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**Report for**

**the European Commission**

**Eurostat**

Task N°4: Statistical results

Task 4 Final Report

Methodological assistance to the LUCAS project

Quality, methodology and research Lot 1: Methodological support

Specific Contract N° SC 000011 ESTAT 2018.0086-2018.0182

under the Framework Contract 2018.0086

Methodological assistance to the LUCAS project

**December 2020**

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|  | in joint-venture with |  |
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# Introduction

## Contract for Methodological assistance to the LUCAS project

This report is produced in the frame of the specific contract on ‘Methodological assistance to the LUCAS project’, specific contract N° SC 000011 ESTAT 2018.0086-2018.0182, in the frame of the Eurostat framework contract, Lot 1: Supply of statistical services in statistical methodology (framework contract number 2018.0086), implemented by GOPA Joint Venture (GOPA).

The objective of the project is the improvement of the Land Use/Cover Area frame Survey (LUCAS) considering not only the topics specific to one single survey (e.g., quality, estimation and relevance of the results), but also the coherence of the past and the future of LUCAS rounds.

The methodology of LUCAS has been continuously improved; an important number of different features is collected besides the recording of physical land cover and socio-economic land use. In 2013 in a similar approach, a first analysis of the unlikely changes between 2009 and 2012 was carried out to draw valuable conclusions from this comparison. This means that generally the improvements of each round were made taking into account the lessons of the past. Now, starting from these data and experience gathered in the previous rounds, the in-depth analysis of all the LUCAS surveys in an integrated manner is subject of this contract. Possibly suggestions and ideas oriented to an improved design for the future surveys will be provided. The resulting changes should be applied in the next rounds of LUCAS (starting with the upcoming one in 2022).

LUCAS outputs include the microdata, the photos, the soil samples and the statistical tables produced by Eurostat based on the collected data. These data, apart from providing harmonised statistics on land cover (LC) and land use (LU) at European Union (EU) level are also used for a variety of environmental and socioeconomic projects related to a wide range of EU policy areas. Moreover, the LUCAS data is used as ground control data for the production, verification and validation of Copernicus products derived from satellite data (i.e., CORINE Land Cover and High Resolution Layers). Therefore, the relevance of LUCAS data implies a sound quality assessment of all the aspects of the survey.

The methodological support offered by GOPA in the frame of this contract targets the actual and previous data collections for LUCAS. This means checking the coherence and comparability of the micro data across the different survey rounds, the quality of the procedures used for the data collection and the coherence of LUCAS estimates with other national and EU sources. In addition, recommendations will be provided to increase the value of the LUCAS results towards the generic public use and other EU institutions or agencies.

In concrete, the project aims to support the Eurostat LUCAS team in the following tasks.

Table 1: List of LUCAS tasks

|  |  |
| --- | --- |
| **Task #** | **Description** |
| 1 | Quality analysis for individual data points |
| 2 | Check and rules for editing of different LUCAS surveys |
| 3 | Alignment of LUCAS survey micro-data for different years |
| 4 | **Statistical results** |
| 5 | Comparisons of LUCAS survey results with other data sources |
| 6 | Quality analysis of data originating from LUCAS |
| 7 | Data analysis and dissemination |
| 8 | Assistance in preparing future LUCAS survey |
| 9 | Comparing National Data on land cover and land use from Grants 2012/2015 |
| 10 | Description of LUCAS production process |
| 11 | Scientific summary |

## Task 4 – Statistical results

Objective of this task is the production of a set of estimates at different domain levels (identified by NUTS classification). Several releases of the estimates were presented during its execution, ranging from those presented to the Working Group on Land Cover-Land Use in October 2019 to the final ones (July 2020).

The estimates were obtained considering the results of the previous tasks, in which the microdata (values of the variables observed in sampled points) were checked, corrected if necessary, and aligned for the different years. Moreover, there was also an interaction with subsequent task 5 (comparison of LUCAS results with other data sources) that lead to consolidated estimates.

It has to be noted that the estimates included Land Cover and Land use but, also, new functional classes that were agreed with Eurostat (for instance the “Settlement-population ratio”, “LUD-Land use with heavy environmental impact”, “LUE- Services and residential Area”).

SAS and R procedures were used to implement the processes of this task; in particular:

* SAS was used to:
  + assign the initial weights for 2009, 2012, and 2015 surveys, calculated as the inverse of the inclusion probabilities in the different strata, i.e. the cross products of NUTS2 and STR05 (the initial weights for 2018 were already defined in the sample that was considered)
  + add to all the surveys the FAO. the Settlement, LUD and LUE variables;
* R was used for producing calibrated weights, estimates and sampling errors.

The Task was divided into five Sub-Tasks:

1. Preparation of the sampled data
2. Analysis and evaluation of the previous estimation procedures
3. Re-weighting of microdata
4. Production of estimates and related sampling errors
5. Formatting of estimates accordingly to Eurostat standards

# Activities by Sub-Task

## Sub-Task 4.1 ´Preparation of the sampled data´

The first activity carried out was the preparation of the sampled data to be considered for producing the estimates; starting from what produced at the end of task 3, the survey datasets (2009, 2012, 2015 and 2018) were:

* integrated with some Photo Interpreted points (2009 and 2012), derived from the 2015 survey;
* deleted of few Photo Interpreted points for the 2015 survey (it has to be noted that in the file with 66461 Photo Interpreted points of 2015, 6898 were identified as not eligible for 2015 and deleted from the 2015 survey);
* filtered by considering those points for which the values of LC/LU were not null, different from “8” (not admitted) and from “G30” (Transitional Water Bodies);
* treated to add new variables:
  + Settlement, equal to 1 if:
    - LC=A10, A11, A12, A13, A20, A21, A22, A30;
    - LU= U210, U220, U221, U222, U223, U224, U225, U226, U227, U228, U310, U311, U312, U314, U315, U316, U317, U318, U319, U320, U321, U322, U330, U340, U341, U342, U350, U360, U362, U370
  + LUD, equals to 1 if:
    - LU=U14\*, U21\*, U22\*, U32\*, U33\*, U31\* (where \* stands for any other digit)
  + LUE equals to 1 if:
    - LU= U34\*, U35\*, U36\*, U37\*
  + FAO forest (with values 1, 2 and 3).

The following table specifies the number of records that were considered at each of the previous step.

|  |  |  |  |
| --- | --- | --- | --- |
| Survey | Initial points (resulting from task 3) | Points after the inclusion/deletion of PI from 2015 | Final points (after filtering not valid values for LC/LU) |
| 2009 | 234623 | 262185 | 261654 |
| 2012 | 270272 | 334557 | 333794 |
| 2015 | 340143 | 333245 | 331985 |
| 2018 | 337854 |  | 337787 |

## Sub-Tasks 4.2 ´Analysis and evaluation of the previous estimation procedures´

Previous estimations procedures were based on a “basic raking algorithm”, i.e. on an iterative procedure in which the marginal totals of some control variables are used to evaluate intermediate sampling weights by means of a proportional adjustment of the cases that belong to the same category of each the control variable.

Convergence of the raking algorithm has received considerable attention in the statistical literature, especially in the context of iterative proportional fitting for log-linear models (Bishop, Y.M.M., S.E. Fienberg, and P.W. Holland. 1975. Discrete Multivariate Analysis: Theory and Practice. Cambridge, MA: MIT Press.), where the number of variables is at least 3 and the process begins with a different set of initial values in the fitted table (often 1 in each cell).

In the context of the previous methodological contracts, the procedure was based on “ad hoc” SAS scripts, that considered the following known totals:

* Nuts2 crossed with Strata (the stratification value observed for each point);
* Nuts1 crossed with classes of elevation (5 classes);
* Nuts0 crossed with Strata and classes of elevation.

## Sub-Tasks 4.3 ´Re-weighting of microdata´

In the framework of this methodological assistance, the re-weighting procedure was based on the use of the R-package ReGenesees, that allows to calculate sampling estimates by using calibration estimators. By using a calibration estimator, the weight given to each unit is obtained according to a procedure divided in several steps:

1. The ”*starting weight*” of each sample unit, named “*direct weight”*, is calculated according to the sampling design, as the reciprocal of the inclusion probability;
2. the starting weight is adjusted in order to account for non-response, obtaining the “*base weight”*;
3. correction factors of the base weight basis are computed to take into account equality constraints between some known parameters of the population and the corresponding sample estimates;
4. the ”*final weight”* is obtained as the product between the base weight and the correction factors.

Steps 2 and 3 not necessarily require to be carried out distinctly: if the non response model is the same than that for the overall calibration, they can be executed jointly. In our case, both the adjustment to correct for non-response and the weight correction to achieve consistency with known population parameters is obtained by solving a unique constrained minimization problem. In details we want to minimize the distance between the weight before and after the calibration phase (“Calibration Estimators in Survey Sampling”, Deville and Sarndal, JASA, 1992).

A calibration estimator requires the definition of a calibration model, where are indicated the variables with respect to which the known totals in the sampling frame are calculated. In our application, we considered the known totals related to NUTS2 and elevation (5 classes), further integrated with other known totals derived from Copernicus estimates (High Resolution Layers). Together with elevation, the final model included (at NUTS2 level):

* imperviousness
* artificial
* agricultural
* woodland
* wetland
* water

All these variables were added to each point in the Master, as binary variables: for instance, for variable “artificial” the value 1 indicates if the point is artificial, 0 is not. When the calibration procedure is invocated in “ReGenesees”, the software calculates the totals in the master by summing the area of all points having values equal to 1.

This was the standard calibration procedure adopted for the generality of countries. In the period between the release of the first batch of estimates (November 2019) and the second release (March 2020), a detailed analysis of estimates (stocks and variations) was carried out, in order to detect critical situations. In particular, the focus was on the detection of non-plausible variations for some aggregates of land cover (i.e., “artificial” and “water”) and settlement.

Non-plausible variations have been accepted if they could be explained by sampling errors, that is, as a rule of thumb, when related confidence intervals were intersecting. Otherwise, a different *ad* hoc procedure was adopted, consisting in interpolating values of estimates in the four years (2009, 2012, 2015 and 2018) and constraining the anomalous values to assume the ones derived from the interpolation of the imperviousness values.

This was done for the following countries:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **2009** | **2012** | **2015** | **2018** |
| CZ | 3383.116 | 3429.525 | 3443.411 | 3449.991 |
| HR |  |  | 1773.833 | 1785.098 |

An even more specific treatment was applied for Sweden and Slovenia in 2018: the value for “settlement” estimate was calculated by multiplying the value of settlement 2015 and the ratio between CLC2018 and CLC2015.

## Sub-Tasks 4.4 ´Production of estimates and related sampling errors´

By using calibrated weights obtained in Task 4.3, a first version of estimates was released in October 2019; these were produced for each survey (2009, 2012, 2015, 2018) and were referred to:

* at country level: Land Cover (1,2 and 3 digits), Land Use (1,2 and 3 digits), FAO class and Settlement, at national level and by NUTS1 and NUTS2;
* EU level: Land Cover (1,2 and 3 digits), Land Use (1,2 and 3 digits), FAO class and Settlement, for 23, 27 and 28 countries, plus 28 countries minus UK.

Some other estimates were then produced, characterized by:

* a finalized set of survey data (from November 2019);
* the introduction on more calibration totals based on Copernicus estimates.

A new release was produced the 23th of March; these allowed the publication of SDG and FAO estimates.

The final estimates were produced the 7th of July 2020; these contained also the LUD and LUE classification variables (referred to all the geographical references, i.e. Nuts0, 1 and 2 and the different EU levels). Compared to the March estimates this time the corrected datasets (Tasks 1 and 2) where used, which resulted in minor changes in land cover area in some LC classes for some countries.

## Sub-Tasks 4.5 ´Formatting of estimates accordingly to Eurostat standards´

The file describing the Eurostat standards’ for formatting the estimates was received on December 2019. In April 2020 the first of estimates were sent according to it. These were referred to the four surveys (2009, 2012, 2015 and 2018), with data based on March estimates at Nuts0 and EU levels on LC and LU (1, 2 and 3 digits), LUD, LUE and FAO class. Flat files have been produced based on July 2020 estimates.

In October 2020 the previous estimates were also extended to NUTS1 and NUTS2.

Annex 1

**FAO class calculation**

It is possible to add a new variable to each LUCAS survey representing the FAO forestry classification, i.e. a new variable characterized by three values:

* 1: FAO forest
* 2: other wooded land
* 3: other land with tree cover.

This is done by considering different combinations of the values of the following variables:

* primary and secondary land cover (LC1 and LC2);
* primary and secondary land use (LU1 and LU2);
* species associated to LC1 (value of the variable LC1\_Species);
* size of the area referred to LC1 (AREA\_SIZE)
* variable referring to the TREE\_HEIGHT;
* variable referring to the FEATURE\_WIDTH;
* variable referring to the SURVEY\_LC\_LU\_SPECIAL\_REMARK.

The table below contains the conditions (combination of the active variables) that were used to obtain the FAO forestry classification, originally realized as a SQL script and further transformed in a specific SAS syntax. It has to be noted that, for each combination, the SAS procedure determines also the identifier (field named “Condition\_FAO\_CLASS) that corresponds to the specific condition that was satisfied by each record.

|  |  |  |  |
| --- | --- | --- | --- |
| **FAO Forestry value** | **Condition\_FAO\_CLASS** | **Original SQL syntax** | **SAS syntax** |
| 0 | 1 | WHERE (((Export20160121.SURVEY\_LC1) Like 'G\*' Or (Export20160121.SURVEY\_LC1) Like 'H\*')); | if (upcase(substr(&lc1\_name,1,1))='G' or upcase(substr(&lc1\_name,1,1))='H') |
| 1 | 2 | WHERE (((Export20160121.SURVEY\_LC1)='A22') AND ((Export20160121.SURVEY\_LU1)='U312') AND ((Export20160121.SURVEY\_LU2)='U120') AND ((Export20160121.FAO\_CLASS) Is Null)); | if (upcase(&lc1\_name)='A22' and upcase(&lu1\_name)='U312' and upcase(&lu2\_name)='U120' and &fao\_class\_name='') |
| 1 | 3 | WHERE (((Export20160121.SURVEY\_LC1)='A30') AND ((Export20160121.SURVEY\_LC2) Like 'c\*' Or (Export20160121.SURVEY\_LC2) Like 'D\*' Or (Export20160121.SURVEY\_LC2) Like 'E\*' Or (Export20160121.SURVEY\_LC2) Like 'F\*') AND ((Export20160121.SURVEY\_LU1)='U319') AND ((Export20160121.SURVEY\_LU2)='U120') AND ((Export20160121.FAO\_CLASS) Is Null)); | if (upcase(&lc1\_name)='A30' and (upcase(substr(&lc2\_name,1,1))='C' or upcase(substr(&lc2\_name,1,1))='D' or upcase(substr(&lc2\_name,1,1))='E' or upcase(substr(&lc2\_name,1,1))='F') and upcase(&lu1\_name)='U319' and upcase(&lu2\_name)='U120' and &fao\_class\_name='') |
| 3 | 4 | WHERE (((Export20160121.SURVEY\_LC1) Like 'B7\*') AND ((Export20160121.SURVEY\_LU1)='U111' Or (Export20160121.SURVEY\_LU1)='U112' Or (Export20160121.SURVEY\_LU1)='U113' Or (Export20160121.SURVEY\_LU1) Like 'U4\*') AND (Not (Export20160121.SURVEY\_LC1\_SPECIES)='B75E' And Not (Export20160121.SURVEY\_LC1\_SPECIES)='B75P') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.FAO\_CLASS) Is Null)); | if (upcase(substr(&lc1\_name,1,2))='B7' and (upcase(&lu1\_name)='U111' or upcase(&lu1\_name)='U112' or upcase(&lu1\_name)='U113' or upcase(substr(&lu1\_name,1,2))='U4') and (upcase(&lc1\_species\_name) ne 'B75E' and upcase(&lc1\_species\_name) ne 'B75P') and &survey\_area\_size\_name>1 and &fao\_class\_name='') |
| 3 | 5 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1)='B81') AND ((Export20160121.SURVEY\_LU1)='U111' Or (Export20160121.SURVEY\_LU1)='U112' Or (Export20160121.SURVEY\_LU1)='U113' Or (Export20160121.SURVEY\_LU1) Like 'U4\*') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1')); | if (upcase(&lc1\_name)='B81' and (upcase(&lu1\_name)='U111' or upcase(&lu1\_name)='U112' or upcase(&lu1\_name)='U113' or upcase(substr(&lu1\_name,1,2))='U4') and &survey\_area\_size\_name>1 and &fao\_class\_name='') |
| 1 | 6 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1\_SPECIES)='B83F') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1')); | if (upcase(&lc1\_species\_name)='B83F' and &survey\_area\_size\_name>1 and &fao\_class\_name='') |
| 1 | 7 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LC2)='8') AND ((Export20160121.SURVEY\_LU1)='U111') AND ((Export20160121.SURVEY\_LU2)='8') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')); | if (upcase(substr(&lc1\_name,1,1))='C' and &lc2\_name='8' and upcase(&lu1\_name)='U111' and &lu2\_name='8' and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 3 | 8\_1 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U111' Or (Export20160121.SURVEY\_LU1)='U112' Or (Export20160121.SURVEY\_LU1)='U113') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU2)='U111' Or (Export20160121.SURVEY\_LU2)='U112' Or (Export20160121.SURVEY\_LU2)='U113') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LC2) Like 'B\*') AND ((Export20160121.SURVEY\_LU1) Like 'U4\*' Or (Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')); | if (upcase(substr(&lc1\_name,1,1))='C' and (upcase(&lu1\_name)='U111' or upcase(&lu1\_name)='U112' or upcase(&lu1\_name)='U113') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 8\_2 | if (upcase(substr(&lc1\_name,1,1))='C' and (upcase(&lu2\_name)='U111' or upcase(&lu2\_name)='U112' or upcase(&lu2\_name)='U113') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 8\_3 | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(substr(&lc2\_name,1,1))='B' and (upcase(substr(&lu1\_name,1,2))='U4' or upcase(&lu1\_name)='U120') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 1 | 9\_1 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U140' Or (Export20160121.SURVEY\_LU2)='U150' Or (Export20160121.SURVEY\_LU2)='U318' Or (Export20160121.SURVEY\_LU2)='U321' Or (Export20160121.SURVEY\_LU2)='U322' Or (Export20160121.SURVEY\_LU2)='U350' Or (Export20160121.SURVEY\_LU2)='U361' Or (Export20160121.SURVEY\_LU2)='U362' Or (Export20160121.SURVEY\_LU2)='U370') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U140' Or (Export20160121.SURVEY\_LU1)='U150' Or (Export20160121.SURVEY\_LU1) Like 'U4\*') AND ((Export20160121.SURVEY\_LU2)='8') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U350') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U120') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U318') AND ((Export20160121.SURVEY\_LU2)='8') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')); | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(&lu1\_name)='U120' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U140' or upcase(&lu2\_name)='U150' or upcase(&lu2\_name)='U318' or upcase(&lu2\_name)='U321' or upcase(&lu2\_name)='U322' or upcase(&lu2\_name)='U350' or upcase(&lu2\_name)='U361' or upcase(&lu2\_name)='U362' or upcase(&lu2\_name)='U370') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 9\_2 | if (upcase(substr(&lc1\_name,1,1))='C' and (upcase(&lu1\_name)='U140' or upcase(&lu1\_name)='U150' or upcase(substr(&lu1\_name,1,2))='U4') and upcase(&lu2\_name)='8' and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 9\_3 | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(&lu1\_name)='U350' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U120') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 9\_4 | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(&lu1\_name)='U318' and upcase(&lu2\_name)='8' and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 2 | 10\_1 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U140' Or (Export20160121.SURVEY\_LU2)='U150' Or (Export20160121.SURVEY\_LU2)='U318' Or (Export20160121.SURVEY\_LU2)='U321' Or (Export20160121.SURVEY\_LU2)='U322' Or (Export20160121.SURVEY\_LU2)='U350' Or (Export20160121.SURVEY\_LU2)='U361' Or (Export20160121.SURVEY\_LU2)='U362' Or (Export20160121.SURVEY\_LU2)='U370') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)='1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U140' Or (Export20160121.SURVEY\_LU1)='U150' Or (Export20160121.SURVEY\_LU1) Like 'U4\*') AND ((Export20160121.SURVEY\_LU2)='8') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)='1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U350') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U120') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)='1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'D\*' Or (Export20160121.SURVEY\_LC1)='E10') AND ((Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U140' Or (Export20160121.SURVEY\_LU2)='U150' Or (Export20160121.SURVEY\_LU2)='U318' Or (Export20160121.SURVEY\_LU2)='U321' Or (Export20160121.SURVEY\_LU2)='U322' Or (Export20160121.SURVEY\_LU2)='U350' Or (Export20160121.SURVEY\_LU2)='U361' Or (Export20160121.SURVEY\_LU2)='U362' Or (Export20160121.SURVEY\_LU2)='U370') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'D\*' Or (Export20160121.SURVEY\_LC1)='E10') AND ((Export20160121.SURVEY\_LU1)='U140' Or (Export20160121.SURVEY\_LU1)='U150' Or (Export20160121.SURVEY\_LU1) Like 'U4\*') AND ((Export20160121.SURVEY\_LU2)='8') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'D\*' Or (Export20160121.SURVEY\_LC1)='E10') AND ((Export20160121.SURVEY\_LU1)='U350') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U120') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')); | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(&lu1\_name)='U120' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U140' or upcase(&lu2\_name)='U150' or upcase(&lu2\_name)='U318' or upcase(&lu2\_name)='U321' or upcase(&lu2\_name)='U322' or upcase(&lu2\_name)='U350' or upcase(&lu2\_name)='U361' or upcase(&lu2\_name)='U362' or upcase(&lu2\_name)='U370') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name=1 and &fao\_class\_name='') |
| 10\_2 | if (upcase(substr(&lc1\_name,1,1))='C' and (upcase(&lu1\_name)='U140' or upcase(&lu1\_name)='U150' or upcase(substr(&lu1\_name,1,2))='U4') and upcase(&lu2\_name)='8' and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name=1 and &fao\_class\_name='') |
| 10\_3 | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(&lu1\_name)='U350' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U120') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name=1 and &fao\_class\_name='') |
| 10\_4 | if ( (upcase(substr(&lc1\_name,1,1))='D' or upcase(&lc1\_name)='E10') and upcase(&lu1\_name)='U120' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U140' or upcase(&lu2\_name)='U150' or upcase(&lu2\_name)='U318' or upcase(&lu2\_name)='U321' or upcase(&lu2\_name)='U322' or upcase(&lu2\_name)='U350' or upcase(&lu2\_name)='U361' or upcase(&lu2\_name)='U362' or upcase(&lu2\_name)='U370') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 10\_5 | if ( (upcase(substr(&lc1\_name,1,1))='D' or upcase(&lc1\_name)='E10') and (upcase(&lu1\_name)='U140' or upcase(&lu1\_name)='U150' or upcase(substr(&lu1\_name,1,2))='U4') and upcase(&lu2\_name)='8' and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 10\_6 | if ( (upcase(substr(&lc1\_name,1,1))='D' or upcase(&lc1\_name)='E10') and upcase(&lu1\_name)='U350' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U120') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 1 | 11\_1 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1)='D10') AND ((Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U140' Or (Export20160121.SURVEY\_LU2)='U150' Or (Export20160121.SURVEY\_LU2)='U318' Or (Export20160121.SURVEY\_LU2)='U321' Or (Export20160121.SURVEY\_LU2)='U322' Or (Export20160121.SURVEY\_LU2)='U350' Or (Export20160121.SURVEY\_LU2)='U361' Or (Export20160121.SURVEY\_LU2)='U362' Or (Export20160121.SURVEY\_LU2)='U370') AND ((Export20160121.SURVEY\_AREA\_SIZE)='1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1)='D10') AND ((Export20160121.SURVEY\_LU1) Like 'U4\*') AND ((Export20160121.SURVEY\_LU2)='8') AND ((Export20160121.SURVEY\_AREA\_SIZE)='1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1)='E10') AND ((Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U140' Or (Export20160121.SURVEY\_LU2)='U150' Or (Export20160121.SURVEY\_LU2)='U318' Or (Export20160121.SURVEY\_LU2)='U321' Or (Export20160121.SURVEY\_LU2)='U322' Or (Export20160121.SURVEY\_LU2)='U350' Or (Export20160121.SURVEY\_LU2)='U361' Or (Export20160121.SURVEY\_LU2)='U362' Or (Export20160121.SURVEY\_LU2)='U370') AND ((Export20160121.SURVEY\_AREA\_SIZE)='1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1)='E10') AND ((Export20160121.SURVEY\_LU1) Like 'U4\*') AND ((Export20160121.SURVEY\_LU2)='8') AND ((Export20160121.SURVEY\_AREA\_SIZE)='1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like "C\*") AND ((Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_LU2)='8' Or (Export20160121.SURVEY\_LU2)='U140' Or (Export20160121.SURVEY\_LU2)='U150' Or (Export20160121.SURVEY\_LU2)='U318' Or (Export20160121.SURVEY\_LU2)='U321' Or (Export20160121.SURVEY\_LU2)='U322' Or (Export20160121.SURVEY\_LU2)='U350' Or (Export20160121.SURVEY\_LU2)='U361' Or (Export20160121.SURVEY\_LU2)='U362' Or (Export20160121.SURVEY\_LU2)='U370') AND ((Export20160121.SURVEY\_AREA\_SIZE)='1')); | if (upcase(&lc1\_name)='D10' and upcase(&lu1\_name)='U120' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U140' or upcase(&lu2\_name)='U150' or upcase(&lu2\_name)='U318' or upcase(&lu2\_name)='U321' or upcase(&lu2\_name)='U322' or upcase(&lu2\_name)='U350' or upcase(&lu2\_name)='U361' or upcase(&lu2\_name)='U362' or upcase(&lu2\_name)='U370') and &survey\_area\_size\_name=1 and &fao\_class\_name='') |
| 11\_2 | if (upcase(&lc1\_name)='D10' and upcase(substr(&lu1\_name,1,2))='U4' and upcase(&lu2\_name)='8' and &survey\_area\_size\_name=1 and &fao\_class\_name='') |
| 11\_3 | if (upcase(&lc1\_name)='E10' and upcase(&lu1\_name)='U120' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U140' or upcase(&lu2\_name)='U150' or upcase(&lu2\_name)='U318' or upcase(&lu2\_name)='U321' or upcase(&lu2\_name)='U322' or upcase(&lu2\_name)='U350' or upcase(&lu2\_name)='U361' or upcase(&lu2\_name)='U362' or upcase(&lu2\_name)='U370') and &survey\_area\_size\_name=1 and &fao\_class\_name='') |
| 11\_4 | if (upcase(&lc1\_name)='E10' and upcase(substr(&lu1\_name,1,2))='U4' and upcase(&lu2\_name)='8' and &survey\_area\_size\_name=1 and &fao\_class\_name='') |
| 11\_5 | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(&lu1\_name)='U120' and (upcase(&lu2\_name)='8' or upcase(&lu2\_name)='U140' or upcase(&lu2\_name)='U150' or upcase(&lu2\_name)='U318' or upcase(&lu2\_name)='U321' or upcase(&lu2\_name)='U322' or upcase(&lu2\_name)='U350' or upcase(&lu2\_name)='U361' or upcase(&lu2\_name)='U362' or upcase(&lu2\_name)='U370') and &survey\_area\_size\_name=1 and &fao\_class\_name='') |
| 3 | 12\_1 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1) Like 'U2\*' Or (Export20160121.SURVEY\_LU1) Like 'U31\*' Or (Export20160121.SURVEY\_LU1) Like 'U32\*' Or (Export20160121.SURVEY\_LU1) Like 'U34\*' Or (Export20160121.SURVEY\_LU1) Like 'U36\*' Or (Export20160121.SURVEY\_LU1)='U370') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1')) OR (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LC1) Like 'C\*') AND ((Export20160121.SURVEY\_LU1)='U350') AND ((Export20160121.SURVEY\_AREA\_SIZE)>'1') AND ((Export20160121.SURVEY\_TREE\_HEIGHT\_MATURITY)>'1') AND ((Export20160121.SURVEY\_FEATURE\_WIDTH)>'1') AND ((Export20160121.SURVEY\_LU2)='U361' Or (Export20160121.SURVEY\_LU2)='U362')); | if (upcase(substr(&lc1\_name,1,1))='C' and (upcase(substr(&lu1\_name,1,2))='U2' or upcase(substr(&lu1\_name,1,3))='U31' or upcase(substr(&lu1\_name,1,3))='U32' or upcase(substr(&lu1\_name,1,3))='U34' or upcase(substr(&lu1\_name,1,3))='U36' or upcase(&lu1\_name)='U370') and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and &fao\_class\_name='') |
| 12\_2 | if (upcase(substr(&lc1\_name,1,1))='C' and upcase(&lu1\_name)='U350' and &survey\_area\_size\_name>1 and &survey\_tree\_height\_maturity\_name>1 and &survey\_feature\_width\_name>1 and (upcase(&lu2\_name)='U361' or upcase(&lu2\_name)='U362') and &fao\_class\_name='') |
| 1 | 13 | WHERE (((Export20160121.FAO\_CLASS) Is Null) AND ((Export20160121.SURVEY\_LU1)='U120') AND ((Export20160121.SURVEY\_LC\_LU\_SPECIAL\_REMARK)='3' Or (Export20160121.SURVEY\_LC\_LU\_SPECIAL\_REMARK)='4' Or (Export20160121.SURVEY\_LC\_LU\_SPECIAL\_REMARK)='5')); | if (upcase(&lu1\_name)='U120' and (&survey\_lc\_lu\_special\_remark\_name=3 or &survey\_lc\_lu\_special\_remark\_name=4 or &survey\_lc\_lu\_special\_remark\_name=5) and &fao\_class\_name='') |
| 0 | In all the other cases | | |

The SAS procedure that adds the FAO forestry classification variable and the specific identifier of the condition that was satisfied by each record is contained in the file: “MacroFAO.sas”, that is characterized by the following input parameter:

%macro AddVariable(in\_ds\_name, out\_ds\_name, fao\_class\_name, lc1\_name, lu1\_name, lc2\_name, lu2\_name, lc1\_species\_name, survey\_area\_size\_name,

survey\_tree\_height\_maturity\_name, survey\_feature\_width\_name, survey\_lc\_lu\_special\_remark\_name);

In particular:

* in\_ds\_name= name of the input data set
* out\_ds\_name= name of the output data set
* lc1\_name, lu1\_name, lc2\_name, lu2\_name, lc1\_species\_name, survey\_area\_size\_name,…= name of the variables used for the evaluation.

For instance, to execute the procedure for the 2015 LUCAS survey, the call to the SAS macro procedure were done by:

%AddVariable(survey\_2015\_complete, survey\_2015\_final,

fao\_class\_name, land\_cover, land\_use, survey\_lc2, survey\_lu2,

survey\_lc1\_spec, SURVEY\_AREA\_SIZE, SURVEY\_TREE\_HEIGHT\_SURVEY, SURVEY\_FEATURE\_WIDTH, SURVEY\_LC\_LU\_SPECIAL\_REMARK);

Annex 2

**Technical execution flow**

The execution flow referred to a generic LUCAS survey considered the following steps:

1. read of the LUCAS data (from a CSV file) in a SAS data set (this step permits, also, to have compatible variable names between the different years);
2. addition/deletion of some PI points
   1. addition of PI points for the 2009 or the 2012 surveys derived from those of 2015 (to compensate the “not eligible” points specific of these surveys)
   2. deletion of some PI points for the 2015 survey
3. deletion of the points in the following conditions:
   1. LC1 missing or equals to 8
   2. LC1 equals to G30 (transitional water)
   3. LU1 missing o equals to 8
4. addition of the FAO forestry classification variable
5. deletion of some points referred to points belonging to NUTS2, NUTS1 or NUTS0 not to be evaluated in the specific LUCAS survey:
   1. 2009: EL22, EL41, EL42, ES53, ES63, ES64, ES70, PT20, PT30, FI20, FR9, BG, HR, CY, MT, RO
   2. 2012: ES63, ES64, ES70, PT20, PT30, FR9, HR
   3. 2015: ES63, ES64, ES70, PT20, PT30, FR9
   4. 2018: ES63, ES64, ES70, PT20, PT30, FR9
6. evaluation of the preliminary weight
   1. 2009, 2012 and 2015: given by considering the NUTS2 and the STR05 variables (so that the weight for each record permits to reproduce the distribution of the two variables for each survey)
   2. 2018: already evaluated when the sample was extracted
7. final calibration of each survey

Annex 3

**Details on SAS scripts**

The SAS scripts used to treat each LUCAS survey were organized as a series of “macros” to be executed according to the specific needs and in order to easily implement the technical execution flow that was previously described.

In particular the main procedures are:

* Macro\_read\_xxxx.sas, where xxxx could be 2009 or 2012 or 2015 or 2018: this macro read the original CSV files, changing the name of the fields to ensure their compatibility between the years;
* Macro\_read\_PI.sas, used to read the list of PI points to be extracted from the 2015 survey and added to the 2009 and 2012 surveys;
* Macro\_FAO.sas: used to add the FAO classification variable to each LUCAS record;
* MACRO\_Read\_Master\_2019.sas: reads the Master 2019 data set.

The use of these macros is done to obtain a suitable ASCII data set (with fields separated by TABs), to be used as input to the R calibration and estimation procedures.

Each survey is treated by a “SAS main script” that manages all the appropriate steps for each LUCAS survey; these are:

* create\_2009.sas: to read the 2009 original data and to create the input data set for the R procedures;
* create\_2012.sas: to read the 2012 original data and to create the input data set for the R procedures;
* create\_2015.sas: to read the 2015 original data and to create the input data set for the R procedures;
* create\_2018.sas: to read the 2018 original data and to create the input data set for the R procedures.

At the beginning of each “SAS main script” there are the paths of the files that were used. The export of the resulting TSV file should be done manually.

Annex 4

**Details on R scripts**

All R script are available in the PWS in the folder

Task 4/Calibration\_estimation\_procedure/Script R

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Procedure for producing LUCAS estimates 2009 / 2018

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Preliminary steps:

- install library ReGenesees in R environment

- modify path in setwd("...") (first instruction of each R script)

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Step 1 - Estimates by country

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\*\*\* Input: survey data for each round

Survey\_2009.txt

Survey\_2012.txt

Survey\_2015.txt

Survey\_2018.txt

\*\*\* Input: master file

master2019\_with\_weights\_and\_strata\_2018.csv

\*\*\* Input: NUTS structure

NUTS2\_16 areas.csv

\*\*\* Process:

execute:

1.estimates\_by\_country\_2009.bat

2.estimates\_by\_country\_2012.bat

3.estimates\_by\_country\_2015.bat

4.estimates\_by\_country\_2018.bat

with R scripts with standard calibration model:

1.estimates\_by\_country\_2009.R

2.estimates\_by\_country\_2012.R

3.estimates\_by\_country\_2015.R

4.estimates\_by\_country\_2018.R

and R scripts with ad hoc calibration model:

1.estimates\_2countries\_2009.R

2.estimates\_2countries\_2012.R

3.estimates\_2countries\_2015.R

4.estimates\_2countries\_2018.R

4.estimates\_2countries\_2018 - SE SI.R

\*\*\* Output:

for each year XXXX:

-- a directory 'estimatesXXXX' with two csv file for each country YY:

-- a 'YY\_est\_LC1\_LU1.csv' (estimates LC1 and LU1)

-- a 'YY\_est\_LC1\_LU1\_NUTS2\_16\_2009.csv' (estimates LC1 and LU1 by NUTS2)

-- a directory 'weightsXXXX' with one file for each country YY:

-- a 'YY\_calibrated\_wgts\_2015.txt' containing calibrated weights

------------------------------------------------

Step 2 - Assign calibrated weights to survey data

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\*\*\* Input: survey data for each round

Survey\_2009.txt

Survey\_2012.txt

Survey\_2015.txt

Survey\_2018.txt

\*\*\* Input:

YY\_calibrated\_wgts\_XXXX.txt in directories 'weightsXXXX'

\*\*\* Process:

execute:

5.attribute\_cal\_wgts.bat

with R script:

5.attribute\_cal\_wgts.R

\*\*\* Output:

Survey\_2009\_cal\_wgt.txt

Survey\_2012\_cal\_wgt.txt

Survey\_2015\_cal\_wgt.txt

Survey\_2018\_cal\_wgt.txt

---------------------------------------------------------------------

Step 3 - Produce concatenate (2009 / 2018) estimates for each country

---------------------------------------------------------------------

\*\*\* Input:

'YY\_est\_LC1\_LU1.csv' files contained in directories 'estimatesXXXX'

\*\*\* Process:

execute:

6.all\_years\_estimates.bat

with R script:

6.all\_years\_estimates.R

\*\*\* Output:

'YY\_est\_all.csv' in directory 'allyears\_estimates'

---------------------------------------------------------------------

Step 4 - Produce estimates for European Union

---------------------------------------------------------------------

\*\*\* Input:

Survey\_2009\_cal\_wgt.txt

Survey\_2012\_cal\_wgt.txt

Survey\_2015\_cal\_wgt.txt

Survey\_2018\_cal\_wgt.txt

\*\*\* Process:

execute:

7.EU\_estimates.bat

with standard R script:

7a.EU\_estimates\_1digit.R

7b.EU\_estimates\_2digits.R

7c.EU\_estimates\_3digits.R

7c.EU\_estimates\_settl\_FAO\_LUE\_LUD.R

and standard R script excluding UK:

7a.EU\_estimates\_1digit\_noUK.R

7b.EU\_estimates\_2digits\_noUK.R

7c.EU\_estimates\_3digits\_noUK.R

7c.EU\_estimates\_settl\_FAO\_LUE\_LUD\_noUK.R

\*\*\* Output:

Europe\_lc\_lu\_1digit.xlsx

Europe\_lc\_lu\_2digits.xlsx

Europe\_lc\_lu\_3digits.xlsx

Europe\_settl\_FAO\_LUE\_LUD.xlsx

in directory 'EU\_estimates'

------------------------------------------------------------------------

Step 5 - Check of estimates variations for Land Cover = A and Settlement

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\*\*\* Input:

'YY\_est\_all.csv' in directory 'allyears\_estimates'

\*\*\* Process:

execute:

8.check.bat

with R script:

8a.check\_estimates.R

8b.check\_estimates\_artificial.R

8c.check\_estimates\_waters.R

8d.check\_estimates\_NUTS2.R

8e.check\_LUCAS\_vs\_HRL\_CLC.R

\*\*\* Output:

artificial\_anomalies.xlsx

waters\_anomalies.xlsx

check.txt

in directory 'anomalies'

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Step 7 - Production of tables for each country

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execute:

9.tables\_country.bat

with R script:

9.tables\_country.R

in directory 'tables\_country'