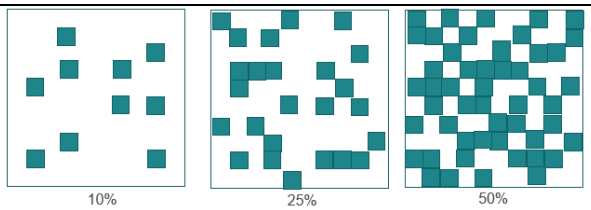
Figure 104 b

	 If the missing part in the ring is greater, discard the soil core and take other following steps 27-28.
29 *Put the soil core in the small plastic bag tagged as "Bag C 20-30 cm"*	Push out the soil core into the small plastic bag labelled as "Bag C 20-30 cm" using the knife. Make sure the entire core is placed in the plastic bag.
30 *Repeat the process at other 2 locations* *(N, E, S, W)*	Select 2 other locations from the 4 cardinal directions (North, East, South, West). From the central LUCAS point, walk 2 m to the selected locations. At each location, repeat steps 27 to 29 to take the soil core from 20-30 cm depth increment. Be aware that you take all material and samples with you when you move to a new location.
31 *Label the small plastic bag containing the 3 soil cores*	Insert the **orange plastic label** with the same progressive number as in steps 12 and 24, and with **"BULK 20-30"** sign printed on it inside the small bag containing the 3 soil cores collected from 20-30 cm depth increment. Close the bag with a tie.  © 2017, European Union, CC BY 4.0 Figure 105
32 *Place the sample in the big plastic bag and close it*	Put the small plastic bag containing the sample inside the big plastic bag (the same bag in which you put the samples taken from 0-10 cm depth and 10-20 cm depth). Make sure that the **orange plastic label** from step 13 is still inside. Close the bag with a tie.  © 2017, European Union, CC BY 4.0 Figure 106
33 *Register the label number in the Field Form*	Record the progressive label number in the appropriate Field Form.

***34** Take the soil photo*	Put the bag and the polystyrene box (if a sample for assessment of soil biodiversity has been taken) next to the LUCAS point. Take a photo of the LUCAS point with the bag (keep the label visible) and the box and as many as possible of the 5 holes clearly visible.
***35** Take additional photo of the label*	The label has to be clearly readable.
***36** Complete the questionnaire on soil*	Complete the questions on the Field Form related to signs of erosion, ploughing, crop residues and stones. See manual 3 for assessment of soil erosion.
***37** Percentage of residuals and percentage of stones are evaluated on the 2m radius area that serves as base for soil collection.*	 © European Union, CC BY 4.0 Figure 107 The surveyor has to estimate the percentage of the surface that is covered with vegetation residues and stones. This assessment is made on the 2m radius area that serves as base for the soil collection. The presence of stones in the soil does not need to be estimated. As explained above, stones should be taken out of the subsamples before making a composite sample.
***38** Take additional pictures if needed*	If appropriate take any additional pictures (e.g. to justify that a subsample was not taken due to excessive amount of thorny shrubs).
***39** Make any necessary remarks*	If the procedure was not followed strictly, report any changes in the comments, explaining the reason (e.g. superficial sample as underground rock, hard due to tree roots). For free text remarks the use of English is mandatory. Special characters are to be avoided.
***40** If applicable take note of the land owner contacts*	If the land owner/land user asks to obtain a copy of the results of the soil analysis, include his/her contact details (at least name, postal address and telephone number; if available, also e-mail address) in the Field Form.

Add a remark about the bulk density sample, if relevant.

Add a remark about the biodiversity sample, if relevant.

9.13.5.3 Measuring thickness of organic layer in the field

If the point is part of the organic soil sample selection, you will have to measure the depth of the organic soil before leaving the point. Otherwise you can skip this part.

1 *Reuse the holes already dug for the soil sampling*	Thickness of organic horizon will be measured in 3 out of the 5 holes already dug for soil sampling. One of the measurements has to be done in the central LUCAS point. The other 2 measurements preferably should be done in the holes following North and South directions. If it is impossible to measure the organic horizon in the appropriate locations (i.e. because the soil is too wet), move to the hole following East and/or West direction. Measure there the thickness of the organic horizon. Location of each measurement has to be recorded in the Field Form. Start from the central LUCAS point.
2 *Dig to 40 cm the opposite face to where you have taken the bulk density sample*	Digging a hole in peat should be easy. Dig to 40 cm the opposite face to where you have taken the bulk density sample. Make sure that the face is vertical to the soil surface. If the bottom of the organic horizon is above 40 cm, you do not need to dig to the 40 cm depth (see step 3 to identify the organic horizon).
3 *Identify the organic horizon*	Organic horizon is formed from the accumulation of organic material deposited on the soil surface. They must have at least 20% of organic carbon and a thickness of 10 cm. The intense dark colour of organic horizon, compared to mineral horizons, make easy to recognize them. Examples of sections through peats showing deep organic soils: image placeholder image placeholder A soil profile showing organic horizon (dark layer) overlaying mineral layers (brown/orange layer): image placeholder We are looking to see if the dark layer is at least 40 cm thick.
4 *Measure the thickness of organic horizon*	Using a meter stick, measure the thickness of organic horizon from the top to the bottom of the horizon on the face of the hole. Record the thickness in the Field Form.
5 *Take a picture*	Take a picture of the face of the hole with the meter stick showing the scale and indicating the label number of the point.

6 *Measure the thickness of organic horizon at the other 2 locations*	The other 2 measurements should be done at a distance of 2 m from the central LUCAS point following North and South directions. Repeat steps 1 to 5 to do the measurements at each location. **REMEMBER:** If it is impossible to measure the organic horizon in the appropriate locations (i.e. because the soil is too wet), move to the hole following East and/or West direction. Measure there the thickness of the organic horizon. Location of each measurement has to be recorded in the Field Form.

Add a remark, if relevant.

9.13.5.4 Leaving the point

Before leaving the point

Close the holes	Using the soil in excess, close the 5 holes you did.
Don't forget to take all material	Be aware that you do not forget material or samples collected on the field before leaving the point.
If applicable take note of the land owner contacts	If the land owner/land user asks to obtain a copy of the results of the soil analysis, include his/her contact details (at least name, postal address and telephone number; if available, also e-mail address) in the Field Form.

9.13.5.5 Weighing and air-drying the bulk density sample and shipping

Before shipping samples to the JRC-Ispra, the weight of bulk density samples need to be recorded on the evening of collection (field-moist weight), air-dried and then the weight recorded again (air-dry weight).

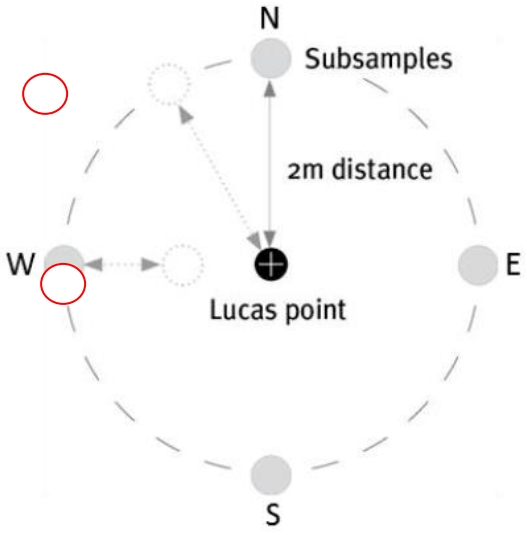
NOT FOR ORGANIC SAMPLES!

Do not dry samples collected for soil biodiversity assessment! These samples need to be kept fresh and shipped to the JRC-Ispra refrigerated.

1 *Weigh the soil samples placed in the big plastic bag*	At the end of the day's work, when you have reached the night's location: Open the big plastic bag. Take out the small bags containing the samples from the big plastic bag. Open the small bags removing the ties. Weigh the samples within their bags. Record the weight of each sample (field-moist weight) in the Field Form.
2 *Air-dry the samples, except organic samples*	Air-dry the soil samples, except organic samples. Roll down the sides of both bags and open as much as possible to dry the soil sample by exposure to the air in a well-ventilated room. **Do not** use an oven or exposure to heat source to dry the sample!

***3** Handle the sample with care*	Make sure that the soil sample do not fall over and contaminate other sample.
***4** Make sure that the sample is well air-dried*	Crumble samples into small clods/peds by hand. Let the sample stay to dry the time needed and inspect whether the samples have already dried. During air-drying, the soil sample will become gradually lighter. At a certain point, no more moisture will evaporate from the soil and the weight of the sample will be constant. This can take several days.
***5** Weigh the air-dried samples*	Weigh the air-dried samples within their bags. Record their weight (air-dried weight) in the Field Form. Not for organic samples.
***6** Close the plastic bags carefully*	Close the inside bag containing the sample with a tie (check that label A is still inside). Close the outer bag with a tie (check that label B is still inside and has the same progressive number as the other). Make sure all bags are properly closed in order to prevent contamination during transport when the boxes may not be kept upright all the time.
***7** Put them again in the big plastic bags*	Put them again in their corresponding big plastic bags. Make sure that the plastic label is still inside the big plastic bag. Close the bag with a tie. Make sure all bags are properly closed.
***8** Ship the samples to the supervisor*	When 5 to 10 samples are collected (total weight around 2.5 kg to 5 kg), they should be shipped to the coordinator (e.g. via mail). Tape the sides of the box for extra security. Buy a new box that you will use for storing the samples to be collected until you will come again to a post office and that you will use for the next shipment.

9.13.6 Collecting the soil sample in special cases

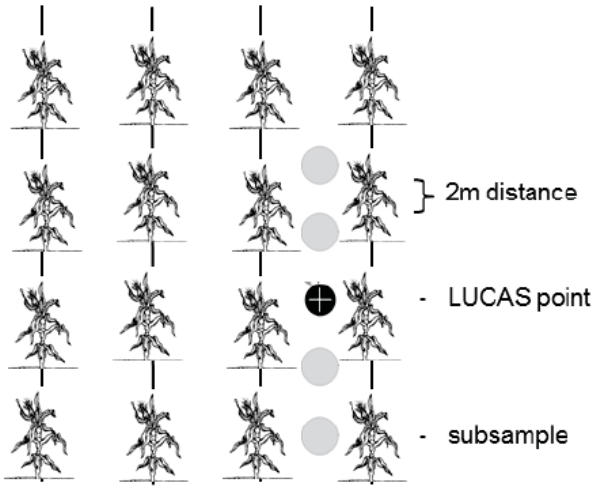
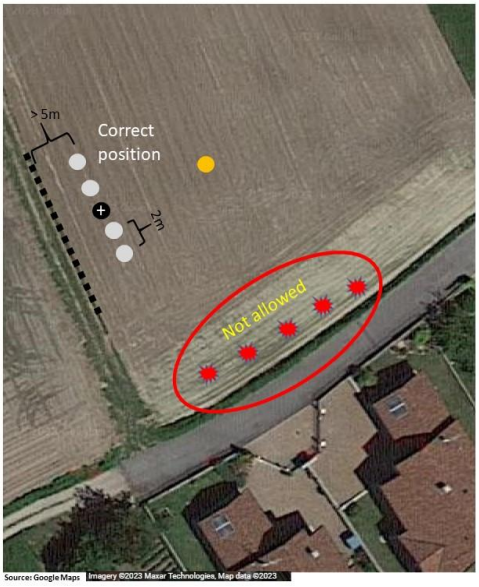
If it is impossible to collect the subsample in the appropriate location, find a suitable location within 2m from the central point	 Figure 108 If in one or more of the 4 subsample locations belonging to the LUCAS soil point (central, North, East, South or West) it is not possible to collect a topsoil sample for any reason (accessibility problems, hardness of the ground, coverage – trees, houses etc.) walk along the dotted line until you find a suitable location or walk less than 2m from central point to take the subsample (represented by the small red circles).

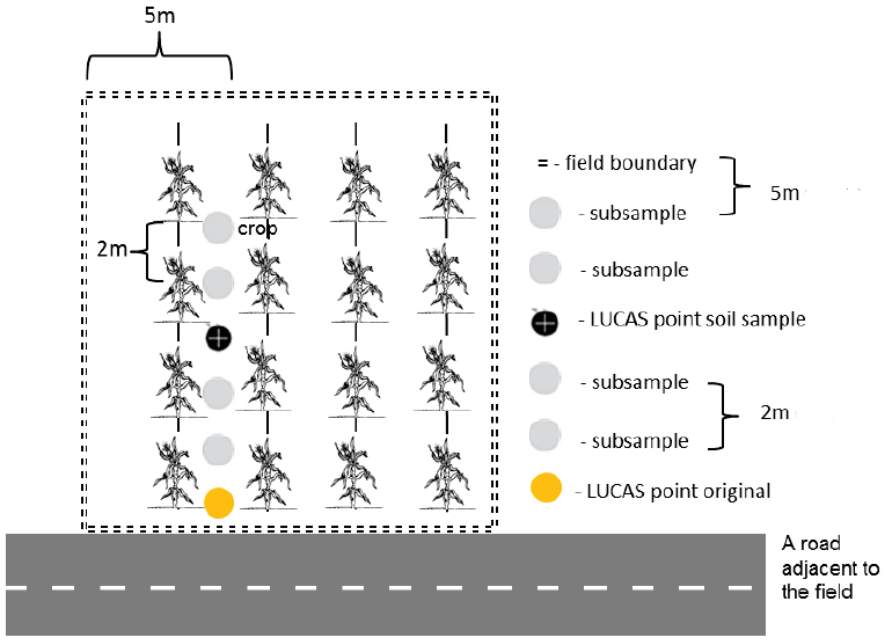
9.13.7 Collecting the soil sample in case of difficult access

If the access is difficult because of:

- a risk of damage to crops;
- harvesting of a crop;
- on-going fertiliser application;

then apply one of the following methods of soil collection. The methods are presented by order of preference.

Linear sample, at least 5m from the edge of the field	 © 2017, European Union, CC BY 4.0 Figure 109 The soil sampling is carried out inside the field, at 5m distance from the edge, in between the rows of the crops using a linear sampling pattern taking as the central one the LUCAS point (if not on the crop) or the one closest to the LUCAS point not on the crop (if LUCAS point on the crop).
Linear sample near the edge of the field	 © Google Maps, Cadrezzate con Osmate, 2023 Figure 110 If it is not possible to collect the soil sample in-between the rows of the crops, then the soil sample has to be taken near the edge inside the field as close as possible to where the original LUCAS point is located. Choose the edge closest to the LUCAS point and as farer as possible from any artificial surface (e.g. road). The same linear sampling pattern, as previously described for sampling in between rows, has to be respected

Linear sample when point is close to a road	 © 2017, European Union, CC BY 4.0 Figure 111 The same linear sampling schema has to be applied if the LUCAS point is too near to the road. In this situation the soil sample can be taken between the rows or, if not possible, on the edge of the fields with the same approach shown in the example above.
Use the remarks field	The need for using special arrangements for soil collection should be reported in the remarks section of the field form

9.13.8 Impossibility to collect the soil sample

Eventually the ground conditions or the owner may prevent the surveyor from taking any soil sample in the LUCAS point.

It is acceptable not to make a soil collection if certain conditions are met.	Ground conditions that prevent the soil collection include: - Abundance of rocks (S ≥ 50 %) - Excessive shrub cover that makes impossible to reach the soil (e.g. excess of thorny shrubs) - The land owner does not allows to take the soil sample If it is not possible to collect soil, a remark has to be added in the Field Form for the point.

9.13.9 Summary of number of subsamples and photos

	Sampling			
	STANDARD	**BULK DENSITY**	**BIODIVERSITY**	**ORGANIC HORIZON**
N° subsamples 0-20 cm	5		5	
N° subsamples 0-10 cm		5		
N° subsamples 10-20 cm		5		
N° subsamples 20-30 cm (only PT)		3		
N° measurements				3
Photo label	1	1	1	
Photo label + holes	1	1	1	
Photo organic horizon + label				3 (1 per measurement)

9.14 Erosion (in DMT before soil)

Erosion by water and wind can be a major type of soil degradation. While it is a naturally occurring process on all land, soil erosion can cause serious losses of topsoil which results reduced crop yields, lower surface water quality, damaged drainage networks and the release of greenhouse gases. Water and wind erosion are responsible for about 84% of all degraded land on the planet.

9.14.1 Assess erosion in point (Erosion point, J)

Field J: "Erosion point" indicates if the point is part of the module on erosion. A point is part of the erosion module if it is part of the grassland module and or if it is part of the soil module.

It the point is part of the erosion module it is to be assessed if the point is a soil point and the point has been reached (observation type =1 and LC at the point reached is the same as in the LUCAS point) (regardless of the fact that the soil sample has been taken or not) and/or if it is part of the grassland module and the grassland has been assessed.

9.14.2 Signs of erosion (257)

Are there any signs of erosion within the field? If so, this has to be indicated in the field called "Signs of erosion" (257). In this case also the further fields on type of erosion are to be filled in (260 - 331).

The reference area is the field, or if there are no field borders the area up to a distance of some 500 m. There is no need for major walks, only the area visible from the point reached in the field is to be assessed.

Photo needed:

I f there are signs of erosion a photo documenting these signs is needed (additional photo "other": fields 669 – 695).

9.14.3 Types of erosion (260 – 331)

In this instance we are asking surveyors to notice if there is any evidence of erosion by water (sheet erosion, rill erosion, gully erosion, mass erosion or re-deposited soil) and/or wind erosion. Erosion is to be assessed in the same field within a distance of 500 m from the LUCAS point (limited to the area visible from the point the surveyor reached). In case of any evidence of erosion, surveyors have to take an additional photo of the area (named "Other") and indicate in the Field Form how far from the LUCAS point erosion occurs and in which direction (North, East, South or West of the LUCAS point).

Erosion is assessed on the point and in the 4 cardinal directions up to a distance of 500m (if visible from the point). Tick the relevant fields if a specific type of erosion is present and specify the distance.

If there is rill or gully erosion, also the number of rills or gullies needs to be assessed.

Examples of the types of water and wind erosion and practices that can reduce erosion that are to be collected are shown below.

1 *Sheet erosion*	A thin layer of topsoil is removed over a significant area —often not be readily noticed. Sheet erosion is usually only a few cm deep but several meters wide. image placeholder
2 *Rill erosion*	Rill erosion occurs when water running along the surface forms narrow and relatively shallow channels (<30 cm deep), often evident where gradient becomes steeper. Rills tend to develop from sheet erosion. image placeholder image placeholder
3 *Gully erosion*	Gullies are significant features that occur when water runoff concentrates to cause a significant movement of soil particles. Gully depth is > 30 cm often limited by the depth of the underlying rock, which means gullies are but may

	reach 10–15m on deep soils. Image placeholder Image placeholder Image placeholder
4 *Mass movement*	Mass movement occurs when gravity moves soil (and sometimes rocks) downslope either slowly (millimetres per year) or suddenly during periods of prolonged and heavy rainfall (e.g. landslides, rock falls). Different forms of mass movement include: - Landslide Image placeholder - Soil creep - small natural terraces/ripples on hill slopes (can resulted in tilted poles, misaligned fences, curved tree trucks) Image placeholder Image placeholder Image placeholder - Rock slides image placeholder
5 *Re-deposited soil*	Perhaps evidence of erosion is not obvious but clear signs that water has moved soil across the land surface. image placeholder
6 *Wind erosion*	Signs of wind erosion may be harder to spot than water erosion. Examples include visible soil particles being blown off the soil, dust clouds following tractors tilling the land, accumulated particles along barriers. image placeholder image placeholder image placeholder

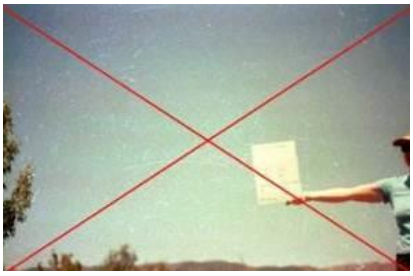
9.15 Photos

The surveyor has to document his observation by means of several photos. What photos have to be taken depends on the type of observation, the land cover, presence or absence of water management, need to collect a soil sample and need to document conflict cases.

Photographs also create a basis for a new kind of long-term monitoring of landscape changes.

Moreover in the context of the Copernicus programme CORINE Land Cover (CLC) and other Pan-EU land cover mapping initiatives, such as the Copernicus HRL (High Resolution Layers), LUCAS micro data and photos are used for production, verification and validation processes. It is thus important that they meet standard quality requirements.

9.15.1 How to take LUCAS photos

Check settings before starting the survey	REMEMBER to check the settings of the camera (date, time and the size of the pictures) before starting the survey! Be aware on the correct date format (regional settings of camera meta data).
Pictures are to be delivered in JPG format	In order to permit simple handling and archiving of the landscape photos, they have to be delivered in digital format (*.jpg file)
All pictures are to be taken in landscape format	The pictures are taken **horizontally** (landscape format).
Dimensions required are 1600x1200 pixels	The image dimension should be 1600 *1200 pixel
Standard format is 4:3	The standard format for LUCAS pictures is 4:3.
Size of pictures between 1Mb to 1.5 Mb	Good quality photos are expected to have a size between 1Mb and 1.5Mb. File sizes from 300Kb (compressed) up to a maximum of 2Mb are accepted.
Keep the camera levelled	 © European Union, CC BY 4.0 Figure 112

	The camera should be kept level (i.e. not tilted). The photo above is unacceptable, since it is neither able to show the location of the point nor reflecting the surrounding landscape.
Use the 5/6 rule	In point and landscape photos the **horizon** must be about 5/6 of the way up the viewfinder (mark the respective line on the camera, or use the camera options).
Exposure	In point and landscape photos the exposure of the photo needs to be optimised for the landscape, not for the sky.
No date in the picture	Disable the date display setting on the pictures in the camera!
No strange elements on the picture	It is important to take care that the photographer's equipment, fingers, backpack, car, assistant, other people etc. are not visible in the picture.
Anonymization	The surveyor is requested to ensure that **the photos do not display any recognisable feature (i.e. faces of persons, vehicle license plates)**. In case that photo-taking is not possible without recording such features, those elements in the **photos need to be anonymized/blurred.** The surveyor shall cover vehicle license plates and/or faces of persons using a dark grey box of adequate size, in a way that the feature(s) shall not be recognisable. **The surveyor must do this before forwarding the photos to the Regional or Central office**. The DMT includes a tool enabling to manipulate the photos. **Points with at least one photo requiring anonymization which is not anonymised will be rejected.**

9.15.2 Types of photos

9.15.2.1 Point photo (P) (602 – 604)

The photos of the point should allow finding the exact location of the observed point in the next LUCAS survey.

Land cover and land use observation refers to the point indicated on the orthophoto. So does the point	The information of GPS coordinates and precision are always referring to the position of the surveyor while doing the observation, but the information on land cover, land use and the photos of the point and of the crop/cover have to refer to the LUCAS point itself (the theoretical point), determined by the orthophoto, even if the point is further away from the real position of the surveyor.

photo.	
Find a stable field element to act as location reference	The distance and the direction of the photo of the point are up to the surveyor's own judgement. The most important aspect is to have stable field elements which act as location references on the picture to ease the work in the next survey (e.g. house, barn, track or any other "quasi-stable" landmark).
Using the flag	A good point indicator is e.g. a bright paper flag in a stick (1 m long). The indicator shall be harmonised at country level, i.e. surveyors within one country shall use the same model. The flag (or point indicator) indicates whether the observation was made at the point (i.e. the point was reached). If a point is observed from a distance >100m it shall not be marked with the flag, even if in this case a point picture in the direction of the point is to be taken.
The flag helps to assess the width of features	When placing the flag take into consideration that it can be used to help the controllers assess the width of features (namely in case of the Look to the North/East rule).
The point Is located at the centre of the picture	The photo has to be taken in landscape format (horizontally) with the point **in the centre**. If the indicator is not visible, then the centre of the picture is considered as the point location. Keep the 5/6 rule and orient the picture to a stable landmark.
Show land cover on the point photo	Point photos <u>need to show the registered land cover</u>. This is the reason why *in-situ* PI points do not need a point photo.
Take meaningful pictures (especially in case of buildings)	Since there is no need to take a "cover" photo in artificial areas, the point photo is often used to check the cover. Therefore, take care that the height of buildings at the point can be assessed: a picture of a wall is seldom helpful for quality controllers to check if a built-up area should be classified as A11 or A12.
Example of a point picture (observation at 100m or less)	 © European Union, CC BY 4.0 Figure 113

	Good photo of a point, with point marker in the centre and a recognizable land mark. The 5/6 horizon rule is kept.

9.15.2.2 Crop/cover photo (C) (605 – 607)

Aim of the photo of the crop/cover is to enable the identification of the recorded land cover by means of the photo.

If the point is not accessible the photo can be taken at the edge of the field	If the point is not accessible but the surveyor can reach the border of the field parcel where the point is located and the point is visible, the crop/cover photo has to be taken from the edge of the field. The surveyor has to be sure that the crop is the same as at the point itself.
Take the photo of the main land cover (LC1). An additional photo of the LC2 can also be taken.	If there are multiple land covers registered (LC1 and LC2), the crop/cover photo of the main land cover has to be taken. An additional photo for LC2 can also be taken. For example, in case permanent crops (B7X, B8X) are registered, together with a second land cover, a zoomed photo of the permanent crop should be taken. The photo of LC2 is not mandatory in this case.
Flash is allowed in some circumstances	In case of dark woodland the use of flash is allowed.
Macro may be used for crops	The zoomed picture should be taken at a close distance, so that the structure of leaves can be clearly seen, as well as flowers or fruits. If to correctly identify the crop, it has to be photographed from a distance of <2 m, use the camera's macro-mode (when available). Do not forget to switch off zoom and macro settings after each photo shot! They are not needed for the other pictures.
Example: red cabbage	 © 2019, Ralph (@Capri© 23Auto), Pixabay License Figure 114

Example: common wheat	 © 2019, Osoian Marcel (@osoian-marcel), Pixabay License Figure 115 Fructification or leaves can be used as a means of crop identification.
Example: barley	 © 2017, Sanjay Acharya, CC BY-SA 4.0 Figure 116 Barley (Hordeum vulgare L.) seeds with husk (left) and with husk removed (right). Seeds and seedlings can be used as a means of identification.
Example: cherry	 © 2016, (@Couleur), Pixabay License Figure 117 When possible, take a picture of leaves and fruit together.

Example: olive	 © 2014, Hans, Pixabay License Figure 118
Example: beech (Fagus sylvatica)	 © 2016, Wälz (@bernswaelz), Pixabay License https://pixabay.com/photos/pillars-gold-beech-fagus-sylvatica-1507732/ Figure 119
Example: pine	 © 2017, Holger Schué (@music4life), Pixabay License https://pixabay.com/photos/fir-trees-needles-cones-pine-cones-2288229/ Figure 120

Example: mixed woodland	 ©2014, Tomasz Proszek, pixabay License https://pixabay.com/photos/autumn-mountains-trees-conifers-548361/ Figure 121

9.15.2.3 Landscape photos (N, E, S, W) (608 – 619)

Landscape images illustrate the character of landscapes. With images it is possible to monitor changes in the landscapes, if the photographs are taken from the same place in different years. Keeping the 5/6 rule is very important in these pictures.

Take the pictures from the place the point observation was made	Landscape photos in digital format will be taken from the place where the visual observation was made. In case of application of the "Look to the North/East rule", the photos have to be taken from the original point, whether on a border or on a linear feature. In case the point is not accessible, the landscape photos have to be taken from the closest point reached (the same point where the GPS coordinates were recorded)
Use a wide angle lens setting and no zoom. Focus at infinity.	The landscape pictures should be taken using a wide-angle lens (equivalent to 35 mm or less). The objective is to photograph the landscape, so sharp foreground details are not necessary. The focus must be on the middle ground and background; this is obtained with the lens focused at infinity. Remember to set the zoom to minimum. Avoid automatic flash.
4 landscape pictures are needed	A photo must be taken in each of the 4 main compass directions (N, S, E, W). This applies even if there is a dense forest, or a wall close by.
Take the pictures looking first to N	The photograph sequence will be taken successively looking North, East, South and West (clockwise rotation).

and then clockwise to E, S and W	This order must be respected in order to archive the pictures without any misinterpretation.
Use the magnetic compass to determine the correct direction	The directions are determined with a handheld compass.
If an error is made, delete and start again	If an error is made during photo-taking, for example a picture is taken twice, incorrect order etc., the wrong ones should be deleted and the correct photo sequence has to be taken again.
Example: landscape photos in NESW sequence	 © 2018, European Union  © 2018, European Union  © 2018, European Union  © 2018, European Union Figure 122 a,b,c,d LUCAS 2018 N, E, S, W photos
Show land cover on the landscape photo if LTN was used	If the "Look to North/East" rule was applied, the N or (respectively) E photo must show the registered land cover

9.15.2.4 Copernicus (K) (620 – 622)

The aim of the photo for the section on Copernicus is to document the land cover at the point the surveyor reaches. It is not a landscape photo. The surveyor should mark the point from which he took the landscape photos (observation point), step back some 5m and then take a photo of the observation point and some 5m on each side.

9.15.2.5 Irrigation photos (I) (623 – 625)

If there is water management on the field, a photo of the water management system has to be taken.

The irrigation photo may have to be taken away from the point of observation	If the irrigation device is not at the point but on the same parcel, it might be necessary for the surveyor to come closer to the device for making an illustrative photo.
If point is PI is irrigation photo needed?	In case a point is PI in-situ, the irrigation photo is needed only if it can be seen from the location of the surveyor.
Take a drainage photo	If drainage is visible, take a drainage photo (as irrigation photo). If both elements (irrigation and drainage) are present take additional photos.
Example: irrigation photo (sprinkler)	 © 2015, WikimediaImages, Pixabay License Figure 123

9.15.2.6 Soil photos (626 – 652)

In case a soil sample (standard topsoil sample or bulk density sample) has been taken, take a photo of the LUCAS point with the bag, label and as many as possible of the 5 holes clearly visible.

For control purposes, please take also a picture of the label clearly readable. This will allow for an extra check to guarantee the label code corresponds to the number filled in the field form. With geo tagged images a further control on location is also possible.

In case a soil biodiversity sample has been taken, please take a photo of the plastic jar with the label clearly visible.

If the organic horizon is assessed 3 photos of the face of the hole with the meter stick showing the scale and indicating the label number of the point are to be taken. One measurement has to be done on the point itself. The other 2 photos should be done in the holes following North and South directions. If it is impossible to measure the organic horizon in the appropriate locations (i.e. because the soil is too wet), move to the hole following East then West direction.

9.15.2.7 Grassland (653 – 667)

The aim of the photos for the grassland survey is to document the grassland, the transect, problems with the survey and important species that cannot be identified and/or that are rare.

Main grassland photos are as follows:
A - Grassland with unclear age
M - Grass transect on map
U - Grass transect from above
R - Grass transect start
Q - Grass transect end

Additional photos can concern legumes, rare species, dominant species.

9.15.2.8 Additional photos (669 – 695)

Up to 9 additional photos can be taken to document and clarify the options taken by the surveyor in the course of the data collection. Additional photo types are:

- Grassland dominant species
- Grassland specific species
- Point access
- Point observation
- Land cover
- Land use
- Copernicus
- Soil
- Water management
- Other (e.g. erosion)

9.15.3 Summary of main photos to be taken

Questionnaire	Value	Label	Point (P)	Cover (C)	North (N)	East (E)	South (S)	West (W)	Addit. Photo type	Remark on additional photo
Observation type	1	Field Survey <= 100 m	Y	Y	Y	Y	Y	Y	N	
	2	Field Survey > 100 m	Y	Y	Y	Y	Y	Y	Y	Take photo showing why point not reached
	3	Photo interpreted	N	N	Y	Y	Y	Y	Y	Take photo showing why point not reached
	4	Point not visible. PI	N	N	N	N	N	N	Y	Take photo showing why point

		not possible								not reached
	5	Out of National territory	N	N	N	N	N	N	N	
	6	Out of EU 28	N	N	N	N	N	N	N	
	7	Photo-interpretation in the office	N	N	N	N	N	N	N	

Questionnaire	Value	Label	Addit. Photo type	Remark on additional photo
Direction of observation	2	North	Y	Take photo supporting decision when "looking to the North"
	3	East	Y	Take photo supporting decision when "looking to the East"

Questionnaire	Value	Land cover 2	Addit. Photo type	Remark on additional photo
Land Cover 2		LC2 like 'B' or 'C' or 'D' or 'E'	Y	Take photo showing the crop in LC2 (if needed)
		LC2 like 'A' or 'G' or 'F' or 'H'	N	
	8	Not relevant	N	

Questionnaire	Value	Copernicus LC (K)	LC (K)	Remark on
Copernicus		LC	Y	Take photo showing the land cover on the point reached by the surveyor

Questionnaire	Value	Presence of water	Irrigation photo (I)	Addit. Photo type	Remark on additional photo
- Presence of water management	1	Irrigation	Y	N	
	2	Potential irrigation	Y	N	
	3	Drainage	Y	N	
	4	Irrigation and drainage	Y	Y	Take photo showing further irrigation/drainage elements.
	5	No visible water manageme nt	N	N	
	8	Not Relevant	N	N	

Questionnaire	Value	Soil biodiversity sample taken	Soil (L, Z)	Addit. Photo type	Remark on additional photo

soil biodiversity sample taken	1	Yes	Y	N	Take a photo of the point, with the sample and as many holes as possible. Take a photo showing clearly the label code
	2	Not possible	N	Y	Take photo showing the reason why soil not taken
	8	Not Relevant	N	N	

Questionnaire	Value	Soil bulk density sample taken	Soil (L, Y)	Addit. Photo type	Remark on additional photo
soil bulk density sample taken ?	1	Yes	Y	N	Take a photo of the point, with the sample and as many holes as possible. Take a photo showing clearly the label code
	2	Not possible	N	Y	Take photo showing the reason why soil not taken
	8	Not Relevant	N	N	

Questionnaire	Value	Soil standard sample taken	Soil (L, X)	Addit. Photo type	Remark on additional photo
soil standard sample taken ?	1	Yes	Y	N	Take a photo of the point, with the sample and as many holes as possible. Take a photo showing clearly the label code
	2	Not	N	Y	Take photo showing the reason why soil not taken

		possible			
	8	Not Relevant	N	N	

Questionnaire	Direction	Depth of organic horizon	Soil (D, B, H, J, R)	Addit. Photo type	Remark on additional photo
Measurements and related photos have to be taken for the hole at the point and for 2 other holes, preferably N and S, then E, then W.					
Organic horizon	Point	Specified	Y	N	Take photo showing the organic horizon depth
	North	Specified	Y	N	Take photo showing the organic horizon depth
	East	Specified	Y	N	Take photo showing the organic horizon depth
	South	Specified	Y	N	Take photo showing the organic horizon depth
	West	Specified	Y	N	Take photo showing the organic horizon depth

Questionnaire	Value	Grassland age	Grassland age (A)	Addit. Photo type	Remark on additional photo
Grass age	2	Unclear grassland age	Y	N	If the age of the grassland is unclear take a photo of the relevant characteristics present

Questionnaire	Value	Grassland transect	Grassland transect on map (M, O, Q, R)	Addit. Photo type	Remark on additional photo
Grass transect		Transect on map	Y (M)	N	Trace the grassland transect on the map and take a photo of the map
		Transect start	Y (O)	N	Take a photo from the start of the transect in the direction of the transect end
		Transect end	Y (Q)	N	Take a photo from the end of transect point in the direction of the starting point of the transect
		Characteristic point from above	Y (R)	N	Take one photo from 1.5 m height pointing the camera vertically downwards to a typical patch of vegetation for the transect.
		Dominant species	N	Y	If you find a dominant species not listed in the field form and that you cannot identify take a photo.

9.15.4 Naming of photos

The correct naming of the photos is essential. The identification is of high importance to enable correct archiving.

Note the photo name.	The camera will assign a name to the image. In order to ease renaming of the photos, the surveyor should write the photo name given by the camera on the field form (**Photo ID**). Together with the date and time of the field survey, it will be an unambiguous identification.
DMT will rename the photos automatically	LUCAS photos are named according to a convention. For each photo a unique identification code is to be given to each photo before delivery, composed of: - Point ID (8 digits) - Photo identifier (1 digit) The photo identifiers are as follows: P - Point C - Crop – Cover N - North E - East S - South W - West K - Copernicus I - Irrigation L - Soil photo X - Soil label photo Y - Soil bulk label photo Z - Soil biodiversity label photo D - Soil organic horizon depth @P B - Soil organic horizon depth @N H - Soil organic horizon depth @E J - Soil organic horizon depth @S V - Soil organic horizon depth @W A - Grassland with unclear age M - Grassland transect on map U - Grassland transect start R - Grassland from above Q - Grassland transect end Additional photos are coded and numbered sequentially. When uploading the images to DMT, they will be renamed automatically.
Example: naming of a photo	The name of the East photo for point 23456789 is **23456789E.jpg**
Delivery of the EXIF data is mandatory	The photo file associated EXIF data (e.g. DateTimeOriginal, GPSLongitudeRef, GPSLongitude, GPSLatitude, ImageHeight, ImageWidth) is used for quality control. Photos without EXIF data will not be accepted.

10 Annexes

10.1 Field form - Record descriptor

This chapter gives an overview of the items, which have to be recorded in the field. The list below shows that beside the land cover and land use information of the point concerned a number of "meta information" has to be collected.

The explanations given follow the structure of the Field Form (LUCAS document C2) and provide a basic definition and description of each item. Moreover, references are given where to find more detailed information and explanations (as in LUCAS reference document C3, Land Use and Land Cover classification). Additional information can also be found in the following annexes.

10.1.1 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**
User 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.
Point altitude (C)	In meters	Prefilled, based on the information on the sample
PI extension point (D)	Yes/No	Prefilled, based on the information on the sample
EX-ANTE point (E)	Yes/No	Prefilled, based on the information on the sample
Date (7)	YYY/MM/DD (e.g. 2018/05/23)	Date of observation. Valid date with YYYY=2018 or 2019, MM=01-12, DD=01..31
Start time (8)	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 (9)	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

10.1.2 Access to point

Car park latitude (11)	DD.dddddd	GPS position (WGS84 latitude) of the location where the car was parked

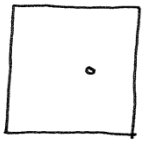
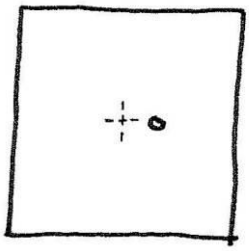
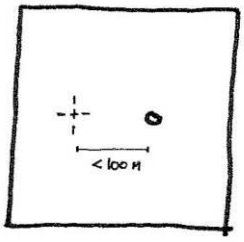
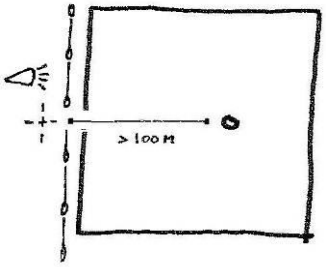
Car park longitude (12, 13)	E/W DD.dddddd	GPS position (WGS84 longitude) of the location where the car was parked
GPS coordinate system (14)	(1) WGS84	Normal functioning of GPS using “WGS 84” as coordinate system.
	(2) Problem with signal	No signal, or bad reception. The reason needs to be noted in the remarks.
GPS Precision (15)	Value (in m)	Indication of average location error as given by GPS receiver (in meters)
GPS Elevation (16)	Value (in m)	GPS value of elevation of the location from which observation is done (in meters above sea level).
Point latitude (17)	DD.dddddd	GPS position of the location from which observation is done (WGS84)
Point longitude (18, 19)	E/W DD.dddddd	GPS position of the location from which observation is done (WGS84)
GPS distance to the point (20)	Value (in m)	Indication of the distance between observation location and the LUCAS point as provided by the GPS receiver (in meters).
GPS calculated distance to point (21)	Value (in m)	Distance calculated automatically by the DMT, based on the position of the surveyor according to the GPS coordinates
Way to the point (previous campaign (F)	Text	If there is information available from a previous campaign it is reported here.

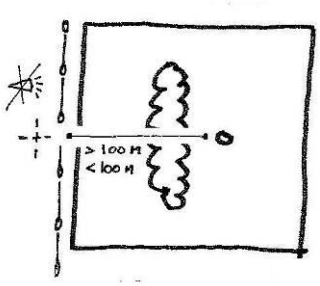
10.1.3 Comments (on the way to the point)

In addition of the obligatory fields to be filled in, the surveyor has the opportunity - and in specific situations the obligation - to add specific comments and remarks. Remarks in the field form are essential for transparent reasoning of any decision taken by the surveyor and for all future LUCAS surveys.

Description of the way to the point (F, 500)	If the point can be accessed without any problem, a specific comment is not necessary. - Structured comments (to be preferred) - Free text comments

10.1.4 Point observation

Type of observation (24)	(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 <u>point</u> 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) Photo-interpretation in the field,	If the <u>point</u> is not accessible and not visible in the field (e.g. the point is located in a

	Point not visible  Fence, barrier, high crop, hedge etc. impeding the point observation  Point not visible	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 visible. PI not possible 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) Out of national territory	The point is located out of the national territory.
	(6) Out of EU 28	The point is locted out of the national territory and out of the EU 28
	(7) Photo-interpretation in the office	The point has been assigned to photo-interpretation in the office a priori
Direction of observation (25)	(1) On the point	Point regularly observed.
	(2) To 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) To 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) N.R. (Not relevant)	If not applicable.

Remarks about point observation (500)	Structured comments Free text comments	It is important to note all those facts related to the observation of the point, which pose specific difficulties. 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.

10.1.5 Land cover and land use

While the information of GPS coordinates and precision are referring to the position of the surveyor while doing the observation, the **information on land cover, land use and the photos of the point and of the crop/cover have to refer to the LUCAS point itself** (the theoretical point), determined by the orthophoto, even if it is further away from the real position of the surveyor.

LC1 land cover 1 (28)	Land cover code	Coding of land cover according to LUCAS 2018 classification. BX1 or BX2 are only possible for points with observation type (24) = 3 (photo interpreted)
LC1 plant species	BXXn	To be filled for crops (LC1=BXX) classified as

(29)		"other" in LC1, and also for nurseries (see Annexes and Document C3 for code lists)
LC1 coverage (%) (30)	Value (0-100%) for land cover 1 (LC1)	Land cover 1 + 2 can sum up to more than 100%.
LC2 land cover 2 (31)	Land cover code	A second cover can be registered if necessary
LC2 plant species (32)	BXXn	To be filled for crops (LC1=BXX) classified as "other" in LC1
LC2 coverage (%) (33)	Value (0-100%) for land cover 2 (LC2)	Land cover 1 + 2 can sum up to more than 100%.
LU1 land use 1 (34)	Land use code	Coding of the land use according to LUCAS LU 2018 classification
LU1 land use type (35)	U22Xn U315n	To be filled for the secondary sector (LU1=U22X) and for transport via pipelines (LU1=U315)
LU1 coverage (%) (36)	Value (0-100%) for land use 1 (LU1)	Land use 1 + 2 can sum up to more than 100%.
LU2 land use 2 (37)	Land use code	A second land use can be registered if necessary.
LU2 land use type (38)	U22Xn U315n	To be filled for the secondary sector (LU2=U22X) and for transport via pipelines (LU2=U315)
LU2 covrage (%) (39)	Value (0-100%) for land use 2 (LU2)	Land use 1 + 2 can sum up to more than 100%.
Parcel area (in ha) (40)	(1) area < 0.1	Size of the observed parcel is smaller than 0.1 ha.
	(2) 0.1<=area < 0.5	Size of the observed parcel ranges between 0.1 and 0.5 ha.
	(3) 0.5 ≤area < 1	Size of the observed parcel ranges between 0.5 and 1 ha.
	(4) 1 ≤ area < 10	Size of the observed parcel ranges between 1 and 10 ha.
	(5) Area ≥ 10	Size of the observed parcel is larger than 10 ha.

10.1.6 FAO parameters

Height of trees at the moment of survey (42)	(1) < 5m	Applicable if the LC is CX0, D10, E10, B81, B82, B83 and trees in B70 (except B75, as this is a mixed class), assess the height of the trees at the moment of the survey.
	(2) ≥ 5m	
	(8) Not relevant	If not applicable.
Height of trees at maturity (43)	(1) < 5m	Applicable if the LC is CX0, D10, E10, B81, B82, B83 and trees in B70 (except B75, as this is a mixed class), assess the height of the trees at maturity.
	(2) ≥ 5m	
	(8) Not relevant	If not applicable.
Width of feature (44)	(1) < 20m	If LC is CX0, D10, E10, B81, B82, B83 and trees in B70 (except B75, as this is a mixed class), assess the width of the feature.
	(2) ≥ 20m	
	(8) Not relevant	If not applicable.

10.1.7 Land management

Sign of ploughing? (46)	(1) Yes	If there are signs of ploughing in the plot.
	(2) No	If there are no signs of ploughing in the plot.
	(8) Not relevant	If not applicable: the point is not located on an agricultural field.
Slope of ploughed field (47)	(1) Flat	

	(2) Gently sloping	no effort when walking up the slope
	(3) Steeply sloping	requires effort to walk up the slope
	(4) Undulating	land slopes in more than one direction
	N.R.	
Plough direction (48)	(1) Across the slope	
	(2) Down the slope	
	NR	
Presence of stone walls (49)	(1) No	
	(2) Stone wall, not maintained	
	(3) Stone wall, well maintained	
	NR	
Presence of crop residues (50)	Yes/No N.R.	
Presence of grass margins (51)	(1) No	
	(2) <= 1m width	
	(3) > 1 m width	
	NR	

10.1.8 Special remarks (on land cover/use)

Signs of grazing in the plot (53)	(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) N.R. Not relevant	If not applicable.
Special status (54)	(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	
Special remarks on land cover / land use (55)	(1) 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
	(2) Tilled and/or sowed	If the parcel is tilled and/or sowed and the crop cannot be recognised: the surveyor has to re-visit the point
	(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) Dump site	
	(8) 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.
	(9) Temporarily flooded	Applies to areas that are flooded at the time of the visit.
	(10) No remark	

10.1.9 COPERNICUS

Only collect Copernicus if "Type of observation" = (1) Field survey, point visible, 0-100m to point

Copernicus point (G)	Yes/No	prefilled
Can you do the Copernicus survey?	Yes/No	
Copernicus LC (58)	Land cover level 2	
Extension of Copernicus LC in the 4 cardinal directions (in m)		
N (60)	Integer: 5 – 51	Extent in meters. If the extend is >= 50, put 51.
E (61)	Integer: 5 – 51	Extent in meters. If the extend is >= 50, put 51.
S (62)	Integer: 5 – 51	Extent in meters. If the extend is >= 50, put 51.
W (63)	Integer: 5 – 51	Extent in meters. If the extend is >= 50, put 51.
Breadth of the next Copernicus LC in the 4 cardinal directions (%)		
N (65)	Integer: 0 - 100	%
E (66)	Integer: 0 - 100	%
(67)	Integer: 0 - 100	%
W (68)	Integer: 0 - 100	%
Next Copernicus LC (if extend of previous cover <50 m)		
N (70)	Land cover level 2	
E (71)	Land cover level 2	
S (72)	Land cover level 2	
W (73)	Land cover level 2	

10.1.10 INSPIRE

To improve the mapping with other products some additional information is collected.

10.1.10.1 Urban areas

Point in urban area? (80)	(1) Yes	A good way to identify the "urban area" is to use the orthophoto. In general, the boundaries of an "urban area" are easily recognisable and marked by, for example, fences or walls around kitchen or allotment gardens, graveyards, residential areas or dwellings.
	(2) No	
Imperviousness (81)	Value (0-100%)	The degree of imperviousness is to be assessed in the extended window of the LUCAS point. The degree of imperviousness is the percentage (0 – 100%) of the area within the extended window that is artificially sealed, according to HRL imperviousness layer definition.

10.1.10.2 INSPIRE PLCC (Pure Land Cover Components)

The following fields are to assess INSPIRE pure land cover components. Data will only be collected for the points where land cover 1 is either woodland (CXX), shrub land (DXX), grassland (EXX) or bare land (FXX) and is to be 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%, the sum of PLCC must be 100%. Assessment of these percentages is made using the "birds-eye" view.

(83) Coniferous forest trees	Value (0-100%)	Assess the percentage of coniferous trees
(84) Broadleaved forest trees	Value (0-100%)	Assess the percentage of broadleaved trees
(85) Shrubs	Value (0-100%)	Assess the percentage of shrubs
(86) Herbaceous plants	Value (0-100%)	Assess the percentage of herbaceous plants
(87) Lichens and mosses	Value (0-100%)	Assess the percentage of lichens and mosses
(88) Consolidated (bare) surface	Value (0-100%)	Assess the percentage of consolidated (bare) surface (e.g. rock outcrops)
(89) Unconsolidated (bare) surface	Value (0-100%)	Assess the percentage of unconsolidated (bare) surface (e.g. sand)
(90) Other	Value (0-100%)	Sum of all classes must be 100%. This field covers for the difference, if it exists.

10.1.11 EUNIS habitat complex

EUNIS complex (92)	X06	Crops, meadows or pastures developed under orchards or other cultivated tree plantations.
	X09	Pasture woods (with a tree layer overlying pasture) with forest trees Large, open-grown or high forest trees (often pollards) at various densities, in a matrix of grazed grassland
Comment (500)	- structured comment - free text	Optional

10.1.12 Grassland

If the point is part of the grassland module

Grassland point (H)	Yes/No	Prefilled, based on the information on the sample
Grassland region (I)	Text	Prefilled, based on the information on the sample
Grassland survey possible? (96)	Yes/No	Is it possible to do the grassland assessment, including the transect, according to the rules? If not, skip the complete grassland module.
Grassland survey cannot be done Comment (500)	- structured comment - free text	Mandatory if survey cannot be done.

10.1.12.1 Grassland EUNIS habitat type

EUNIS Grass habitat type (98)	A2, B1, C3, D1-D6, E1-E7, F2-F9, FA, FB, G1-G5, I1, I2	See Annex 9.8 for a description of the different habitat types
EUNIS Grass Habitat type Comment (500)	- structured comment - free text	

10.1.12.2 Grassland site

Site orientation (100)	(1) Flat	

	(2) N	North
	(3) NE	North-East
	(4) E	East
	(5) SE	South-East
	(6) S	South
	(7) SW	South-West
	(8) W	West
	(9) NW	North-West
	N.R.	Not relevant
Site slope (101)	Value (in degrees)	
Site moisture (102)	(1) Wet	
	(2) Moist	
	(3) Mesic	
	(4) Semi-dry	
	(5) Dry	
	(6) Mixed	
	N.R.	Not relevant
Soil surface (103)	(1) Even	
	(2) Heterogeneous	
	(3) Very heterogeneous	
	N.R.	Not relevant
Presence of animal paths (104)	Yes/No N.R. (not relevant)	

10.1.12.3 Grassland fertilisation

Fertilisation (106)	(1) No	
	(2) Probably	
	(3) For sure	
	(4) Unclear	
	N.R:	Not relevant

Type of fertilisation (if, probably or for sure) (107)	(1) Mineral	
	(2) Slurry	
	(3) Solid manure	
	(4) Pasture dung	
	(5) Unclear	
	N.R.	Not relevant

10.1.12.4 Grassland type

Grassland type (109)	(1) Meadow	
	(2) Pasture	
	(3) Other grassland	
	N.R.	Not relevant
Growth if meadow (110)	(1) 1st growth	
	(2) 2nd growth	
	(3) Fallow meadow	
	N.R.	Not relevant
Grazing if pasture (112)	(1) Before 1st grazing	
	(2) After 1st grazing	
	(3) Fallow pasture	
	N.R.	Not relevant
Other grassland type (124)	(1) Meadow or pasture (not clear or both)	
	(2) Pastured woodland	
	(3) Amenity grassland	
	(4) Ruderal grassland	
	(5) Fallow other grassland	
	(6) Other kind of grassland n.e.s.	Other kind of grassland not elsewhere specified
	N.R.	Not relevant
If recently mown meadow (111)	(1) <=1 week	

	(2) 1-3 weeks	
	(3) >=3 weeks ago	
	N.R.	Not relevant
If freshly grazed pasture (113)	(1) Rough grazing	
	(2) Seasonal grazing	
	(3) Strip grazing	
	(4) Unclear	
	N.R.	Not relevant
If other kind of grassland n.e.s. Comment (500)	- structured comment - free text	
Animals if grazed pasture (multiple choice)	(1) Cattle (115)	
	(2) Horses (116)	
	(3) Sheep (117)	
	(4) Goats (118)	
	(5) Donkeys (119)	
	(6) Pigs (120)	
	(7) Geese/ducks/… (121)	
	(8) Deer/roebuck/… (122)	
	(9) Other (123)	
Age, if fallow meadow, fallow pasture or fallow other grassland (125)	(1) >=2 years	
	(2) >2 years	
	N.R.	Not relevant

10.1.12.5 Grassland age

Grassland age (127)	(1) <=5 years	
	(2) >5 years	
	(3) Unclear	
	N.R.	Not relevant

If visible signs are unclear Comment (500)	- structured comment - free text	
Grassland installation (if age >=5 years) (128)	(1) seeded	
	(2) Re-vegetated	
	(3) Other signs	
	N.R.	Not relevant
If other signs for judgement in grassland installation Comment (500)	If visible signs are unclear Comment	- structured comment - free text

10.1.12.6 Grassland transect

Grassland transect starting point (130)	(1) On the point	
	(2) Shifted	
	N.R.	Not relevant
Direction of the grass transect shift (if shifted) (131)	(1) N	North
	(2) NE	North-East
	(3) E	East
	(4) SE	South-East
	(5) S	South
	(6) SW	South-West
	(7) W	West
	(8) NW	North-West
	N.R.	Not relevant
Distance of grass transect shift (if shifted) (132)	Value (in m)	
Reason of grass transect shift Comment (500)	- structured comment - free text	
Direction of grass transect (133)	(1) N	North
	(2) NE	North-East

	(3) E	East
	(4) SE	South-East
	(5) S	South
	(6) SW	South-West
	(7) W	West
	(8) NW	North-West
	N.R.	Not relevant
Length of grass transect (134)	Value (in m)	
Start of grass transect latitude (135)	DD.dddddd	GPS position (WGS84 latitude) of the start of grass transect latitude
Start of grass transect longitude (136, 137)	E/W DD.dddddd	GPS position (WGS84 longitude) of the start of grass transect longitude
End of grass transect latitude (138)	DD.dddddd	GPS position (WGS84 latitude) of the end of grass transect latitude
End of grass transect longitude (139, 140)	E/W DD.dddddd	GPS position (WGS84 longitude) of the end of grass transect longitude

10.1.12.7 Grassland vegetation layers

Vigour of vegetation (142)	(1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5) N.R. (not relevant)	
Herbaceous layer on grasss transect (%) (143)	Integer (0-100)	Total >=100
Bare layer on grass transect (%) (144)	Integer (0-100)	
Woody layer on enlarged grass transect (%) (145)	Integer (0-100)	
Herbaceous layer components (on grass transect) (Percentage, total >=100)		
Graminoids (147)	Integer (0-100)	
Forbs (148)	Integer (0-100)	
Mosses (150)	Integer (0-100)	
Lichens (151)	Integer (0-100)	
Bare layer components (on grass transect) (Percentage, total >=100)		

Bare soil (153)	Integer (0-100)	
Rocks and/or stones (154)	Integer (0-100)	
Litter (155)	Integer (0-100)	
Woody layer components (on enlarged grass transect) (Percentage, total >=100)		
Orchard (157)	Integer (0-100)	
Old trees (158)	Integer (0-100)	
Shrub (159)	Integer (0-100)	
Dwarf shrub (160)	Integer (0-100)	
Other wooded (161)	Integer (0-100)	
Dead wood (162)	Integer (0-100)	

10.1.12.8 Grassland herb layer

Number of hwérb layer(s): Average height of the layer (cm) top first, bottom last, N.R. if less layers		
Layer 1 (165)	Value (in cm)	
Layer 2 (166)	Value (in cm)	
Layer 3 (167)	Value (in cm)	
Layer 4 (168)	Value (in cm)	
Layer 5 (169)	Value (in cm)	
Herb layer heterogeneity (170)	(1) Homogenous	
	(2) Heterogeneous	
	(3) Very heterogeneous	
	N.R.	Not relevant
Herb layer heterogeneity reason (171)	(1) Fallow succession	
	(2) Many ungrazed patches	
	(3) Invasive neophytes	
	(4) Variation in water supply on the site	
	(5) Variation in site soil	

	conditions	
	(6) Other reasons	
	N.R.	Not relevant
Comments on height and dominance (500)	- structured comments - free text	

10.1.12.9 Grassland flowes

Number of species of flowering forbs (173)	Integer	
Flower density (174) (all flowers)	(1) None	
	(2) Very few	
	(3) Very few to few	
	(4) Few	
	(5) Few to medium	
	(6) Medium	
	(7) Medium to dense	
	(8) Dense	
	(9) Dense to very dense	
	(10) Very dense	
	N.R.	Not relevant

10.1.12.10 Grassland key species / species group richness

Key species richness for each of the 10 regions (multiple choice): [41 different species in total; only 20 per region]		
Number of plants for each of the 20 species relevant for the region		
	Classe: 1, 2, 3, 4, 5 ,6, 7, 8, 9, 10, 11	For more than 10 put 11.
Achillea spp. (177)		
Adonis spp. (178)		
Apiaceae (179)		
Artemisia spp. (180)		
Asphodelus spec., Narthecium spec., Paradisea liliastrum (181)		

Astragalus spp., Coronilla spp., Onobrychis spp., Hedysarum coronaria with red or red-white flowers (182)		
Bistorta officinalis, Polygonum bistorta (183)		
Campanula spp. (184)		
Centaurea spp., Serratula tinctoria (185)		
Cichorioideae without Tragopogon spp. and without Taraxacum spp. (186)		
Cirsium spp., Carduus spp., Carlina spp. (187)		
Cistus spp. (188)		
Clematis integrifolia (189)		
Eryngium planum and other, Echinops spp. (190)		
Euphorbia spp. (191)		
Euphrasia spp. (192)		
Filipendula spp. (193)		
Galium spp. (white flowering) (194)		
Galium verum (195)		
Genista spp. , Spartium spp., Calicotome spp., others (196)		
Geranium spec. with big flowers (flower diameter >=1cm) (197)		
Juncus spp. (198)		
Leucanthemum spp. (199)		
Limonium spp. (200)		
Myosotis spp. (201)		
Orchidaceae spp. (202)		
Pedicularis spp. (203)		
Phlomis fruticosa (204)		
Potentilla spp. without Potentilla anserine (205)		
Rhinanthus spp. (206)		
Salvia spp. (207)		
Sanguisorba spp. (208)		
Scabiosa spp., Knautia spp., Succisa spp. (209)		
Silene spp., Lychnis flos-cuculi, Dianthus spp. (red flowering) (210)		
Thalictrum spp. (211)		
Thymus spp. (212)		
Tragopogon spp., Scorzonera spp. (213)		
Trifolium spp. (red flowering) (214)		
Trifolium spp., Medicago spp.,		

Lotus spp., Coronilla (yellow flowering) (215)		
Valeriana spp. (216)		
Vicia spp., Lathyrus spp., Astragalus spp. (blue or purple flowering) (217)		

10.1.12.11 Grassland structural characterisation (on grass transect)

Structural species / species group: (multiple choice)		
	Value (percentage)	
Shrub/ Brushwood/ Bramble (221)	Integer (0-100)	
Phrygana / Garrigue (222)	Integer (0-100)	
Thistles (Carduus spp, and others) (223)	Integer (0-100)	
Stinging nettles (Urtica dioica) (224)	Integer (0-100)	
Docks (Rumex obtusifolius, and others) (225)	Integer (0-100)	
Bracken (Pteridium aquilinum) (226)	Integer (0-100)	
Rushes (Juncus spp.) (227)	Integer (0-100)	
Sedges (Carex spp.) (228)	Integer (0-100)	
Reed (Phragmites) (229)	Integer (0-100)	
Wood small-reed (Calamagostis) (230)	Integer (0-100)	
Moor grass (Molinia caerulea) (231)	Integer (0-100)	
Feather grass (Stipa spp.) (232)	Integer (0-100)	
Matgrass (Nardus stricta) (233)	Integer (0-100)	

Number of other dominant structural species (234)	Integer >= 0	

Insert remark if other dominant species are present Comment (500)	- structured comment - free text	

10.1.12.12 Grassland legume cover

Total cover of legumes (%) (236)	Integer (0-100)	

10.1.13 Water management on the field

These fields are only relevant for points where LU = U111 or U112. If more than one source of irrigation or delivery system exists, mark the most important source. Note if irrigation is visible from the way to the point or along the transect.

Presence of water management (251)	(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 (252)	(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 (253)	(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 (254)	(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.

10.1.14 Soil (Tab 13 in DMT)

Only collect soil samples if observation distance <=100 m and the point reached has the same land cover as the LUCAS point

10.1.14.1 Soil (Type of soil point)

Soil point? (K)	Yes/No (pre-filled)	Indicates whether a point is to be considered for soil collection (Yes) or not (No)
Organic horizon point (L)	Yes/No (pre-filled)	Indicates whether a point is to be considered for determining the organic horizon (Yes) or not (No)
Bulk point (M) (0–10)	Yes/No (pre-filled)	Indicates whether a point is to be considered for collecting the bulk density sample (Yes) or not (No)
Bulk point (N) (10–20)	Yes/No (pre-filled)	Indicates whether a point is to be considered for collecting the bulk density sample (Yes) or not (No)
Bulk point (O) (20–30)	Yes/No (pre-filled)	Indicates whether a point is to be considered for collecting the bulk density sample (Yes) or not (No)
BIO point (P)	Yes/No (pre-filled)	Indicates whether a point is to be considered for collecting the biodiversity sample (Yes) or not (No)

10.1.14.2 Soil site

Stones on the surface (%) (341)	1 – 100	Indicate the percentage of stones on the surface (does not include stones covered by soil)

10.1.14.3 Soil biodiversity

If the point is a soil biodiversity point:

Soil biodiversity sample taken? (343)	Yes/No N.R.	
Biodiversity label (if sample is	Value (Char 5)	Corresponds to the number on the green

taken) (344)	N.R. = 88888	plastic label placed in the plastic jar
Biodiversity expedition date (345)	YYY/MM/DD (e.g. 2018/05/23)	Date of observation. Valid date with YYYY=2018 or 2019, MM=01-12, DD=01..31
Remarks about biodiversity (500)	Comments on special circumstances or problems: - Structured comments (to be preferred) - Free text comments	

10.1.14.4 Soil bulk density

If the point is a bulk density point:

Bulk (0–10) sample taken? (347)	Yes/No N.R.	
Bulk (0-10) label (if sample is taken) (348)	Value (Char 5) N.R. = 88888	Corresponds to the number on the yellow plastic label showing BULK 0-10
Bulk (10–20) sample taken? (349)	Yes/No N.R.	
Bulk (10-20) label (if sample is taken) (350)	Value (Char 5) N.R. = 88888	Corresponds to the number on the yellow plastic label showing BULK 10-20
Bulk (20–30) sample taken? (351) (only for Portugal)	Yes/No N.R.	
Bulk (20-30) label (if sample is taken) (352) (only for Portugal)	Value (Char 5) N.R. = 88888	Corresponds to the number on the yellow plastic label showing BULK 20-30
0-10 cores taken (multiple choice)		
Point (354)	Yes/No	
North (355)	Yes/No	
East (356)	Yes/No	
South (357)	Yes/No	
West (358)	Yes/No	

10-20 cores taken (multiple choice)		
Point (367)	Yes/No	
North (368)	Yes/No	
East (369)	Yes/No	
South (370)	Yes/No	
West (371)	Yes/No	
20-30 cores taken (multiple choice) (only for Portugal)		
Point (381)	Yes/No	
North (382)	Yes/No	
East (383)	Yes/No	
South (384)	Yes/No	
West (385)	Yes/No	
Remarks about the bulk soil sample (500)	- structured remark - free text	
Weight of samples (field)		
Bulk 0-10 moist weight (395)	Value in g	
Bulk 10-20 moist weight (396)	Value in g	
Bulk 20-30 moist weight (397)	Value in g	Only for Portugal
Weight of samples (air dried)		
Bulk 0-10 dried weight (399)	Value in g	
Bulk 10-20 dried weight (400)	Value in g	
Bulk 20-30 dried weight (401)	Value in g	Only for Portugal

10.1.14.5 Standard soil sample

If the point is not a bulk density point.

Standard soil sample taken (403)	(1) Yes	If the point is a standard soil point and the soil sample was taken.
	(2) Not possible	If the point is a standard soil point and it is not possible to collect the soil sample (e.g. point not visible, or near a road).
	(8) Not relevant	If not applicable: the point is not a standard soil point.

Soil label (404)	Value (Char 5)	The number of the label placed on the plastic bag with the topsoil sample.
Remarks about the soil sample (500)	Structured comments Free text comments	For free text the use of English is mandatory. Special characters are to be avoided.

10.1.14.6 Land owner details (soil sample results)

And owner requested soil results? (408)	Yes/No N.R:	
Land owner name (409)	CHAR(255)	
Land owner address (410)	CHAR(255)	(street/number/postal code/city/country)
Land owner phone (411)	CHAR(255)	
Land owner e-mail (412)	CHAR(255)	

10.1.14.7 Soil organic horizon for peat soils

If the point is an organic horizon soil point, then the depth of the organic horizon in 3 holes – among which the hole at the point – needs to be evaluated.

Can depth be evaluated? (414)	Yes/No N.R.	
Is soil cultivated? (415)	Yes/No N.R.	
Measure depth of organic horizon in the point hole and in two of the other regular collection holes (in cm, up to 40cm)		
Depth of organic horizon at the point (417)	in cm: 0 – 40 (integer)	
Or check if more than 40 cm (423)	Yes/No	
Depth of organic horizon on the N hole (418)	in cm: 0 – 40 (integer)	
Or check if more than 40 cm (424)	Yes/No	
Depth of organic horizon on the E hole (419)	in cm: 0 – 40 (integer)	
Or check if more than 40 cm (425)	Yes/No	
Depth of organic horizon on the S hole (420)	in cm: 0 – 40 (integer)	
Or check if more than 40 cm (426)	Yes/No	

Depth of organic horizon on the W hole (421)	in cm: 0 – 40 (integer)	
Or check if more than 40 cm (427)	Yes/No	
Remarks about the soil organic horizon assessment (500)	- structured comment - free text	

10.1.15 Erosion (Tab 12 in DMT)

For points that are in the grassland module or in the soil module.

Field	Content	Comment
Erosion point (J)	Yes/No	Prefilled, based on the information on the sample. Indicates whether a point is to be considered for assessing erosion (Yes) or not (No)
Signs of erosion (257)	(1) Yes	
	(2) No	
	N.R. (not relevant)	

10.1.15.1 Sheet erosion

Sheet erosion (within 500 m, if visible): direction (multiple choice)		
Point (260)	Yes/No	
North (261)	Yes/No	
East (262)	Yes/No	
South (263)	Yes/No	
West (264)	Yes/No	
Sheet erosion (within 500 m, if visible): distance from LUCAS point (one for each direction selected, except point)		
North (266)	Value (in m)	
East (267)	Value (in m)	
South (268)	Value (in m)	
West (269)	Value (in m)	

10.1.15.2 Rill erosion

Rill erosion (within 500 m, if visible): direction (multiple choice)		
Point (272)	Yes/No	
North (273)	Yes/No	
East (274)	Yes/No	
South (275)	Yes/No	
West (276)	Yes/No	
Rill erosion (within 500 m, if visible): distance from LUCAS point (one for each direction selected, except point)		
North (278)	Value (in m)	
East (279)	Value (in m)	
South (280)	Value (in m)	
West (281)	Value (in m)	

10.1.15.3 Gully erosion

Gully erosion (within 500 m, if visible): direction (multiple choice)		
Point (284)	Yes/No	
North (285)	Yes/No	
East (286)	Yes/No	
South (287)	Yes/No	
West (288)	Yes/No	
Gully erosion (within 500 m, if visible): distance from LUCAS point (one for each direction selected, except point)		
North (290)	Value (in m)	
East (291)	Value (in m)	
South (292)	Value (in m)	
West (293)	Value (in m)	

10.1.15.4 Mass movement

Mass movement (within 500 m, if visible): direction (multiple choice)		
Point (296)	Yes/No	
North (297)	Yes/No	
East (298)	Yes/No	
South (299)	Yes/No	
West (300)	Yes/No	
Mass movement (within 500 m, if visible): distance from LUCAS point (one for each direction selected, except point)		
North (302)	Value (in m)	
East (303)	Value (in m)	
South (304)	Value (in m)	
West (305)	Value (in m)	

10.1.15.5 Re-deposition of soil

Re-deposited soil (within 500 m, if visible): direction (multiple choice)		
Point (308)	Yes/No	
North (309)	Yes/No	
East (310)	Yes/No	
South (311)	Yes/No	
West (312)	Yes/No	
Re-deposited soil (within 500 m, if visible): distance from LUCAS point (one for each direction selected, except point)		
North (314)	Value (in m)	
East (315)	Value (in m)	
South (316)	Value (in m)	
West (317)	Value (in m)	

10.1.15.6 Wind erosion

Wind erosion (within 500 m, if visible): direction (multiple choice)

Point (320)	Yes/No	
North (321)	Yes/No	
East (322)	Yes/No	
South (323)	Yes/No	
West (324)	Yes/No	
Wind erosion (within 500 m, if visible): distance from LUCAS point (one for each direction selected, except point)		
North (326)	Value (in m)	
East (327)	Value (in m)	
South (328)	Value (in m)	
West (329)	Value (in m)	

10.1.15.7 Number of rills or gullies

Number of rills or gullies (331)	(1) <5 rills or gullies	
	(2) 5-10 rills or gullies	
	(3) >10 rills or gullies	
	N.R.	

10.1.16 Comments

Remarks (500)	- structured comment - free text	See in the respective sections the fields numbered "500"

10.1.17 Photos

It is mandatory that the surveyor does the anonymisation directly before sending the photos to the upper level (i.e. the Regional or the Central Office). According to the LUCAS 2018 tender, non-compliance to this rule is considered a breach of contract and will lead to legal consequences.

Photo of the Point (602)	(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.
Photo ID (P)	(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.
To be anonymized (604)	(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!).
Photo of Crop/Cover (605)	(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.
Photo ID (C)	(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.
To be anonymized (607)	(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!).
North (608) East (611) South (614) West (617)	(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)
Photo ID (N, E, S, W)	(Value)	File name (in the camera). This information is for use as reference by the surveyor. The

	Photo ID	renaming of the photos by DMT is automatic.
To be anonymized (610, 613,616, 619)	(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!).
Copernicus photo (620)	(1) Photo taken	For the Copernicus assessment a photo of the location the surveyor reached has to be taken
	(2) Photo not taken	
	(8) Not relevant	If not applicable (e.g. in the case the point is not observed)
Photo ID (K)	(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.
To be anonymized (622)	(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!).
Photo of Irrigation (623)	(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)
Photo ID (I)	(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.
To be anonymized (625)	(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!).
Photo of soil (626)	(1) Photo taken	In case a soil sample (standard topsoil sample or bulk density 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.
Photo ID (L)	(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.
To be anonymized (628)	(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!).
Photo of soil label (629)	(1) Photo taken	In case a standard topsoil has been taken, take a photo of the label
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
Photo ID (L)	(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.
To be anonymized (628)	(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!).
Photo of bulk density label (632)	(1) Photo taken	In case a bulk density sample has been taken, take a photo of the label
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
Photo ID (Y)	(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.
To be anonymized (634)	(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!).
Photo of biodiversity label (635)	(1) Photo taken	In case a biodiversity sample has been taken, take a photo of the label
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
Photo ID (Z)	(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.
To be anonymized (637)	(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!).
Organic horizon: Point (638) North (641) East (644) South (647) West (650)	(1) Photo taken	Take a photo of the 3 holes in which the organic horizon is assessed (one of the holes is at the point)
	(2) Photo not taken	
	(8) Not relevant	If not applicable (e.g. in the case the point is not observed)
Photo ID (D, B, H, J, V)	(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.
To be anonymized (640, 643, 646, 649,652)	(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!).
Grassland with unclear age (653)	(1) Photo taken	If the age of the grassland is unclear take a photo to document the available characteristics
	(2) Photo not taken	

	(8) Not relevant	If not applicable.
Photo ID (A)	(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.
To be anonymized (655)	(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!).
Grassland transect on the map (656)	(1) Photo taken	Draw the grassland transect on the ground document and take a photo
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
Photo ID (M)	(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.
To be anonymized (658)	(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!).
Grassland transect start (659)	(1) Photo taken	Take a photo from the start of the grassland transect looking towards the end of the grassland transect
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
Photo ID (U)	(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.
To be anonymized (661)	(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!).
Grassland from above (662)	(1) Photo taken	Take a photo of a typical area of the grassland transect from above (by holding

		up the camera)
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
Photo ID (R)	(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.
To be anonymized (664)	(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!).
Grassland transect end (665)	(1) Photo taken	Take a photo from the end of the grassland transect looking towards the start of the grassland transect
	(2) Photo not taken	
	(8) Not relevant	If not applicable.
Photo ID (Q)	(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.
To be anonymized (667)	(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!).
Additional photos (669, 672,675, 678, 681, 684, 687, 690, 693)	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
Photo ID (respectively: 1, 2, 3, 4, 5, 6, 7, 8, 9)		File name (in the camera). This information is for use as reference by the surveyor. The renaming of the photos by DMT is automatic.
To be anonymized (respectively: 671, 674, 677, 680, 683,		Tick the box if in the photo there are either people or vehicle license plates (including

686, 689, 692,695)		the plates of the surveyors' car!).
Remarks about photos Comment (500)	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.

10.1.18 GPS tracks and points

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

10.2 Code lists

10.2.1 Code list for land cover (LUCAS LC 2018)

Land cover code	Land cover	Observation
8	Not relevant	Point (1.5m radius)
A11	Buildings with 1 to 3 floors	Point (1.5m radius)
A12	Buildings with more than 3 floors	Point (1.5m radius)
A13	Greenhouses	Point (1.5m radius)
A21	Non built-up area features	Point (1.5m radius)
A22	Non built-up linear features	Point (1.5m radius)
A30	Other artificial areas	Point (1.5m radius)
B11	Common wheat	Point (1.5m radius)
B12	Durum wheat	Point (1.5m radius)
B13	Barley	Point (1.5m radius)
B14	Rye	Point (1.5m radius)
B15	Oats	Point (1.5m radius)
B16	Maize	Point (1.5m radius)
B17	Rice	Point (1.5m radius)
B18	Triticale	Point (1.5m radius)
B19	Other cereals	Point (1.5m radius)
B21	Potatoes	Point (1.5m radius)
B22	Sugar beet	Point (1.5m radius)
B23	Other root crops	Point (1.5m radius)
B31	Sunflower	Point (1.5m radius)
B32	Rape and turnip rape	Point (1.5m radius)
B33	Soya	Point (1.5m radius)
B34	Cotton	Point (1.5m radius)
B35	Other fibre and oleaginous crops	Point (1.5m radius)
B36	Tobacco	Point (1.5m radius)
B37	Other non-permanent industrial crops	Point (1.5m radius)
B41	Dry pulses	Point (1.5m radius)
B42	Tomatoes	Point (1.5m radius)
B43	Other fresh vegetables	Point (1.5m radius)
B44	Floriculture and ornamental plants	Point (1.5m radius)
B45	Strawberries	Point (1.5m radius)
B51	Clovers	Point (1.5m radius)
B52	Lucerne	Point (1.5m radius)
B53	Other leguminous and mixtures for fodder	Point (1.5m radius)
B54	Mixed cereals for fodder	Point (1.5m radius)
B55	Temporary grasslands	Point (1.5m radius)
B71	Apple fruit	Extended window (20m radius)
B72	Pear fruit	Extended window (20m radius)
B73	Cherry fruit	Extended window (20m radius)
B74	Nuts trees	Extended window (20m radius)
B75	Other fruit trees and berries	Extended window (20m radius)
B76	Oranges	Extended window (20m radius)
B77	Other citrus fruit	Extended window (20m radius)
B81	Olive groves	Extended window (20m radius)

B82	Vineyards	Extended window (20m radius)
B83	Nurseries	Extended window (20m radius)
B84	Permanent industrial crops	Extended window (20m radius)
Bx1	Arable land (only PI)	Point (1.5m radius)
Bx2	Permanent crops (only PI)	Extended window (20m radius)
C10	Broadleaved woodland	Extended window (20m radius)
C21	Spruce dominated coniferous woodland	Extended window (20m radius)
C22	Pine dominated coniferous woodland	Extended window (20m radius)
C23	Other coniferous woodland	Extended window (20m radius)
C31	Spruce dominated mixed woodland	Extended window (20m radius)
C32	Pine dominated mixed woodland	Extended window (20m radius)
C33	Other mixed woodland	Extended window (20m radius)
D10	Shrubland with sparse tree cover	Extended window (20m radius)
D20	Shrubland without tree cover	Extended window (20m radius)
E10	Grassland with sparse tree/shrub cover	Extended window (20m radius)
E20	Grassland without tree/shrub cover	Extended window (20m radius)
E30	Spontaneously vegetated surfaces	Extended window (20m radius)
F10	Rocks and stones	Extended window (20m radius)
F20	Sand	Extended window (20m radius)
F30	Lichens and moss	Extended window (20m radius)
F40	Other bare soil	Extended window (20m radius)
G11	Inland fresh water bodies	Point (1.5m radius)
G12	Inland salty water bodies	Point (1.5m radius)
G21	Inland fresh running water	Point (1.5m radius)
G22	Inland salty running water	Point (1.5m radius)
G30	Transitional water bodies	Point (1.5m radius)
G40	Marine sea	Point (1.5m radius)
G50	Glaciers, permanent snow	Point (1.5m radius)
H11	Inland marshes	Extended window (20m radius)
H12	Peatbogs	Extended window (20m radius)
H21	Salt marshes	Extended window (20m radius)
H22	Salines and other chemical deposits	Extended window (20m radius)
H23	Intertidal flats	Extended window (20m radius)

10.2.2 Code list for species: crops and nurseries

LC_SPECIES_CODE	LC_SPECIES_LABEL
8	Not relevant
B19a	Sorghum (Sorghum bicolor)
B19b	Buckwheat (Fagopyrum esculentum Mill.)
B19c	Common, golden or proso millet (Panicum miliaceum L.)
B19d	Canary grass (Phalaris canariensis L.)
B19f	Quinoa (Chenopodium quinoa)
B19g	Fonio (Digitaria spp.)
B19h	Other cereals not specified elsewhere
B23a	Fodder beet (roots of Beta vulgaris)
B23b	Fodder kale (Brassica oleracea L.)
B23c	Swedes (Brassica napus L. var. napobrassica (L.) Robb.)
B23d	Carrots (roots of Daucus carota L.)
B23e	Turnips (roots of Brassica rapa L.)
B23f	Jerusalem artichoke (Helianthus tuberosus L.)
B23g	Sweet potatoes (Ipomoea batatas (L.) Lam.)
B23h	Fodder parsnips (Pastinaca sativa L.)
B23i	Yam (Discorea sp.)
B23j	Manioc, Cassava (Manihot esculenta Crantz, syn. M. utilissima)
B23k	Horseradish (Cochlearia armoracia)
B23l	Tuberous chervil (Chaerophyllum bulbosum)
B23m	Other tropical tubers
B23n	Other root or tuber crops not specified elsewhere
B35a	Flax (Linum usitatissimum straw)
B35b	Hemp (Cannabis sativa straw)
B35c	Poppy seeds (Papaver somniferum L.)
B35d	Mustard seeds (Sinapis alba L., Sinapis nigra)
B35e	Safflower (Carthamus tinctorius L.)
B35f	Earth almond (Cyperus esculentus L.)
B35g	Sesame (Sesamum indicum)
B35h	Jute (Corchorus spp.)
B35i	Ramie (Boehmeria nivea)
B35j	Sisal (Agave sisalana)
B35k	Kenaf (Hibiscus cannabinus)
B35l	Bird rape (Brassica rapa var. silvestris)
B35m	Castor beans (Ricinus communis)
B35n	Other fibre and oleaginous crops not elsewhere specified
B37a	Chicory roots (Cichorium intybus var. sativum)
B37b	Hops (Humulus lupulus)
B37c	Medicinal plants (see C3)
B37d	Spices and aromatic plants (see C3)
B37e	Sugar cane (Saccharum officinarum)
B37f	Other non permanent industrial crops not specified elsewhere

B43a	Brassicas
B43b	Leaf and stalked vegetables other than brassicas (see C3)
B43c	Leguminous vegetables, incl. production for tins
B43e	Vegetables cultivated for fruit other than tomatoes
B43f	Cultivated mushrooms
B43g	Wild products (e.g.truffle, water chesnut)
B43h	Other fresh vegetables not specified elsewhere
B53a	Sainfoin (Onobrychis viciifolia Scop.)
B53b	Sweet clover or Trefoil (Lotus corniculatus L.)
B53c	Chickling vetch (Lathyrus sativus)
B53d	Black medick (Medicago lupulina L.)
B53e	Melilot (Melilotus alba Lam.)
B53f	Serradella (Ornithopus sativus)
B53g	Fenugreek (Trigonella foenum-graecum)
B53h	Sulla (Hedysarium coronarium)
B53i	Sweet lupins (Lupinus albus, Lupinus angustifolius, Lupinus luteus)
B53j	California bluebell (Phacelia tanacetifolia)
B53k	Other leguminous and mixtures for foddernot specified elsewhere
B75a	Apricot (Prunus armeniaca)
B75b	Cornel (Cornus mas)
B75c	Figs (Ficus carica)
B75d	Juneberry (Amelanchier vulgaris)
B75e	Kiwi (Actinidia chinensis)
B75f	Loquat (Eriobotrya japonica)
B75g	Medlar (Mespilus germanica)
B75h	Mirabellas (Prunus insititia var. syriaca)
B75i	Peach, nectarine and platerine (Prunus persica; Amygdalus persica; Persica laevis)
B75j	Persimons (Diospyros kaki)
B75k	Plums (Prunus domestica)
B75l	Pomegranates (Punica granatum)
B75m	Oleaster (Eleagnus sp.)
B75n	Quinces (Cydonia oblonga)
B75o	Sloes (Prunus spinosa)
B75p	Small fruits and berries (see C3)
B75q	Tropical fruits (see C3)
B75r	Other fruit trees and berries not specified elsewhere
B77a	Bergamot (Citrus bergamia)
B77b	Citron (Citrus. medica var. cedrata)
B77c	Grapefruit and pomelo (Citrus maxima, C. grandis, C. paradisea)
B77d	Lemons (Citrus limon)
B77e	Limes (Citrus aurantifolia, Citrus limetta)
B77f	Satsumas (Citrus unshiu)
B77g	Mandarines (Citrus deliciosa, C. nobilis)
B77h	Clementines (C. clementina)
B77i	Kumquats (Fortunella spp.)
B77k	Other citrus fruit not specified elsewhere
B83a	Horticultural nurseries

B83b	Vine and root-stock nurseries
B83c	Fruit tree nurseries
B83d	Ornamental plants nurseries
B83e	Tree and bushes nurseries (for planting in gardens, parks, embankments)
B83f	Forest tree nurseries
B83g	Other, non-specialized nurseries
B84a	Reeds, canary grass (Phalaris arundinacea) when cultivated and not natural
B84b	Other plants for plaiting (see C3)
B84c	Coffee
B84d	Tea
B84e	Other industrial plants for beverages (see C3)
B84f	Industrial plants for oil (see C3)
B84g	Permanent aromatic plants (see C3)
B84h	Permanent textile plants (see C3)
B84i	Plants for rubber and tannin (see C3)
B84j	Rose trees cultivated for rose-oil production (not as ornamental plants)
B84k	Other permanent industrial crops (see C3)
B84l	Miscanthus (Miscanthus giganteus)
B84m	Willow

10.2.3 Code list for land use (LUCAS LU 2018)

LU_CODE	LU_LABEL
8	Not relevant
U111	Agriculture (excluding fallow land and kitchen gardens)
U112	Fallow land
U113	Kitchen garden
U120	Forestry
U130	Aquaculture and fishing
U140	Mining and quarrying
U150	Other primary production
U210	Energy production
U221	Manufacturing of food, beverages and tobacco products
U222	Manufacturing of textile products
U223	Coal, oil and metal processing
U224	Production of non-metal mineral goods
U225	Chemical and allied industries and manufacturing
U226	Machinery and equipment
U227	Wood based products
U228	Printing and reproduction
U311	Railway transport
U312	Road transport
U313	Water transport
U314	Air transport
U315	Transport via pipelines
U316	Telecommunication
U317	Logistics and storage
U318	Protection infrastructures
U319	Electricity, gas and thermal power distribution
U321	Water supply and treatment
U322	Waste treatment
U330	Construction
U341	Commerce
U342	Financial, professional and information services
U350	Community services
U361	Amenities, museums, leisure
U362	Sport
U370	Residential
U411	Abandoned industrial areas
U412	Abandoned commercial areas
U413	Abandoned transport areas
U414	Abandoned residential areas
U415	Other abandoned areas
U420	Semi-natural and natural areas not in use

10.2.4 Code list for land use types

LU_TYPE_CODE	LU_TYPE_LABEL
U221L	Manufacture of food beverages or tobacco products (light end)
U222R	Manufacturing of textile products (raw)
U222L	Manufacturing of textile products (light end)
U223R	Coal, oil and metal processing (raw)
U223H	Coal, oil and metal processing (heavy end)
U224R	Production of non-metal mineral goods (raw)
U225R	Chemical and allied industries and manufacturing (raw)
U225L	Chemical and allied industries and manufacturing (light end)
U226H	Machinery and equipment (heavy end)
U226L	Machinery and equipment (light end)
U227R	Wood based products (raw)
U228L	Printing and reproduction (light end)
U315W	Transport of water via pipelines
U315O	Transport of other material via pipelines

10.2.5 Code lists for structured remarks

10.2.5.1 Type of comments for field work

CODE	TYPE OF COMMENT (Field wok)
AA	Description of the way
AB	Reasons for not reaching the point
AC	Vehicle
BA	Quality of background information
BC	Application of the look N/E rule
BD	Land cover
BE	GPS
BF	Exceptional survey time
BH	Data entry
BJ	Point marker
BP	Panel points
FA	Photos
GA	Grassland age
GB	Grassland installation
GC	Grassland EUNIS
GD	Grassland dominance
GL	Grassland legumes
GN	Grassland assessment
GO	Grassland other species
GR	Grassland richness
GS	Grassland transect shift
GG	Grassland other
HA	EUNIS Habitat Complex
PA	Copernicus
QA	Land management
RA	Erosion
SA	Soil
SB	Soil bulk
SC	Soil biodiversity
SD	Soil organic horizon
WA	Water management

Type of comments for quality checks

CODE	TYPE OF COMMENT (Quality checks)
EA	Overall quality
EB	Observation problems
EC	Land cover problems
ED	Land use problems
EF	Additional information problems
EG	Grassland problems
EH	EUNIS Habitat Complex problems
EI	Photos missing
EJ	Corrupt photos

EK	Bad quality photos
EL	Non-anonymized photos
EM	Missing geo-tags in photos
EN	Missing GPS tracks
EO	Other comments
EP	Copernicus problems
EQ	Land management problems
ER	Erosion problems
ES	Soil problems
EW	Water management problems

10.2.5.2 Code list for field work comments

CODE	LABEL
AA01	Long walk
AA02	Water body between the road and the point
AA03	Easiest access from North
AA04	Easiest access from South
AA05	Easiest access from East
AA06	Easiest access from West
AA07	Information requested by land owner
AA08	Point revisited (insert date of previous visit)
AA99	Other description of the way comments
AB01	Fence, wall, locked gate/door, natural obstacle
AB02	Access forbidden sign found
AB03	Landowner refused the entrance
AB04	Adverse meteorological conditions (storm, flooding, snow ice etc.)
AB05	Dangerous animals (cows/bulls, dogs, wild animals etc.)
AB06	Impenetrable vegetation / poisonous plants
AB07	Point in water
AB08	Point in wetland
AB09	Shortest possible walking time (from car to point and back without time for data collection) more than 1 hour
AB10	Military or official area (e.g. naval, airfield)
AB11	Steep slope
AB12	High crop on the ground
AB13	Non-drivable road/track
AB14	Access forbidden due to natural protected area
AB15	Restricted access due to fire hazard
AB16	Restricted access due to hunting
AB17	Restricted access due to fitossanitary treatment
AB18	Restricted access. Payment needed
AB19	Need to cross by boat to access the point
AB20	GPS problem : impossible to reach the point
AB99	Other reasons for not reaching the point comments
AC01	Car damaged
BA01	Ground documents not correct
BA02	Orthophoto not available
BA03	Not updated orthophoto
BA04	PI reference other than GD ortho

BA99	Other quality of background information comments
BB10	Military or official area
BC01	Applied because of a border
BC02	Applied because of a linear feature
BC99	Other look to N/E comments
BD01	Dehesa
BD02	Layered crop
BD03	Local knowledge
BD04	Tilled arable land not sown during current season
BD05	Management of migratory animals
BD99	Other land cover comments
BE01	GPS battery discharged - track to the point not saved
BE02	GPS battery discharged - point location not saved
BE03	GPS battery discharged - track and point location not saved
BE04	GPS not working - track to the point not saved
BE05	GPS not working - point location not saved
BE06	GPS not working - track and point location not saved
BE07	GPS signal weak, lost or high positional error (forest, dense urban,…)
BE08	GPS wrong settings (different ellipsoid/coordinate system,…)
BE20	GPS problem : impossible to reach the point
BE21	Ground document quality problem : impossible to reach the point
BE22	GPS & Ground document quality problems : impossible to reach the point
BE99	Other GPS comments
BF01	Survey time < 15' because it was impossible to reach the point
BF02	Survey time < 15' because it was easy to assess the LC/LU and walk the transect
BF03	Survey time < 15' because LC/LU and transect photo interpreted
BF04	Survey time < 15' because transect photo interpreted
BF05	Survey time < 15' because it was easy to reach the point and walk the transect
BF06	Survey time > 1h 15' because it was very difficult to assess the LC/LU
BF07	Survey time > 1h 15' because it was very difficult to walk the transect
BF08	Survey time > 1h 15' because it was very difficult to reach the point
BF99	Other survey time comments
BH01	Problem with data input: hardware
BH02	Problem with data input: software
BH03	Problem using the anonymization tool
BH04	Problem using the photo resizer
BJ01	Point marker/flag missing
BJ02	Point marker/flag replaced by other object
BJ03	Point marker/flag placed by mistake or not on point
BJ99	Other point marker comments
BP01	Previous data probably erroneous or wrongly located
BP02	Different location from previous survey/visit: better GD
BP03	Different location from previous survey/visit: point not reachable in present campaign
BP04	Different location from previous survey/visit: closer or better view to the point
BP05	Different Look to N/E decision than in previous survey/visit. Explain why.
BP06	Shift in Orthophotos of different years
BP07	Shift between Orthophoto and GPS
BP08	Different decision on LC: real change
BP09	Different decision on LU: real change
BP10	Different decision on transect: real change
BP11	Different decision than in previous survey/visit: rules changed
BP12	Different decision than in previous survey/visit: PI in previous survey
BP99	Other panel points comments

FA01	Camera's battery discharged - impossible to take photo(s)
FA02	Camera broken - impossible to take photo(s)
FA03	Memory Card Problem
FA04	Land owner refused photos
FA05	1/6 horizon rule not respected because an object in the front (house wall)
FA06	1/6 horizon rule not respected because photo taken in forest
FA07	Camera date/time set incorrectly
FA08	Compass malfunctioning
FA11	Additional photo type 1 (Point access) not taken, specify …
FA12	Additional photo type 2 (North/east rule) not taken, specify …
FA13	Additional photo type 3 (Land cover) not taken, specify …
FA14	Additional photo type 4 (Land use) not taken, specify …
FA15	Additional photo type 5 (Transect) not taken, specify …
FA16	Additional photo type 6 (Soil) not taken, specify …
FA17	Additional photo type 7 (Water management) not taken, specify …
FA18	Additional photo >9
FA99	Other photo comments
GA99	Other grassland age comments
GB99	Other grassland installation comments
GC99	Other grassland EUNIS comments
GD99	Other grassland heterogeneity comments
GL99	Other grassland legumes comments
GO99	Other grassland other species comments
GR99	Other grassland comments
GS99	Other grassland transect shift comments
GG99	Other grassland comments
HA99	Other EUNIS Habitat Complex comments
PA99	Other Copernicus comments
QA99	Other land management comments
RA99	Other erosion comments
SA01	Soil sample very wet
SA02	Stoned area in the point, stones removed
SA04	Soil sample collected at the edge or within high crop field
SA05	Ground conditions unfavourable
SA06	Inaccessible point (e.g. fenced area)
SA07	Land owner refused the soil sample
SA99	Other soil comments
SB01	Not all cores were collected
SB99	Other soil bulk comments
SC99	Other soil biodiversity comments
SD99	Other soil horizon comments

10.2.5.3 Code list for quality checks comments

CODE	LABEL
EA01	Point ID and location do not match
EA02	Data entry not complete
EA03	Observed data do not belong to the point
EA04	Point not correctly surveyed – to be visited again
EA05	Point corrected after DR (double rejection)
EA06	Point not correctable after DR (double rejection)

EA99	Other overall quality problems
EB01	Incorrect date
EB02	Incorrect start/end time
EB03	Observation time rare - missing explanation
EB04	Point not accessible questionable
EB05	Observation type questionable
EB06	PI reasons not justifiable
EB07	Observation direction questionable/wrong
EB08	Coordinates or distance to the point wrong
EB09	Distance to point unreasonably long
EB10	Track record and lat/long do not match
EB11	Missing track records
EB12	Incorrect application of look to the north/east rule
EB13	Remarks about special circumstances missing
EB99	Other observation problems
EC01	LC 1 questionable/not corresponding to the plant photo
EC02	LC 2 questionable/not corresponding to the plant photo
EC03	LC 1 questionable/not corresponding to the orthophoto
EC04	LC 2 questionable/not corresponding to the orthophoto
EC05	LC 1 questionable/not corresponding to previous data
EC06	LC 2 questionable/not corresponding to previous data
EC07	LC 2 missing
EC08	Percentage of land cover 1 wrong
EC09	Percentage of land cover 2 wrong
EC99	Other land cover problems
ED01	LU 1 questionable/not corresponding to the plant photo
ED02	LU 2 questionable/not corresponding to the plant photo
ED03	LU 1 questionable/not corresponding to the orthophoto
ED04	LU 2 questionable/not corresponding to the orthophoto
ED05	LU 1 questionable/not corresponding to previous data
ED06	LU 2 questionable/not corresponding to previous data
ED07	LU 2 missing
ED08	LC & LU unlikely combination
ED99	Other land use problems
EF01	Height of trees questionable
EF02	Parcel area questionable
EF03	Width of feature missing/wrong
EF04	Plant species missing/wrong
EF05	Questionable grazing code
EF06	Wrong special remark
EF99	Other additional information problems
EG99	Other grassland problems
EH99	Other EUNIS Habitat Complex problems
EI01	Point photo missing
EI02	Crop photo missing
EI03	North photo missing
EI04	East photo missing
EI05	South photo missing
EI06	West photo missing
EI07	Transect photo missing
EI08	Irrigation photo missing
EI09	Soil photo missing
EI10	Additional photo missing
EI11	Crop photo missing due to change in LC (ex-post)

EI99	Other photo missing problems
EJ01	Point photo corrupt
EJ02	Crop photo corrupt
EJ03	North photo corrupt
EJ04	East photo corrupt
EJ05	South photo corrupt
EJ06	West photo corrupt
EJ07	Transect photo corrupt
EJ08	Irrigation photo corrupt
EJ09	Soil photo corrupt
EJ10	Additional picture corrupt
EJ99	Other corrupt photo problems
EK01	Point photo of bad quality
EK02	Crop photo of bad quality
EK03	North photo of bad quality
EK04	East photo of bad quality
EK05	South photo of bad quality
EK06	West photo of bad quality
EK07	Transect photo of bad quality
EK08	Irrigation photo of bad quality
EK09	Soil photo of bad quality
EK10	Additional photo of bad quality
EK99	Other bad quality photo problems
EL01	Point photo not anonymised
EL02	Crop photo not anonymised
EL03	North photo not anonymised
EL04	East photo not anonymised
EL05	South photo not anonymised
EL06	West photo not anonymised
EL07	Transect photo not anonymised
EL08	Irrigation photo not anonymised
EL09	Soil photo not anonymised
EL10	Additional photo not anonymised
EM01	Point photo with wrong/missing geo-tag
EM02	Crop photo with wrong/missing geo-tag
EM03	North photo with wrong/missing geo-tag
EM04	East photo with wrong/missing geo-tag
EM05	South photo with wrong/missing geo-tag
EM06	West photo with wrong/missing geo-tag
EM07	Transect photo with wrong/missing geo-tag
EM08	Irrigation photo with wrong/missing geo-tag
EM09	Soil photo with wrong/missing geo-tag
EM10	Additional photo with wrong/missing geo-tag
EN01	GPS Point missing
EN02	GPS Point and Track missing
EN99	GPS Track missing
EO01	Requires Eurostat correction in previous campaign
EO02	Quality check at CO was bypassed via DMT Client
EP99	Other Copernicus problems
EQ99	Other land management problems
ER99	Other erosion problems
ES99	Other soil problems
EW01	Missing irrigation data (seen on the photo)

EW02	No source of irrigation identified
EW03	Type of irrigation questionable
EW04	Water delivery system questionable
EW99	Other water management problems

10.3 Combinations of LC1 x LC2

LUCAS2018_C1_CrossTables_20170518.xlsx

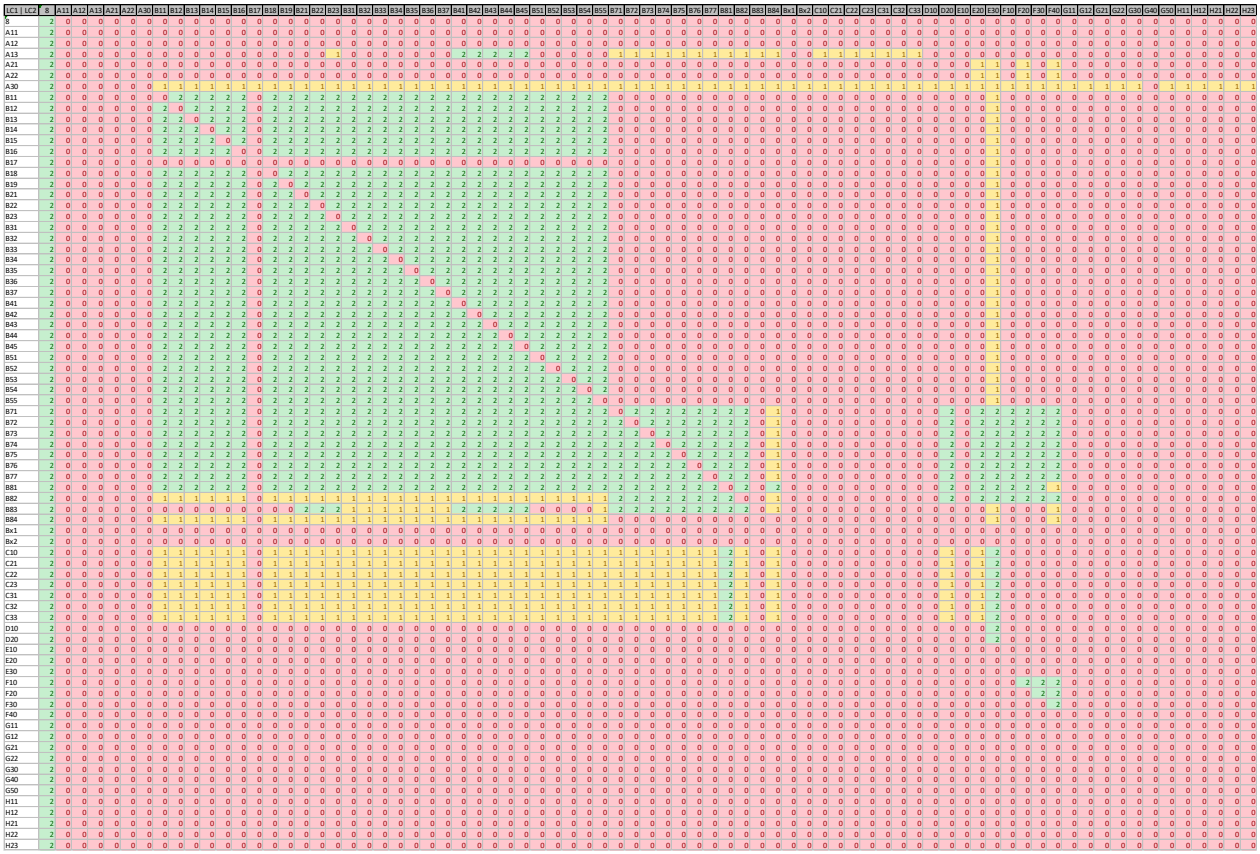
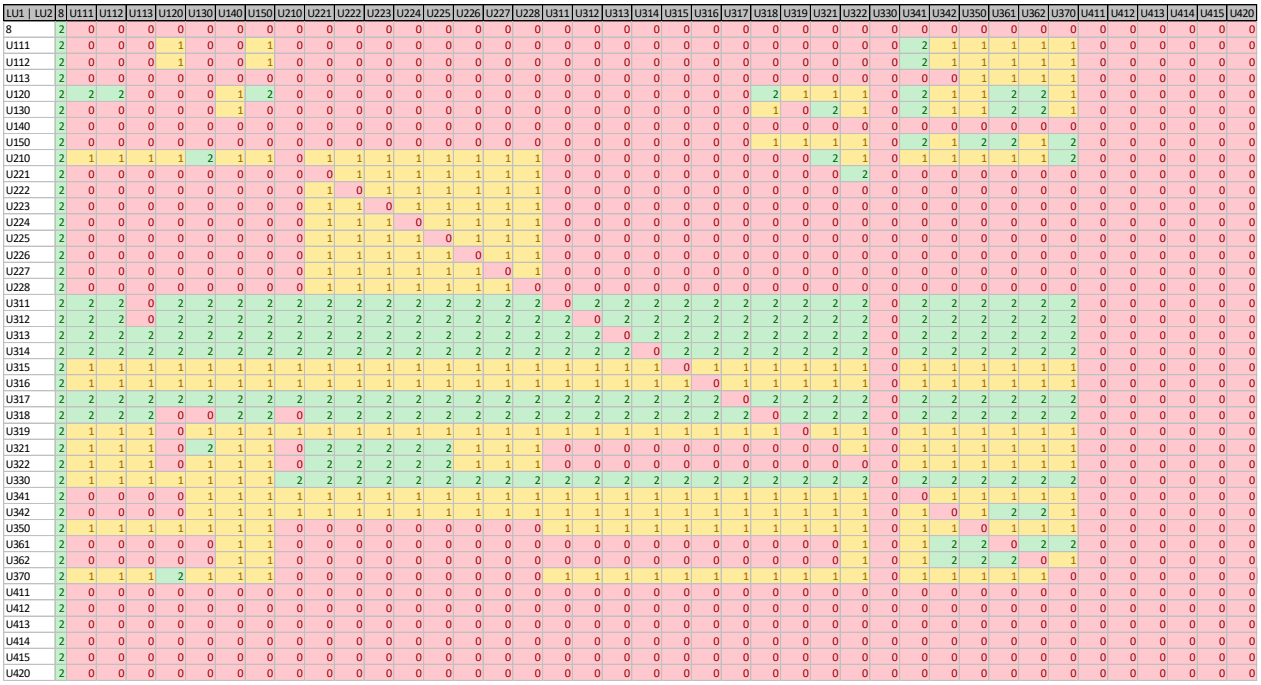


Figure 124

10.4 Combinations of LU1 x LU2

LUCAS2018_C1_CrossTables_20170518.xlsx



LU1 \ LU2	8	U111	U112	U113	U120	U130	U140	U150	U210	U221	U222	U223	U224	U225	U226	U227	U228	U311	U312	U313	U314	U315	U316	U317	U318	U319	U321	U322	U330	U341	U342	U350	U361	U362	U370	U411	U412	U413	U414	U415	U420
8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U111	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	0	0	0	0	0	0
U112	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	0	0	0	0	0	0
U113	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0
U120	2	2	2	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0	2	1	1	2	2	1	0	0	0	0	0	0
U130	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	2	1	1	2	2	1	0	0	0	0	0	0
U140	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U150	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	2	1	2	2	1	2	0	0	0	0	0	0
U210	2	1	1	1	1	2	1	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	2	1	0	1	1	1	1	1	2	0	0	0	0	0	0
U221	2	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
U222	2	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U223	2	0	0	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U224	2	0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U225	2	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U226	2	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U227	2	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U228	2	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U311	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	0	0	0	0	0	0
U312	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	0	0	0	0	0	0
U313	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	0	0	0	0	0	0
U314	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	0	2	2	2	2	2	2	0	0	0	0	0	0
U315	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0	0	0
U316	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0	0	0
U317	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	0	2	2	2	2	2	2	0	0	0	0	0	0
U318	2	2	2	2	0	0	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0	2	2	2	2	2	2	0	0	0	0	0	0
U319	2	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	0	0	0	0	0	0
U321	2	1	1	1	0	2	1	1	0	2	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0
U322	2	1	1	1	0	1	1	1	0	2	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
U330	2	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	0	0	0	0	0	0
U341	2	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	0	0	0	0	0
U342	2	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	2	2	1	0	0	0	0	0	0
U350	2	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	0	0	0	0	0	0
U361	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	2	0	2	2	0	0	0	0	0	0
U362	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	2	2	0	1	0	0	0	0	0	0
U370	2	1	1	1	2	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0
U411	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U412	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U413	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U414	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U415	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U420	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 125

10.5 Combinations of LC x LU

LUCAS2018_C1_CrossTables_20170518.xlsx

LC_CODE	8	U111	U112	U113	U120	U130	U140	U150	U210	U221	U222	U223	U224	U225	U226	U227	U228	U311	U312	U313	U314	U315	U316	U317	U318	U319	U321	U322	U330	U341	U342	U350	U361	U362	U370	U411	U412	U413	U414	U415	U420
8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A11	1	2	0	0	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
A12	1	2	0	0	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
A13	1	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	2	2	1	1	2	1	0	2	2	2	2	2	0
A21	1	2	0	0	1	1	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	1	2	2	2	2	1	1	2	2	2	2	2	2	2	2	2	0
A22	1	2	0	0	1	1	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	1	2	2	2	2	1	1	2	2	2	0	2	2	2	2	2	0
A30	1	2	0	0	1	1	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2	2	2	0
B11	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B12	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B13	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B14	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B15	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B16	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B17	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B18	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B19	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B21	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B22	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B23	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B31	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B32	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B33	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B34	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B35	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B36	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B37	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B41	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B42	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B43	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B44	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
B45	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B51	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B52	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B53	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B54	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B55	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B71	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B72	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B73	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B74	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B75	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B76	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B77	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B81	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B82	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B83	1	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0
B84	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
Bx1	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
Bx2	1	2	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
C10	1	1	0	0	2	0	1	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	2	0	0	1	0	0	0	2	2	2	1	1	1	1	1	1	2
C21	1	1	0	0	2	0	1	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	2	0	0	1	0	0	0	2	2	2	1	1	1	1	1	1	2
C22	1	1	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	2	0	0	1	0	0	0	2	2	2	1	1	1	1	1	1	2
C23	1	1	0	0	2	0	1	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	2	0	0	1	0	0	0	2	2	2	1	1	1	1	1	1	2
C31	1	1	0	0	2	0	1	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	2	0	0	1	0	0	0	2	2	2	1	1	1	1	1	1	2
C32	1	1	0	0	2	0	1	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	2	0	0	1	0	0	0	2	2	2	1	1	1	1	1	1	2
C33	1	1	0	0	2	0	1	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	2	0	0	1	0	0	0	2	2	2	1	1	1	1	1	1	2
D10	1	1	1	0	2	0	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1	1	2	2	2	1	1	1	1	1	1	2
D20	1	1	1	0	2	0	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1	1	2	2	2	1	1	1	1	1	1	2
E10	1	2	0	0	2	0	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	2	2	2	1	2	2	2	2	2	2
E20	1	2	0	0	2	0	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	2	2	2	1	2	2	2	2	2	2
E30	1	1	2	0	2	0	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	2	2	2	1	2	2	2	2	2	2
F10	1	1	1	1	1	0	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	1	2	2	2	2	2	2	1	2	2	2	2	2	2
F20	1	1	1	1	2	0	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	1	2	2	2	2	2	2	1	2	2	2	2	2	2
F30	1	1	1	1	1	0	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	1	2	2	2	2	2	2	1	2	2	2	2	2	2
F40	1	2	2	2	2	0	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	1	2	2	2	2	2	2	1	2	2	2	2	2	2
G11	1	2	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	1	1	1	1	2	2	2	1	1	1	1	1	1	2
G12	1	1	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	1	1	1	1	2	2	2	1	1	1	1	1	1	2
G21	1	2	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	1	1	1	1	2	2	2	1	1	1	1	1	1	2
G22	1	1	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	1	1	1	1	2	2	2	1	1	1	1	1	1	2
G30	1	0	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	1	1	1	1	2	2	2	1	1	1	1	1	1	2
G40	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G50	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	1	1	1	1	1	1	2
H11	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1	1	1	2	2	2	2	2	2
H12	1	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1	1	1	2	2	2	2	2	2
H21	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1	1	1	2	2	2	2	2	2
H22	1	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1	1	1	2	2	2	2	2	1
H23	1	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1	1	1	1	1	1	1	1	2

Figure 126

10.6 Unlikely land cover changes

LUCAS2018_C1_CrossTables_20170518.xlsx

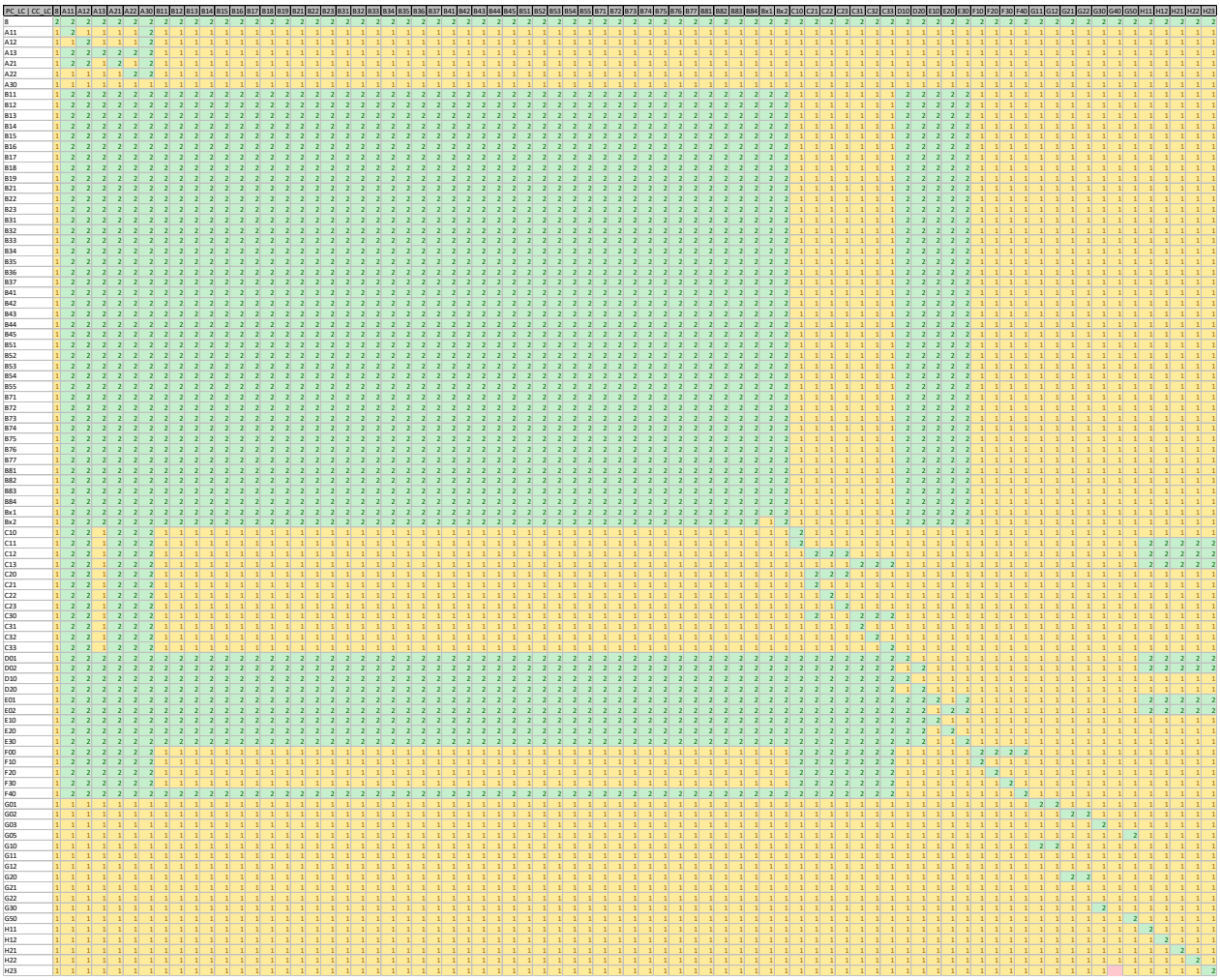


Figure 127

10.7 Unlikely land use changes

LUCAS2018_C1_CrossTables_20170518.xlsx

PC_LU	8	U111	U112	U113	U120	U130	U140	U150	U210	U221	U222	U223	U224	U225	U226	U227	U228	U311	U312	U313	U314	U315	U316	U317	U318	U319	U321	U322	U330	U341	U342	U350	U361	U362	U370	U411	U412	U413	U414	U415	U420
8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	2
U111	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U112	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U113	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U120	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U130	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U140	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U150	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U210	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U221	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U222	2	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U223	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U224	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U225	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U226	2	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U227	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U228	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
U311	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
U312	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
U313	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
U314	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
U315	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
U316	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
U317	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
U318	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
U319	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
U321	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
U322	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1
U330	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	1
U341	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	1
U342	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1
U350	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1
U361	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1
U362	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1
U370	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1
U410	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
U420	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2

Figure 128

10.8 EUNIS Habitat Classification – Quick Guide

Guidance for LUCAS surveyors on the use of EUNIS habitat categories

The most relevant EUNIS types for the LUCAS grassland survey are the types E1-E7 (category E "Grasslands and lands dominated by forbs, mosses or lichens").

However, there may be some cases in which it is important to be able to identify different EUNIS habitat types. The following provides an identification guide and a description of possibly relevant types. Please note that this guidance is written for whole Europe, so some types can be immediately excluded for specific regions (e.g. boreal types don't apply for the Mediterranean zone).

10.8.1 Summary of EUNIS and LUCAS types in grassland-relevant habitats

Broad habitat categories	**Potential habitat types**	
	EUNIS	**LUCAS**
Grasslands	E1-E7, FA, FB	**E10, E20, E30, B55, B70-B77**
Grassland-relevant habitats other than lowland agricultural or semi-natural grassland		
Seashore	A2, B1	**H20**
Lakeshore	**C3**	**H10**
Mires, bogs and swamps	**D1-D6, F9**	**H10**
Riverbanks	**C3, E3, E5, F9**	**E10, E20, E30, H10**
Subalpine and alpine	**E4, E5, F2**	**B55, D10, D20, E10, E20, E30**
Heath and scrub	**F2- F9**	**D10, D20, E10**
Woodland/scattered trees	**E5, E7, G1-G5**	**B70, B80, C10, C20, C30, D10, E10**
Anthropogenic	**I1, I2**	**A30, B50, B55, E10, E20, E30**
Steppe	**E1, E6, E7**	**C10, E10, E20**

Several broad habitat types have similar descriptions for both LUCAS and EUNIS systems, for example **C10 Broadleaved woodland** and **G1 Broadleaved deciduous woodland** or **G2 Broadleaved evergreen woodland**. Similarly, the definitions of **E10 Grassland with sparse tree/shrub cover** and **E7 Sparsely wooded grassland** match quite closely (note that both LUCAS and EUNIS define woodland as areas with a canopy cover of >10 %). However, this is not always the case and particular care should be taken when assigning habitat types in the following categories:

- Inland wetlands (LUCAS **H10**) are differentiated into at least seven categories in EUNIS (**C3, D1-6**)

- Grassland without tree/shrub cover (LUCAS **E20**) can belong to at least 6 EUNIS types, including specialised habitats ranging from subalpine grasslands to salt steppes (**E1-6**).
- Shrubland with sparse tree cover (LUCAS **D10**) or Shrubland without tree cover (**D20**) could correspond to 10 EUNIS types (**F2-9, FA** or **FB)**.

The following key to the EUNIS types frequently encountered in the LUCAS survey is based on the principle that first those habitat situations which are very specific and only apply to a limited number of points are excluded (e.g. if there is a direct marine or coastal influence, a littoral zone of an inland surface waterbody or woodland).

As this key is developed for the whole of the European LUCAS grassland survey the surveyors may exclude some of the options presented in this key for their survey zone.

10.8.2 Key to the EUNIS types frequently encountered in the LUCAS survey

Please note that this is a shortened summary of the official EUNIS key, adapted to show the most common grassland types that may be encountered during the LUCAS survey.

Habitat descriptions for the most common EUNIS habitat types are listed at the end of this key. When checking the descriptions, please always keep in mind that for the LUCAS grassland survey, **only points / transects are relevant with at least 50 % cover of grass, forbs or moss** (for example, not sandy shores).

1. Is there a marine or coastal influence?

Yes – go to 2

No – go to 3

2. Is the habitat in an intertidal zone?

Yes - **A2 Littoral sediment** (N.B. for LUCAS purposes, A2 is typified by subtype **A2.5 Coastal saltmarshes and saline reedbeds**)

No - **B1 Coastal dunes and sandy shores**

3. Is the habitat strongly influenced by water/waterlogged with < 10 % tree canopy cover?

Yes – go to 4

No – go to 5

4. Is the habitat next to/near to a waterbody?

Yes - **C3 Littoral zone of inland surface waterbodies** (see also **F9 Riverine and fen scrubs**)

No – go to 10 (sub-key **D Mires, bogs and fens**)

5. Is the habitat or has the habitat been regularly cultivated (and lies fallow now)?

Yes – **I1 Arable land and market gardens or I2 Cultivated areas of gardens and parks**

No – go to 6

6. Is the habitat dominated by forbs and grasses with < 10 % tree canopy cover?

Yes – go to 15 (sub-key **E Grasslands and lands dominated by forbs, mosses or lichens**

No – go to 7

7. Is the habitat dominated by low-growing woody plants (up to 6 m) with multiple stems and less than < 10 % canopy cover in the tree layer?

Yes – go to 21 (sub-key **F Heathland, scrub and tundra**)

No – (> 10 % tree canopy cover) go to 8 (Sub-key **G Woodland, forest and other wooded land**)

Sub-key **G Woodland, forest and other wooded land**

8. Is there a strong anthropogenic influence?

Yes - **G5 Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice**

No – go to 9

9. > 75% of the stand is dominated by…

Broadleaved deciduous trees - **G1 Broadleaved deciduous woodland**

Broadleaved evergreen trees - **G2 Broadleaved evergreen woodland**

Conifers - **G3 Coniferous woodland**

Mixture of deciduous and conifer trees - **G4 Mixed deciduous and coniferous woodland**

Sub-key **D Mires, bogs and fens**

10. Does the habitat contain large areas of tall grasses and reeds normally without free-standing water?

Yes – go to 11

No – go to 12

11. Is the habitat influenced by saline or brackish water?

Yes - D6 Inland saline and brackish marshes and reedbeds

No - D5 Sedge and reedbeds, normally without free-standing water

12. Is the habitat in the arctic, subarctic or northern boreal zone with conspicuous patterning caused by frozen mounds or ridges interspersed with hollows?

Yes – D3 Aapa, palsa and polygon mires

No – go to 13

13. Is the area dominated by relatively species-rich herbaceous vegetation with little sphagnum moss visible?

Yes - D4 Base-rich fens and calcareous spring mires

No – go to 14

14. Is the vegetation dominated by sedges and/or has a convex form (valley or basin)?

Yes – D2 Valley mires, poor fens and transition mires

No - D1 Raised and blanket bogs

Sub-key **E Grasslands and lands dominated by forbs, mosses or lichens**

15. Is there significant tree presence (but <10% canopy cover) scattered over the survey area

Yes - E7 Sparsely wooded grasslands

No – go to 16

16. Is the habitat adjacent to a woodland area, and obviously affected by the shading of the canopy (e.g. with tall forbs)?

Yes - E5 Woodland fringes and clearings and tall forb stands

No – go to 17

17. Is the habitat in the alpine or subalpine zone (from around 1200 m a.s.l. upwards)?

Yes - E4 Alpine and subalpine grasslands

No – go to 18

18. Does the habitat contain aturally sparse or low-growing herbaceous vegetation?

Yes – go to 19

No – go to 20

19. Is the habitat saline (e.g. with succulent plants, crystalline salt on the surface)

Yes – E6 Inland salt steppes

No –E1 Dry grasslands

20. Is there generally dense herbaceous vegetation with signs of excess water supply (e.g. standing water after recent rain, or patches of rushes, club-rushes or sedges)

Yes - E3 Seasonally wet and wet grasslands

No – E2 Mesic grasslands

Sub-key **F Heathland, scrub and tundra**

21. Does the woody vegetation form a linear structure, usually planted as a field boundary, sometimes containing fully-grown trees?

Yes - FA Hedgerows

No – go to 22

22. Are there planted shrubs, usually all of the same species (or only a few species) in regular rows?

Yes – FB Shrub plantations

No – go to 23

23. Is the habitat adjacent to a river, or in a wetland?

Yes – F9 Riverine and fen scrubs

No – go to 24

24. Is the habitat in the arctic, alpine or subalpine zone?

Yes - F2 Arctic, alpine and subalpine scrub

No – go to 25

25. Is the habitat in the Mediterranean zone (below the montane belt)?

Yes – go to 26

No – go to 28

26. Is the habitat dominated by low-growing, spiny shrubs?

Yes – F7 Spiny Mediterranean heaths (phrygana, hedgehog-heaths and related coastal cliff vegetation)

No – go to 27

27. Does the vegetation have an open structure, usually with some open ground and patches of shrubs (e.g. Cistus, Lavendula and Rosmarinus)?

Yes – F6 Garrigue

No (closed structure, mainly consisting of shrubs with scattered trees) - F5 Maquis, arborescent matorral and thermo-Mediterranean brushes

28. Is the habitat n the Canary islands and Madeira, on generally dry slopes and rich in succulents?

Yes – F8 Thermo-Atlantic xerophytic scrub

No – go to 29

29. Is the habitat dominated by heather?

Yes – F4 Temperate shrub heathland

No – F3 Temperate and mediterranean-montane scrub

10.8.3 EUNIS descriptions of the most frequent habitat types in the LUCAS grassland survey to Level 2

A Marine habitats

A2 Littoral sediment

Littoral sediments are found across the entire intertidal zone, including the strandline. Sediment biotopes can extend further landwards (dune systems, marshes) and further seawards (sublittoral sediments). Sediment shores are generally found along relatively more sheltered stretches of coast compared to rocky shores. Muddy shores or muddy sand shores occur mainly in very sheltered inlets and along estuaries, where wave exposure is low enough to allow fine sediments to settle. Sandy shores and coarser sediment (gravel, pebbles, cobbles) shores are found in areas subject to higher wave exposures.

> ***NB.*** *For the purposes of LUCAS, A2 Littoral sediment is typified by the subtype A2.5 Coastal saltmarshes and saline reedbeds:*

Angiosperm-dominated stands of vegetation, occurring on the extreme upper shore of sheltered coasts and periodically covered by high tides. The vegetation develops on a variety of sandy and muddy sediment types and may have admixtures of coarser material. The character of the saltmarsh communities is affected by height up the shore, resulting in a zonation pattern related to the degree or frequency of immersion in seawater.

B Coastal habitats

B1 Coastal dunes and sandy shores

Sand-covered shorelines of the oceans, their connected seas and associated coastal lagoons, fashioned by the action of wind or waves. They include gently sloping beaches and beach-ridges, formed by sands brought by waves, longshore drift and storm waves, as well as dunes, formed by aeolian deposits, though sometimes re-fashioned by waves.

C Inland surface waters

C3 Littoral zone of inland surface waterbodies

Reedbeds and other water-fringing vegetation by lakes, rivers and streams; exposed bottoms of dried up rivers and lakes; rocks, gravel, sand and mud beside or in the bed of rivers and lakes.

D Mires, bogs and fens

Wetlands, with the water table at or above ground level for at least half of the year, dominated by herbaceous or ericoid vegetation. Includes inland saltmarshes and waterlogged habitats where the groundwater is frozen. Excludes the water body and rock structure of springs (C2.1) and waterlogged habitats dominated by trees or large shrubs (F9.2, G1.4, G1.5, G3.D, G3.E). Note that habitats that

intimately combine waterlogged mires and vegetation rafts with pools of open water are considered as complexes.

D1 Raised and blanket bogs

Peatlands formed by ombrotrophic acid peat, which is (or was while actively growing) capable of growth fed by rainfall rather than by the inflow of water from higher ground in the vicinity.

D2 Valley mires, poor fens and transition mires

Weakly to strongly acid peatlands, flushes and vegetated rafts formed in situations where they receive water from the surrounding landscape or are intermediate between land and water. Included are quaking bogs and vegetated non-calcareous springs. Excluded are calcareous fens (D4), and reedbeds (C3, D5).

D3 Aapa, palsa and polygon mires

Patterned mire complexes of the arctic, subarctic and northern boreal zones.

D4 Base-rich fens and calcareous spring mires

Peatlands, flushes and vegetated springs with calcareous or eutrophic ground water, within river valleys, alluvial plains, or on hillsides. As in poor fens, the water level is at or near the surface of the substratum and peat formation depends on a permanently high watertable. Excluded are reedbeds (C3, D5).

D5 Sedge and reedbeds, normally without free-standing water

Sedge and reedbeds forming terrestrial mire habitats, not closely associated with open water. Excluded are reedbeds and sedges where they form emergent or fringing vegetation beside water bodies (C3.2).

D6 Inland saline and brackish marshes and reedbeds

Saline wetlands, with closed or open vegetation, which are the non-coastal analogue of coastal saltmarshes and saline reedbeds (A2.5). Drier saline habitats are classified as inland salt steppe (E6) or saline scrubland (F6.8).

E Grasslands and lands dominated by forbs, mosses or lichens

Non-coastal land which is dry or only seasonally wet (with the water table at or above ground level for less than half of the year) with greater than 30% vegetation cover. The vegetation is dominated by grasses and other non-woody plants, including mosses, macrolichens, ferns, sedges and herbs. Includes semiarid steppes with scattered [Artemisia] scrub. Includes successional weedy vegetation and managed grasslands such as recreation fields and lawns. Excludes regularly tilled habitats (I1) dominated by cultivated herbaceous vegetation such as arable fields.

E1 Dry grasslands

Well-drained or dry lands dominated by grass or herbs, mostly not fertilized and with low productivity. Included are [Artemisia] steppes. Excluded are dry mediterranean lands with shrubs of other genera where the shrub cover exceeds 10%; these are listed as garrigue (F6).

E2 Mesic grasslands

Lowland and montane mesotrophic and eutrophic pastures and hay meadows of the boreal, nemoral, warm-temperate humid and mediterranean zones. They are generally more fertile than dry grasslands (E1), and include sports fields and agriculturally improved and reseeded pastures.

E3 Seasonally wet and wet grasslands

Unimproved or lightly improved wet meadows and tall herb communities of the boreal, nemoral, warm-temperate humid, steppic and mediterranean zones.

E4 Alpine and subalpine grasslands

Primary and secondary grass- or sedge- dominated formations of the alpine and subalpine levels of boreal, nemoral, mediterranean, warm-temperate humid and Anatolian mountains.

E5 Woodland fringes and clearings and tall forb stands

Stands of tall herbs or ferns, occuring on disused urban or agricultural land, by watercourses, at the edge of woods, or invading pastures. Stands of shorter herbs forming a distinct zone (seam) at the edge of woods.

E6 Inland salt steppes

Saline land with dominant salt-tolerant grasses and herbs. Excludes saline scrubland, listed under F6.8 xero-halophile scrubs.

E7 Sparsely wooded grasslands

Grasslands with a wooded overstorey that normally has less than 10% cover.

This category E7 is restricted to three subcategories – please use E7 only for these types:
E 7.1: Atlantic parkland: Extensive surfaces of Atlantic regions of nemoral Europe occupied by grassland dotted with widely planted trees,characteristic of the British Isles, where they are usually enclosed, used for cattle or deer grazing.
E7.2: Sub-continental parkland: Grassland dotted with widely planted trees, to the east of the Atlantic zone of nemoral Europe.
E7.3: Dehesa: A characteristic landscape of the southwestern quadrant of the Iberian peninsula in which

crops, pasture land or Mediterranean scrub, in juxtaposition or rotation, are shaded by a fairly closed to very open canopy of native oaks, Quercus suber, Quercus rotundifolia, Quercus pyrenaica, Quercus faginea.

F Heathland, scrub and tundra

Non-coastal land which is dry or only seasonally inundated (with the water table at or above ground level for less than half of the year) with greater than 30% vegetation cover. Tundra is characterised by the presence of permafrost. Heathland and scrub are defined as vegetation dominated by shrubs or dwarf shrubs of species that typically do not exceed 5 m maximum height.

Includes shrub orchards, vineyards, hedges (which may have occasional tall trees).

Also includes stands of climatically-limited dwarf trees (krummholz) < 3 m high, such as occur in extreme alpine conditions. Includes [Salix] and [Frangula] carrs.

Excludes coppice (G5.7) and [Alnus] and [Populus] swamp woodland (G1.4).

[F1 Tundra] [not relevant for LUCAS survey as Tundra occurs only north/east of EU-28]

F2 Arctic, alpine and subalpine scrub

Scrub occurring north of or above the climatic tree limit, but outside the permafrost zone. Scrub occurring close to but below the climatic tree limit, where trees are suppressed either by late-lying snow or by wind or repeated browsing.

F3 Temperate and mediterranean-montane scrub Shrub communities of nemoral affinities. They include deciduous and evergreen scrubs of the nemoral zone, and deciduous scrubs of the submediterranean and supramediterranean zones. Excluded are heathlands with dominant [Ericaceae] F4, and the typically mediterranean maquis F5, garrigue F6 and phrygana F7.

F4 Temperate shrub heathland

Shrub communities of nemoral affinities, in which [Ericaceae] are dominant or at least prominent. Such heaths are best developed on acid soils in the Atlantic zone and also in sub-Atlantic Europe.

F5 Maquis, arborescent matorral and thermo-Mediterranean brushes

Evergreen sclerophyllous or lauriphyllous shrub vegetation, with a closed or nearly closed canopy structure, having nearly 100% cover of shrubs, with few annuals and some vernal geophytes; trees are nearly always present, some of which may be in shrub form. Shrubs, sometimes tall, of [Arbutus], [Cistus], [Cytisus], [Erica], [Genista], [Lavandula], [Myrtus], [Phillyrea], [Pistacia], [Quercus] and [Spartium] are typical. Included is pseudomaquis, in which the dominants are mixed deciduous and evergreen shrubs.

F6 Garrigue

Evergreen sclerophyllous or lauriphyllous shrub vegetation, with an open canopy structure and some bare ground, usually with many winter annuals and vernal geophytes. Low shrubs of [Cistus], [Lavandula], [Rosmarinus] and [Stoechas] are usually present, and there may be some larger shrubs and scattered trees. Garrigue is found mostly in the Mediterranean, Macaronesian and Pontic regions, where it typically derives from degradation or regrowth of broad-leaved evergreen forests (G2), but it extends into deciduous forest areas in the supra-Mediterranean zone and sub-Mediterranean zones and into steppe areas in Anatolia. Includes scrubby land with mainly herbaceous vegetation and a large component of unpalatable non-vernal monocots ([Asphodelus], [Urginea]) and thistles, provided that shrub cover exceeds 10%.

F7 Spiny Mediterranean heaths (phrygana, hedgehog-heaths and related coastal cliff vegetation)

Shrublands with dominant low spiny shrubs, widespread in Mediterranean and Anatolian regions with a summer-dry climate, occurring from sea level to high altitudes on dry mountains.

F8 Thermo-Atlantic xerophytic scrub

Xerophytic scrub formations of the lower slopes of the Canary Islands and Madeira, rich in succulents, in particular cactiform or dendroid spurges [Euphorbia] spp., rosette-forming [Aeonium] spp. and composites.

F9 Riverine and fen scrubs

Riversides, lakesides, fens and marshy floodplains dominated by woody vegetation less than 5 m high.

FA Hedgerows

Woody vegetation forming strips within a matrix of grassy or cultivated land or along roads, typically used for controlling livestock, marking boundaries or providing shelter. Hedgerows differ from lines of trees (G5.1) in being composed of shrub species, or if composed of tree species then being regularly cut to a height less than 5 m.

FB Shrub plantations

Plantations of dwarf trees, shrubs, espaliers or perennial woody climbers, mostly cultivated for fruit or flower production, either intended to have permanent cover of woody plants when mature, or else for wood or small tree production with a regular whole-plant harvesting regime.

G Woodland, forest and other wooded land

Woodland and recently cleared or burnt land where the dominant vegetation is, or was until very recently, trees with a canopy cover of at least 10%. Trees are defined as woody plants, typically single-stemmed, that can reach a height of 5 m at maturity unless stunted by poor climate or soil. Includes lines of trees, coppices, regularly tilled tree nurseries, tree-crop plantations and fruit and nut tree

orchards. Includes [Alnus] and [Populus] swamp woodland and riverine [Salix] woodland. Excludes [Corylus avellana] scrub and [Salix] and [Frangula] carrs. Excludes stands of climatically-limited dwarf trees (krummholz) < 3m high, such as occur at the arctic or alpine tree limit. Excludes parkland and dehesa with canopy less than 10%, which are listed under sparsely wooded grasslands E7.

G1 Broadleaved deciduous woodland

Woodland, forest and plantations dominated by summer-green non-coniferous trees that lose their leaves in winter. Includes woodland with mixed evergreen and deciduous broadleaved trees, provided that the deciduous cover exceeds that of evergreens. Excludes mixed forests (G4) where the proportion of conifers exceeds 25%.

G2 Broadleaved evergreen woodland Temperate forests dominated by broad-leaved sclerophyllous or lauriphyllous evergreen trees, or by palms. They are characteristic of the Mediterranean and warm-temperate humid zones.

G3 Coniferous woodland Woodland, forest and plantations dominated by coniferous trees, mainly evergreen ([Abies], [Cedrus], [Picea], [Pinus], [Taxus], Cupressaceae) but also deciduous [Larix]. Excludes mixed forests (G4) where the proportion of broadleaved trees exceeds 25%.

G4 Mixed deciduous and coniferous woodland

Forest and woodland of mixed broad-leaved deciduous or evergreen and coniferous trees of the nemoral, boreal, warm-temperate humid and mediterranean zones. They are mostly characteristic of the boreonemoral transition zone between taiga and temperate lowland deciduous forests, and of the montane level of the major mountain ranges to the south. Neither coniferous, nor broadleaved species account for more than 75% of the crown cover. Deciduous forests with an understorey of conifers or with a small admixture of conifers in the dominant layer are included in unit G1. Conifer forests with an understorey of deciduous trees or with a small admixture of deciduous trees in the dominant layer are included in unit G3.

G5 Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice

Stands of trees greater than 5 m in height or with the potential to achieve this height, either in more or less continuous narrow strips or in small (less than about 0.5 ha) plantations or small (less than about 0.5 ha) intensively-managed woods. Woodland and coppice that is temporarily in a successional or non-woodland stage but which can be expected to develop into woodland in the future. Excludes parkland (E7.1, E7.2).

I Regularly or recently cultivated agricultural, horticultural and domestic habitats

I1 Arable land and market gardens

Croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. They include fields of cereals, of sunflowers and other oil seed plants, of beets, legumes, fodder, potatoes and other forbs. Croplands comprise intensively cultivated fields as well as traditionally and extensively cultivated crops with little or no chemical fertilisation or pesticide application. Faunal and floral quality and diversity depend on the intensity of agricultural use and on the presence of borders of natural vegetation between fields.

> ***NB.*** *For the purposes of LUCAS, I1 Arable land and market gardens is typified by the subtype I1.5 Bare tilled, fallow or recently abandoned arable land*

Fields abandoned or left to rest, and other interstitial spaces on disturbed ground. Set-aside or abandoned arable land with forbs planted for purposes of soil protection, stabilization, fertilisation or reclamation. Abandoned fields are colonised by numerous pioneering, introduced or nitrophilous plants. They sometimes provide habitats that can be used by animals of open spaces.

I2 Cultivated areas of gardens and parks

Cultivated areas of small-scale and large-scale gardens, including kitchen gardens, ornamental gardens and small parks in city squares. Excludes allotment gardens (I1.2).

> ***NB.*** *For the purposes of LUCAS, I2 Cultivated areas of gardens and parks is typified by the subtype I2.3 Recently abandoned garden areas.*

Abandoned flowerbeds and vegetable plots in gardens are rapidly colonized by abundant weeds

For more detailed information please consulate the original EUNIS habitat description:

Davies, C.E., Moss, D., Hills, M.O. (2004): EUNIS Habitat classification, revised 2004. R Report to the European Environment Agency / European Topic Centre on Nature Protection and Biodiversity. 310 pages. Download under: https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjqkaj4iLfPAhVBmhQKHeDOCIUQFggfMAA&url=http%3A%2F%2Fwww.eea.europa.eu%2Fthemes%2Fbiodiversity%2Feunis%2Feunis-habitat-classification%2Fdocumentation%2Feunis-2004-report.pdf%2Fdownload&usg=AFQjCNFDKB_30ZzitUDVJwHwEZCtfhc_3Q

Last access 30/09/2016

10.9 Soil Sampling - Quick Guide

See LUCAS2018_C1_SoilSampling-QuickGuide_final_20180215.pdf

10.10 LUCAS Survey – Decision Tree

LUCAS2018_C1_DecisionTree_20180220.vsd

LUCAS2018_C1_DecisionTree_20180220.pdf

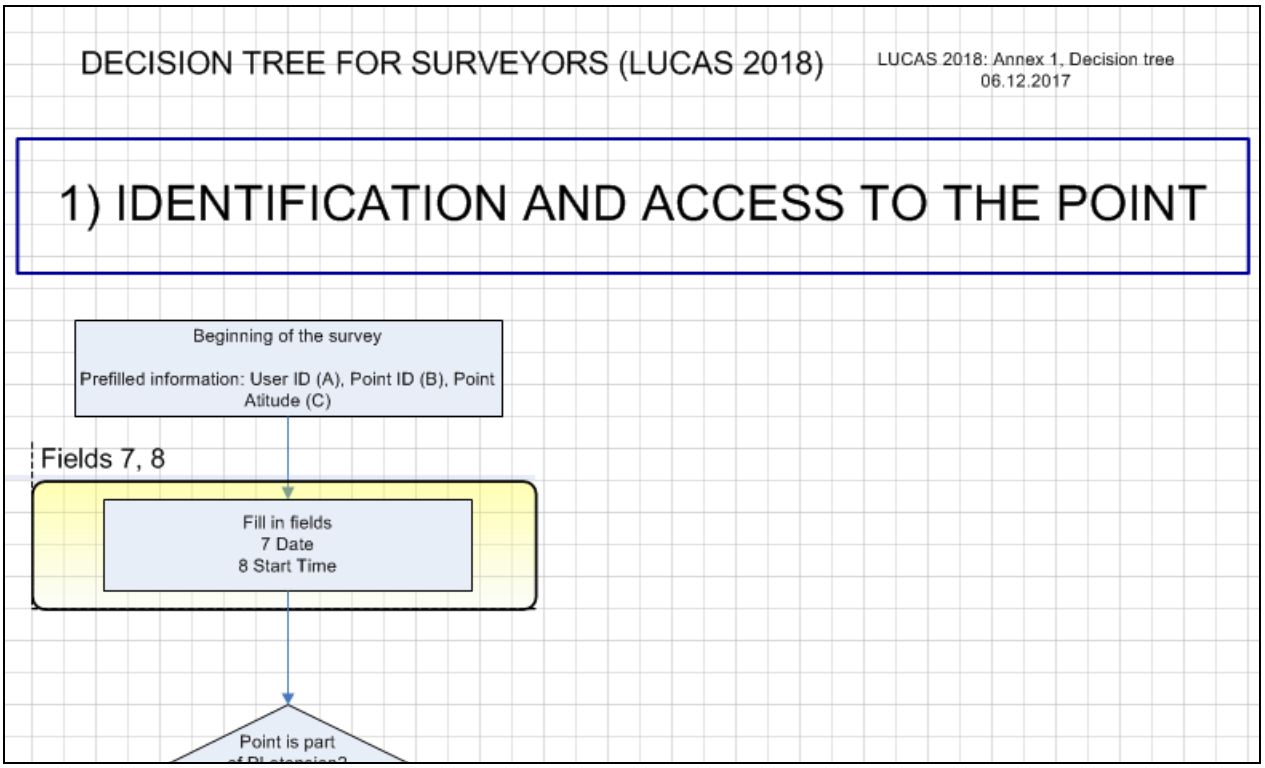


Figure 129

10.11 INSPIRE Pure Land Cover Components

LUCAS2018-INSPIRE-PLCC-v3.docx

11 Table 1.

Section	Image Nr	Copyright	Source	LICENSE NAME	LICENSE
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8.2.2 How to find the exact LUCAS point	Figure 2	Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0)). Edited: addition of the EW of observation	https://map.geoportail.lu/theme/main?lang=en&version=3&zoom=11&X=720515&Y=6389005&rotation=0&layers=2056&opacities=1&bgLayer=basemap_2015_global	CC0 1.0 Universal	https://creativecommons.org/publicdomain/zero/1.0/
8.2.2 How to find the exact LUCAS point	Figure 3	Source of the ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0). Edited: addition of the EW of observation	https://map.geoportail.lu/theme/main?lang=en&version=3&zoom=11&X=720515&Y=6389005&rotation=0&layers=2056&opacities=1&bgLayer=basemap_2015_global	CC0 1.0 Universal	https://creativecommons.org/publicdomain/zero/1.0/

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8.3.3. Field: Direction of observation	Figure 5	Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0) Edited: addition of the EW of observation and LTN rule	https://map.geoportail.lu/theme/main?lang=en&version=3&zoom=11&X=720515&Y=6389005&rotation=0&layers=2056&opacities=1&bgLayer=basemap_2015_global	CC0 1.0 Universal	https://creativecommons.org/publicdomain/zero/1.0/
8.3.3. Field: Direction of observation	Figure 6	Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0) Edited: addition of the EW of observation and LTN rule	https://map.geoportail.lu/theme/main?lang=en&version=3&zoom=11&X=720515&Y=6389005&rotation=0&layers=2056&opacities=1&bgLayer=basemap_2015_global	CC0 1.0 Universal	https://creativecommons.org/publicdomain/zero/1.0/
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8.4.1 Extended window of observation	Figure 9	© 2019, Mikhail Nilov, Pexels License Edited: addition of the EW of observation	https://map.geoportail.lu/theme/main?lang=en&version=3&zoom=11&X=720515&Y=6389005&rotation=0&layers=2056&opacities=1&bgLayer=basemap_2015_global	CC0 1.0 Universal	https://creativecommons.org/publicdomain/zero/1.0/
8.4.1 Extended window of observation	Figure 10	© 2018, Carlos Aguilar (@zenderista), Pixabay License. Edited: addition of the EW of observation	https://pixabay.com/photos/south-arid-landscape-south-of-spain-3718807/	Pixabay License	https://pixabay.com/nl/service/license/
8.4.1 Extended window of observation	Figure 12	Source: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0) Edited: addition of the EW of observation	https://map.geoportail.lu/theme/main?lang=en&version=3&zoom=11&X=720515&Y=6389005&rotation=0&layers=2056&opacities=1&bgLayer=basemap_2015_global	CC0 1.0 Universal	https://creativecommons.org/publicdomain/zero/1.0/

8.4.6 Field: LC2 land cover 2 and coverage (%) - Multiple registration of land cover (31, 32)	Figure 17	© 2014, Gary Fisher (@gafisher), Pixabay License	https://pixabay.com/photos/orchard-apple-agriculture-fruit-244297/	Pixabay License	https://pixabay.com/nl/service/license/
8.11.1 Artificial land	Figure 18	© 2017, René Boinski (@ReneBoinski), Pixabay License	https://pixabay.com/zh/photos/skogar-museum-iceland-grass-roofs-1989483/	Pixabay License	https://pixabay.com/nl/service/license/
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8.9.3 8.9.3 INSPIRE PLCC	Figure 45	Source of the orthophoto: ortho_2020 WMS, Open Data WMS and WMTS de l'Administration du cadastre et de la topographie du Grand-Duché du Luxembourg (data.public.lu), Creative Commons Zero (CC0 1.0)	https://map.geoportail.lu/theme/main?lang=en&version=3&zoom=11&X=720515&Y=6389005&rotation=0&layers=2056&opacities=1&bgLayer=basemap_2015_global	CC0 1.0 Universal	https://creativecommons.org/publicdomain/zero/1.0/
8.11.3.3 Field: Site moisture	Figure 46	© Rainer Oppermann, 2016			

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8.11.8.4. Fields: Bare layer components	Figure 53	© Rainer Oppermann, 2018			
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8.15.2.5 Irrigation photos	Figure 123	© 2015, WikimediaImages, Pixabay License	https://pixabay.com/it/photos/patata-campi-irrigazione-acqua-839469/	Pixabay License	https://pixabay.com/it/service/license/

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