LAMASUS
Land Management for Sustainability

D3.1 Report on Stocktake of Requirements and Technical Specifications for the LUM Policy Database

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Abstract

Within the framework of the LAMASUS project, Work Package 3 is dedicated to the creation of a comprehensive spatial agriculture and forest policy database. This endeavor serves the purpose of assessing policies by reviewing existing funding schemes and accommodating the modeling requirements of the project. A thorough understanding of data needs from consortium partners is needed to construct those databases. This understanding enables the assessment of LUM drivers and policies. Additionally, WP3 entails the preparation of requests for non-public databases and the development of a technical concept for data operation and harmonization. The overarching goal of this effort is to ensure the harmonization and mapping of regional and variable classifications across various data sources over time. This deliverable involves reviewing existing frameworks, identifying databases and policy measures, collecting data needs from partners, and developing the technical framework for data handling. This deliverable marks the beginning of our efforts to secure access to essential data, laying the foundation for the project's effective analysis of LUM drivers and policies.

Keywords: Land Use and Land Use Change, Data operation and harmonization, Farm Accountancy Data Network, Common Agricultural Policy, European Structural and Cohesion Funds, European Regional Development Fund, European Social Fund, Cohesion Fund, Just Transition Fund, Clearance of Accounts Audit Trail System, Drivers influencing land use change, GitLab, Continuous integration, Downscale policy-related indicators

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Abbreviations

AI	Artificial Intelligence
ALTZLESF	Combination of altitude zone and less favoured area zone
CAP	Common Agricultural Policy
CATS	Clearance of Accounts Audit Trail System
CF	Cohesion Fund
CHELSA	Climatologies at high resolution for the earth's land surface areas
CI	Continues Integration
CIRCABC	Communication and Information Resource Centre for Administrations, Businesses and Citizens
CO	Constraint Optimization
ERDF	European Regional Development Fund
ESF/ESF+	European Social Fund (Plus)
EU	European Union
EU-DEM	European Digital Elevation Model
EUROSTAT	European Statistical Office
FADN	Farm Accountancy Data Network
FMU	Farm Mapping Units
FSS	Farm Structure Survey
GDP	Gross Domestic Product
GHG	Greenhouse Gas Protocol

GNI	Gross National Income
HSU	Homogeneous Spatial Units
INSPIRE	Infrastructure for Spatial Information in the European Community
JTF	Just Transition Fund
LFA	Less Favored Area
LUCAS	Land Use and Coverage Area Frame Survey
LUM	Land Use and Land Management
MFF	Multiannual Financial Framework
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne.
NUTS	Nomenclature of Territorial Units for Statistics
OPs	Operational Programs
PPS	Purchasing Power Standards
SME	Small and Medium-sized Enterprises
TEN-T	Trans-European Transport Networks
UAA	Utilized Agricultural Area
USCIE	Unified Spatial Characterization Identifier for Europe
USDA	United States Department of Agriculture
WP	Work Package

Executive summary

WP3 aims to create a spatial agriculture and forest policy database for assessing policies through reviewing existing funding schemes and modeling requirements. This includes compiling both policy-related and non-policy-related spatial databases. The task involves gathering data needs from consortium partners for assessing LUM drivers and policies, preparing requests for non-public databases, and developing the technical concept for data operation and harmonization. This effort will ensure the harmonization and mapping of regional and variable classifications across various data sources over time.

In chapter 2, we delve into frameworks and publications essential to the LAMASUS project's integrated modeling framework. EU REGIONAL POLICY, also known as cohesion policy, is the EU's strategy to address regional disparities and stimulate balanced development across member states and regions. It utilizes funds such as the European Regional Development Fund (ERDF), European Social Fund (ESF/ESF+), and Cohesion Fund (CF), co-financing projects aligned with strategic goals like labor market strengthening and social infrastructure enhancement. The Just Transition Fund (JTF) aligns with the European Green Deal. Eligibility is determined at the NUTS2 level, classifying regions as less developed, transition, or more developed, based on GDP per capita (PPS). Funds underpinning regional policy are allocated during multiannual financial frameworks (MFFs). Operational programs (OPs) run concurrently with the MFF and are managed by designated authorities, selecting projects that align with OP goals. We detail the ERDF, ESF/ESF+, and CF, highlighting budgets, priorities, and co-financing rates for different MFF periods. These funds are pivotal in achieving economic cohesion, social inclusion, and regional development. CAP (Common Agricultural Policy) emphasizes sustainable farming and environmental concerns. Individual farm models are vital for micro-level assessment of farmer responses to CAP instruments. The Farm Accountancy Data Network (FADN) database, containing around 80,000 farms, plays a crucial role in providing data for CAP impact analyses at the farm micro level.

Chapter 3 discusses the results of a survey conducted among consortium partners to identify their data needs for analyzing the drivers and policies related to LUM in certain project tasks (WP4 & WP8). Out of 15 partners, 9 expressed a need for data for their analyses. They primarily rely on data sources like FADN, CATS, Regional funds (from 2007 to 2020), and Directives and Regulations. Specifically, partners like WUR, IIASA, WIFO, and INRAE are involved in ex-post analysis tasks (4.1 and 4.2) using the mentioned data sources. Task 4.3 involves ex-post analyses by IIASA, INRAE, WIFO, and UV, also using the mentioned data sources. In the realm of ex-ante evaluation, WUR and VUA are engaged in Tasks 6.1 and 6.2, respectively, using data from FADN, CATS, and directives and regulations. Task 6.3 involves ex-ante assessments by IIASA, BOKU, and WIFO, utilizing the same data sources. Furthermore, ex-ante analysis is conducted by IIASA in Task 7.1 and by Thünen in Task 7.2. In Task 8.2, PBL, VUA, and Thünen are involved in further ex-ante analysis, while PBL takes on further ex-ante assessment in Task 8.3. The text also mentions that a table provides a summary of these survey findings, indicating the project tasks involving ex-post or ex-ante analysis, the primary data sources, and the partner organizations involved.

Chapter 4 introduces various data sources vital to the LAMASUS project, providing a comprehensive overview of each source. NATIONAL AND EUROPEAN WIDE FADN DATA: The Farm Accountancy Data Network (FADN) serves as a crucial micro database tracking farm income and activities across the agricultural sector. Its a primary source for assessing the impact of Common Agricultural Policy (CAP) measures. FADN ensures consistency in bookkeeping principles across Europe and offers documentation in CIRCABC, a public domain. Farms are sampled based on region, economic size, and farming type, with a focus on representativeness. FADN provides essential data at the individual farm level, contributing to CAP impact analyses. The Clearance of Accounts Audit Trail System (CATS) database provides information on EU spend for Guarantee measures, including area size, beneficiaries, and payment year. EUROPEAN STRUCTURAL AND COHESION FUNDS is data on EU regional funds encompasses project and beneficiary details, policy contributions, monetary information, and project dates. The dataset covers multiple EU member states and funding periods, though harmonizing data between periods presents challenges. The section about POLICY-RELATED LAYERS, DRIVERS explores the drivers influencing land use changes, including socio-economic, land use, price, geographic, geophysical, climatic, and agricultural factors. The data collected informs land use change models and policy analysis within the project. Finally, the NORWEGIAN POLICY DATABASE is comprehensive, covering various subsidies, production quantities, and activity levels. These datasets, openly available, provide insight into Norway's agricultural policies, including supply control and regionally differentiated payment rates. The data sources will end up in the LAMASUS database and will be publicly available. Thereby we will ensure data confidentiality.

Chapter 5 presents downscaling approaches. It describes how spatially explicit farm data collected by EU member states remain confidential, necessitating a downscaling approach to construct a comprehensive spatial database while preserving confidentiality. An overview of existing approaches is provided. The LAMASUS project aims to improve farm allocation fit and calculate spatially dependent environmental indicators for the entire EU. The approach extends previous methods by utilizing EU-wide spatial data on farm types and UAA share per farm type. This approach not only improves environmental indicators but also aids statistical analysis and impact assessments based on FADN data. Finally results from former projects applying this method are presented.

Chapter 6 discusses the use of GitLab as a tool for data access and code sharing in the LAMASUS project. GitLab is described as a comprehensive DevOps platform that enhances team collaboration and project management. It offers features such as version control, issue tracking, code reviews, continuous integration, and more, making it an essential tool for streamlining development workflows. GitLab also allows for project synchronization between different instances, facilitating cross-platform collaboration. In summary, GitLab is highlighted as a powerful platform for collaboration and project management, but its full capabilities may not be needed for all project members. The core of collaboration in the project is expected to revolve around sharing code, data, and insights among team members.

1. Introduction

The LAMASUS project's overarching mission is to develop an integrated modeling framework tailored to meet the demands of policy development. Work Package 3 (WP 3) generates a comprehensive spatial agriculture and forest policy and payments database to support the backward and forward-looking models. This deliverable serves as a vital document outlining the specific prerequisites and technical specifications essential for the successful development of this pivotal database.

For the design of the database, we embarked on a comprehensive review of funding measure frameworks and pertinent publications to inform our database's structure. Additionally, we actively engaged our project partners, soliciting their valuable insights and data requirements through a comprehensive questionnaire.

This report encapsulates the outcomes of these extensive efforts, offering a concise overview of our primary data sources, which include the Farm Accountancy Data Network (FADN), the Common Agricultural Policy Tracking System (CATS), EU regional policy data, and various policy layers. Furthermore, we elucidate the technical concept governing data access within the project, laying a strong foundation for the broader modeling framework.

Finally, this deliverable delves into the intricacies of handling FADN data, addressing the necessity for downscaling, and providing a detailed methodology that elucidates the steps and procedures involved in this critical process. Given the sensitivity and farm-level granularity of the FADN data, the downscaling approach not only safeguards confidentiality but also enables the creation of a comprehensive spatial database tailored to our specific requirements.

No sensitive farm level data will be made public. Our comprehensive aggregated database will be structured according to the NUTS 2016 classification and will be accessible to the public through the LAMASUS portal.

2. Review of frameworks and publications for funding measures

2.1. EU REGIONAL POLICY

EU regional policy, also known as cohesion policy, refers to a comprehensive set of policies and strategies formulated by the EU to address regional disparities and promote balanced development across its member states and regions. It encompasses a range of measures aimed at coordinating regional relations, fostering economic growth, social progress, environmental sustainability, political stability, and cultural development.

EU regional policy utilizes several funding sources, including the European Regional Development Fund (ERDF), the European Social Fund (ESF/ESF+), and the Cohesion Fund (CF), collectively known as the EU's regional funds. These funds play a vital role in co-financing projects that form part of operational programs (OPs) and align with strategic priorities such as strengthening the labor market, improving social infrastructure, and enhancing transportation networks. Additionally, there are additional funds, such as the newly created Just Transition Fund (JTF), which was established within the context of the European Green Deal.

Budget, funding priorities, and eligible regions for each of these funds are determined for each multiannual financial framework (MFF). The MFF sets out the budgetary framework for the EU over a specific period, typically spanning six years, with the current period encompassing the years from 2021 to 2027. Operational programs are designed to run for this exact length, with rules allowing for payments for approved projects for up to three years.

The eligibility for funding of regions is determined at the NUTS2 level. Regions are classified as less developed regions if their GDP per capita (in purchasing power standards – PPS) is 75% or less than the EU average. Transition regions have a GDP per capita (PPS) of more than 75% but less than 90% than the EU average. All other regions are categorized as more developed regions. This categorization determines which funds regions are eligible and the share of funds coming from national or EU sources.

Each OP is managed by a managing authority, which can be a public or private body designated by the member state. It holds the responsibility of identifying suitable and promising projects. The responsibility for project implementation lies with various entities, including firms, institutions, and other organizations. These projects are selected to receive co-financing from the managing authority of the specific OP. In this context, the beneficiaries are accountable for ensuring the successful implementation of the projects, while the managing authorities are responsible for selecting projects that align with the OP's goals.

2.2. FUNDS AT A GLANCE

The European Regional Development Fund (ERDF) focusses on strengthening the economic and social cohesion in the European Union by correcting imbalances between its regions. It is accessible for less developed regions, transition regions, and more developed regions alike.

The *European Social Fund (ESF)*, which has now evolved into ESF+ (European Social Fund Plus), is a financial instrument of the EU aimed at promoting social inclusion, employment, and education across Europe.

The *Cohesion Fund* (CF) is a financial instrument of the EU designed to support economic and social cohesion among its member states. Its primary objective is to reduce the development disparities between the more economically advanced regions and less developed regions. Not all member states are eligible for support, as it is limited to those whose GNI per capita is below 90% of the EU average.

In the appendix, the funds ERDF (Table 8), ESF (Table 9) and CF (Table 10) are presented with more detailed information.

2.3. CAP

The Common Agricultural Policy (CAP) has increasingly been adapted to integrate environmental concerns and one of the core objectives of the CAP is to ensure a sustainable way of farming and the provision of environmentally beneficial public goods and services. One important lesson from previous CAP evaluations is that some policy effects are difficult to assess at national or even regional levels. Moreover, recent CAP reforms have introduced a set of farm-specific measures whose uptake and economic effects differ significantly between individual farms. Consequently, there is an increasing demand for micro level assessment to fully understand farmer responses to CAP instruments and market signals and to better grasp the net effect of policy measures. To assess such effects, individual farm models have been developed, which require detailed input data. For the EU, the Farm Structure Survey (FSS) collects information on the whole population of farms each 2nd or 3rd year and publishes results for administrative regions. The Farm Accountancy Data Network (FADN) currently contains around 80,000 farms, representing a population of about 5,000,000 farms in the EU and about 90% of the total agricultural production. Most farm level models for the EU represent the farm population using a sample of individual farms recorded in FADN to enhance the capability of providing scientific support for CAP impact analyses at the farm micro level (Offermann et al., 2005; Kellermann et al., 2008; OECD, 2010; De Cara and Jayet, 2011; Gocht and Britz, 2011; Gocht et al., 2013; Louhichi et al., 2015; Louhichi et al., 2018; Ciaian et al., 2020).

3. Consortium partner data needs for ex-post and ex-ante assessments of LUM drivers and policies

In total, 9 out of the 15 partners of the consortium stated that they needed data for their analysis. The data used for the analysis are mainly obtained from sources such as FADN, CATS, Regional funds from 2007 to 2020, and Directives and Regulations.

The partners WUR, IIASA, WIFO, and INRAE are involved with ex-post analysis in Task 4.1. Similarly, IIASA, INRAE, Thünen, WIFO, and ZHAW are also involved in ex-post analysis in

Task 4.2. As part of Task 4.3, IIASA, INRAE, WIFO, and UV perform ex-post analyses using data from FADN, CATS, regional funds, and directives and regulations.

Moreover, WUR is involved in ex-ante evaluation in Task 6.1, while VUA is engaged in ex-ante evaluation in Task 6.2. Using data from FADN, CATS, and directives and regulations, IIASA, BOKU, and WIFO conduct ex-ante assessments in Task 6.3.

In Task 7.1, IIASA performs ex-ante analysis while Thünen performs ex-ante analysis in Task 7.2. PBL, VUA and Thünen are involved in further ex-ante analysis in Task 8.2, while PBL undertakes further ex-ante assessment in Task 8.3.

The next Table shows a summary of the survey. It lists the tasks of the LAMASUS project in which ex-post or ex-ante analyses are carried out, the main data source, and which partners are involved. The complete results from the survey are in the appendix (Figure , Table 11 to Table 16).

Table 1: Overview of consortia partners involved in different tasks and used data sources for ex-post or ex-ante analysis

Tasks	Main data sources	Ex-post analysis	Ex-ante analysis	Consortium partners
Task 4.1: Develop LUM models at country and regional resolution (M7-M36) Task 4.1 involves developing regional (NUTS-2/3) and national resolution econometric models. These models will be used to calibrate the behaviours of the ex-ante models in WP7 and to assess LUM policies at the EU level.	FADN, CATS, Regional funds - Cohesion + ERDF + INTERREG 2007-2013, Regional funds - Cohesion + ERDF + INTERREG FP 2014-2020, Directives and Regulations	X		WUR, INRAE, WIFO, IIASA
Task 4.2: Develop LUM models at the land-user level (M7-M36) In this task, econometric models will be developed for farmland allocation decisions in selected EU member states. The models will be used in ex-ante CAPRI modelling in WP7 and ex-post LUM policy assessment in the selected case study regions.	FADN, CATS, Directives and Regulations	X		INRAE, IIASA, Thünen, WIFO, ZHAW
Task 4.3: Develop gridded LUM models at high-resolution (M7-M36) This task will focus on developing a spatial statistics model to inform the dynamics and further downscale the results of the high-resolution land system model CLUE/CLUMondo in WP6. The model will be	FADN, CATS, Regional funds - Cohesion + ERDF + INTERREG 2007-2013, Regional funds - Cohesion + ERDF + INTERREG FP 2014-2020,	X		IIASA, INRAE, WIFO, UV

Tasks	Main data sources	Ex-post analysis	Ex-ante analysis	Consortium partners
based on country-specific prototypes developed by UV, UW and INRAE.	Directives and Regulations			
Task 6.1: Conceptualizing the LAMASUS Modelling Toolbox (M1-M12) This task aims to develop and document an approach that can be used to translate outcomes from economic land use models with a spatial resolution of countries and NUTS2 regions to land use models operating at a greater spatial resolution.	FADN, CATS, Regional funds - Cohesion + ERDF + INTERREG 2007-2013, Directives and Regulations		X	WUR
Task 6.2: Upgraded high-resolution spatial land use model (M4-M30) This task will build upon existing spatial land use models to provide a high-resolution simulation of landscape change with EU coverage at 100m to 1 km2 spatial resolution. It will integrate the land use modelling results with the environmental impacts from WP5.	Directives and Regulations		X	VUA
Task 6.3: Regional case studies to verify high-resolution model using ex-ante behavioural models (M7-M36) In this task, behavioural models will be developed to analyse microeconomic implications of policies consistent with the macro-level dynamics simulated with large-scale economic models. These models will be used to verify the high-resolution spatial model.	FADN, CATS, Directives and Regulations		X	IIASA, BOKU, WIFO
Task 7.1: Improve the representation of management systems in macro-level models (M21-M42) Building on WP2 data and detailed spatially explicit environmental and economic indicators for different management systems developed in WP5, if necessary supplemented by parameters taken from the literature, a diverse set of management options will be parameterized and implemented in the ex-ante models.	FADN		X	IIASA
Task 7.2: Implementation of local behavioural dynamics into macro-level models (M25-M42)	CATS, Regional funds -Cohesion + ERDF + INTERREG 2007-2013,		X	Thünen

Tasks	Main data sources	Ex-post analysis	Ex-ante analysis	Consortium partners
This task focuses on integrating behavioural parameters derived from econometric models in WP4 into the ex-ante macro-level models for a better representation of bottom-up land use change dynamics.	Regional funds - Cohesion + ERDF + INTERREG FP 2014-2020			
Task 8.2: Baseline generation with improved models and development of harmonized reporting templates (M25-M37) Policy-relevant LUM scenarios are designed in close collaboration with stakeholders and implemented and simulated in the newly designed LAMASUS toolbox. All relevant climate and land use policies are represented in the analysis, such as the EU Green Deal and the CAP. MAGNET/IMAGE will focus on long-term impacts of climate change, and LUM will benchmark policy outcomes against the EU medium- and long-term targets.	FADN, CATS, Regional funds - Cohesion + ERDF + INTERREG 2007-2013, Regional funds - Cohesion + ERDF + INTERREG FP 2014-2020, Directives and Regulations		X	PBL, Thünen, VUA
Task 8.3: An integrated view on agriculture, land use and climate policies for the land use sector (M40-M48) Across-model comparison will be carried out at the level of high-resolution land-use projections, allowing for an assessment of robustness and uncertainty as well as hot-spot analysis (D8.2). The analysis will be complemented by selected regional LUM policy case study scenarios building on T6.3 that are aligned with the macro-level models. In this way a comprehensive and detailed view of land use, environment, and economic indicators under different LUM policy futures is provided across spatial scales.	Directives and Regulations		X	PBL

Source: Own compilation

Work packages 4, 6, 7, and 8 with 9 partners are involved in ex-ante or ex-post analysis with the FADN, CATS, regional funds and the directives and regulations data bases. In each of the tasks, the partners are working together and will use the capabilities of GitLab as a collaboration tool to produce data, code, insights, and knowledge.

4. Data sources (data description, level of observation, technical texts, data tables)

4.1. NATIONAL AND EUROPEAN WIDE FADN DATA

The farm accountancy data network (FADN) is a micro database that tracks the income and business activities of farms in the agricultural sector.[i] It also provides valuable information for assessing the effects of the policies under the CAP. FADN is the only source of microeconomic data that follows consistent bookkeeping principles throughout Europe. All the relevant FADN documents and information can be found in CIRCABC, a public domain area.[ii] The documentation changes as the bookkeeping principles evolve. The latest document describing the catalogue of variables was released in May 2020 for the farm return in 2019, but older versions are also available. We applied for data up to 2017/18 for MIND STEP. The document for the methodology can be downloaded from this location. The Commission does not collect data directly, but delegates this task to a Liaison Agency in each Member State. In order to capture the diversity of farming, the sample is stratified by three criteria: region, economic size and type of farming. Farms are chosen in the sample based on a selection plan that ensures their representativeness of the farm population, as depicted by FSS. FADN includes only farms that are considered commercial above a cut-off limit, measured by economic size. A weight is computed for each farm in the survey. Moreover, standard results are a set of indicators derived from the catalogue and downloadable from CIRCABC. They show the economic situation of farmers by different groups and regions. Data at the individual farm level are usually not disclosed outside the Directorate General for Agriculture of the Commission unless they are used for research projects. The FADN survey catalogue consists of 13 tables based on inventory, cash book or journal records kept by the farmer or field officer.[iii] FADN differs from FSS, which contains structural information for all farms, as it collects bookkeeping data for a subset of farms. The data is collected annually.

4.1.1. Farm data

The utilized farm data is obtained via the FADN, a European system of sample surveys conducted every year to collect structural and accountancy data on farms, with the aim of monitoring the income and business activities of agricultural holdings and evaluating the

[i] The Farm Return is specified in Commission Regulation (EEC) No 2237/77 of 23 September 1977 and subsequent amendments until the year 2008 accounting included, then in Regulation (EC) 868/2008 from the financial year 2009.

[ii] More information about the FADN network can be found at: https://agriculture.ec.europa.eu/data-and-analysis/farm-structures-and-economics/fadn_en.

[iii] Table A: General information; Table B Type of occupation and Breakdown of the farm area: owned, rented or sharecropped; Table C: Labor; Table D: Assets; Table E: Quotas and other rights; Table F: Debts; Table G: Value added tax (VAT). Table H: Inputs; Table I: Crops; Table J: Livestock production: Table K: Animal products and services: Table L: Other gainful activities; Table M: Subsidies.

economic impact of the measures taken under the Common Agricultural Policy. The FADN is the only source of micro-economic data harmonized across the EU, i.e. the same book keeping principles apply in each member country. FADN data are collected in all FADN regions, which are not always equal to a particular NUTS level. Exact natural conditions and/or the location of the holdings cannot be derived from the data set mainly for confidentiality reasons. However, some elements of the FADN data represent spatial characteristics relevant for our analysis. For each sample farm, FADN records report whether it is located in a specific altitude zone and in a Less Favoured Area (LFA). Furthermore, many farms are assigned to sub-region codes, which can identify lower levels of administrative units (typically NUTS 2 or NUTS 3). Additionally, the land use patterns and crop yields recorded give hints for the spatial location of the farm. Under the FADN methodology, farms are selected for the database according to a sampling plan aiming at representativity of the sample for the population of farms in a FADN region with respect to a classification by type of farming, economic size and region. To allow for corrections of deviations from a perfect stratified sampling, an individual weight (statistical representation factor) is provided for each farm in the sample calculated as the ratio between the total number of holdings in the farm population and the sampled number of holdings in the same classification. (Kempen et al. 2011).

Additionally, we use data received from Eurostat 2010 containing information about the share of UAA (utilised agricultural area) per farm type on a 10km² grid level. This data will be used as a priori information to improve the allocation procedure of FADN farms and to validate the estimation results for the CO approach. In order to partially compensate for the truncation of the Eurostat 2010 data, the adjustment procedure also uses data from the agricultural census (Farm Structure Survey 2010, full survey) at the NUTS2 region.

4.1.2. Spatial information

The most important spatial data in this study are the Homogeneous Spatial Units (HSU). HSUs are defined as clusters of 1 km² raster cells within a subnational region (e.g. NUTS2/3) which covers an area of similar characteristics in terms of soil, climate and relief. They are delineated by the intersection of soil mapping units, landform classes and a 0.25 degrees grid (to facilitate the match with meteorological spatial data sets). Land use cover information was excluded as a delineation criterion, except for areas for which a land use change in the near future was considered as highly unlikely (water, ice, barren, built up). The minimum spatial unit is a 1 km² raster cell and conforms with the European Reference Grid and Coordinate Reference System proposed under INSPIRE (Infrastructure for Spatial Information in the European Community).

4.2. CATS

CATS is the Clearance of Accounts Audit Trail System, i.e., the database used for audit based on information received from Member States. It includes:

- actual total EU spend for individual Guarantee measures;
- the area size included in the payment (in ha);
- the number of beneficiaries to the payment.
- the year in which the payment was made

It primarily includes beneficiaries of direct income support, which is a component of the Common Agricultural Policy (CAP) of the EU. This policy aims to ensure a fair standard of living for the agricultural community by increasing the individual earnings of persons engaged in agriculture.

The agricultural income often lags behind income from other sectors due to price volatility and risks associated with climate change. The CAP income support helps stabilize farm income and remunerates farmers for their contribution to public goods related to environment, biodiversity, climate, and landscape features. This system plays a crucial role in maintaining the viability of farms and promoting sustainable agriculture across the EU. It's an essential tool in the EU's efforts to balance economic growth with environmental sustainability.

4.3. EUROPEAN STRUCTURAL AND COHESION FUNDS

4.3.1. Broad description of data set

Data on EU regional funds contains variables on the project itself (title, description, location), the project's beneficiary (name, location), the policy area to which the policy area contributes, monetary information (type of fund used, co-financing rate, paid sums, eligible costs, etc.), and project end and/or start date.

The dataset contains observations for all EU member states, and in case of Interreg projects, on some EU neighboring states. The UK, as well as the outermost regions, were not included in the dataset. This is (i) due to the needs of the project, and (ii) due to data availability.

The dataset covers observations of projects funded in the 2017-2013 and 2014-2020 period. Data for cohesion policy during the two funding periods originates from distinct sources: The data from 2007-2013 comes from a compilation of national and subnational lists of beneficiaries of EU structural funds (for an in-depth description of the methods used for compilation, see Bachtrögler et al. 2018). Data for the 2014-2020 period stems from the EU-Kohesio database, an EU-wide database for projects implemented since 2014.

Harmonizing data across the two funding periods poses a significant challenge. This is primarily due to disparities in data availability and variations in the legal framework governing each period. It is the project's ambition to propose a method to enhance comparability between values. However, it is crucial to note that these values should be interpreted with a degree of caution.

4.3.2. Presentation of the data

While the original data sets are on the project level, the final data set with land-use relevant payments will be aggregated to the regional level. To this end, the following steps are envisioned:

- Harmonization of data between the two funding periods using proxy variables
- Categorization of the projects into land-use effects (brownfield conversion, construction, environment, natural risk prevention, and management) using machine learning and automated translation
- Aggregation and presentation of data per year and NUTS2 (or NUTS3) region

The exemplary table below illustrates how the final data from regional funds will be structured. Please note that it only contains fictitious values and that the categories are subject to change.

Table 2: Illustration of the final data from regional funds

NUTS3	Year	Brownfield conversion	Construct-ion: buildings	Construct-ion: energy	Construct-ion: transport	Environ ment, incl.N2K	Natural risk prevention and management
AT130	2014	15	70	60	79	20	4
AT130	2015	**12**	80	70	89	10	5
AT130	2016	14	86	58	57	15	6
AT130	2017	10	87	45	80	50	2
AT130	2018	12	67	45	69	32	6
AT130	2019	13	89	69	69	60	4
AT130	2020	13	78	56	100	50	3

Source: *Fictitious values, expressed in million EUR.*

4.4. POLICY-RELATED LAYERS, DRIVERS

In econometric estimation for land use change in WP4, drivers are the factors or variables that influence and explain why land use patterns change over time. These drivers are essential components in land use change models and econometric analyses, as they help researchers and policymakers understand the underlying causes of land use changes. Identifying and quantifying these drivers can provide valuable insights for land use planning, environmental management, and policy development. Some common drivers in econometric estimation for land use change are: Demographic Factors: Changes in population size, distribution, and composition. For example, population growth may lead to urban expansion, while population decline could result in land abandonment. Economic Factors: Economic conditions, such as income levels (FADN), employment opportunities, and economic activities (e.g., agriculture, industry, and services), can impact land use decisions. Economic growth often drives urbanization and changes in land use patterns. Technological Factors: Advances in technology can affect land use by making certain land uses more or less attractive. For instance, improvements in transportation infrastructure may increase the accessibility of remote areas for development (CATS and *European Social Fund*). Policy and Regulatory Factors: Land use regulations, zoning laws, land tenure systems, and environmental policies can shape land use patterns. Changes in these policies can directly impact land use decisions and change. Environmental Factors: Environmental conditions, such as climate, soil quality, and natural resources, can influence land use choices. Climate change and environmental degradation can also lead to shifts in land use. Infrastructure and Transportation: The availability and quality of infrastructure, including roads, public transit, and utilities, can affect land use. Improved infrastructure often encourages urbanization and development. Land Market Dynamics: Factors like land prices (FADN), land supply, and land market

dynamics play a crucial role in shaping land use changes. High land prices in urban areas, for instance, may encourage the conversion of rural land to urban use. Cultural and Social Factors: Cultural preferences, social norms, and lifestyle choices can influence land use decisions. For example, cultural traditions may dictate agricultural practices or the preservation of certain landscapes. Government Interventions: Government interventions such as land subsidies (CAP payments), tax incentives, or land preservation programs (N2K) can drive specific land use changes or conservation efforts. Globalization: Global economic trends and international trade can have indirect effects on land use patterns, particularly in regions that are integrated into the global economy. In WP4, the LAMASUS team uses various statistical models to quantify the relationships between these drivers and land use changes (collected in WP2). These models help estimate the magnitude and significance of each driver's impact on land use, which can inform land use planning and policy decisions. Additionally, understanding the interactions among these drivers is crucial for predicting and managing future land use changes. The next table summarizes the collected data for drivers.

Table 3: Policy related drivers

Category	Variables	Reso-lution	Temporal Resolution	Data Source
Socio-economic	Total Population (Regional Accounts), Employment by NACE sector, Total Employment, GVA by NACE sector at constant prices ref. 2015, GDP at constant prices ref.	NUTS3	Annual: 1980 – 2021	ARDECO online https://knowledge4policy.ec.europa.eu/territorial/ardeco-online_en
	Hours Worked by NACE sector, Total Labour Force, Compensation of Employees by NACE sector at constant prices (ref. 2015)	NUTS2	Annual: 1980 – 2021	
	Share of low education workers, Share of high education workers	NUTS2	Annual: 2000 - 2017	EUROSTAT
LUM	Land cover in CLC classes, 1-year, 5-year, and 10-year change	grid	Annual: 1999 - 2020	https://zenodo.org/record/4725429#.ZD-gGi8RqLf
Prices	Selling price of crop products (absolute prices), Selling price of animal products (absolute prices), Purchase prices of the means of agricultural production (absolute	NUTS0	Annual: 1989 - 2022	EUROSTAT
Geographic	Area, Latitude, longitude of centroids	grid, NUTS0, NUTS1, NUTS2, NUTS3	2016	Based on raster file and shapefile of regions using Eurostat NUTS 2016 shapefile at 1:1M resolution
Geo-physical	Altitude	grid	2011	European Digital Elevation Model (EU-DEM) v1.1

Category	Variables	Reso-lution	Temporal Resolution	Data Source
				https://land.copernicus.eu/imagery-in-situ/eu-dem/eu-dem-v1.1?tab=metadata
	Aspect, Slope	grid	2000	Aspect derived from EU-DEM v1.0 https://land.copernicus.eu/imagery-in-situ/eu-dem/eu-dem-v1-0-and-derived-products/aspect?tab=metadata
	Soil type in USDA soil textural classes derived from clay, silt and sand maps and Clay, silt, sand, coarse fragments content	grid	2009	Topsoil physical properties for Europe (based on LUCAS topsoil data) https://esdac.jrc.ec.europa.eu/content/topsoil-physical-properties-europe-based-lucas-topsoil-data
	pH soil chemical property, Cation Exchange Capacity soil chemical property, Calcium carbonates soil chemical property, C:N ratio soil chemical property, Nitrogen (N) soil chemical property, Phosphorus (P) soil chemical property, Potassium (K) soil chemical property	grid	2009/2012	Maps of Soil Chemical properties at European scale based on LUCAS https://esdac.jrc.ec.europa.eu/content/chemical-properties-european-scale-based-lucas-topsoil-data#tabs-0-description=0
Climatic	Minimum temperature, maximum temperature, average temperature, precipitation	grid	1980 - 2016	CHELSA climate data
	Minimum temperature, maximum temperature, average temperature, precipitation	grid	1980 - 2100	Multiple potential data sources: https://www.isimip.org/gettingstarted/input-data-bias-adjustment/ https://www.euro-cordex.net/060374/index.php.en [CMIP6] https://www.worldclim.org/data/cmip6/cmip6climate.html https://climate.copernicus.eu/high-resolution-climate-projections https://cds.climate.copernicus.eu/cdsapp#!/dataset/rea

Category	Variables	Reso-lution	Temporal Resolution	Data Source
				nalysis-era5-land?tab=overview
Agricultural	Described in Annex 17	FADN region	Annual: 1989 - 2020	FADN Public Database (SO), available for FADN regions (can be mapped to NUTS-3)

Source: Own compilation.

4.5. NORWEGIAN POLICY DATABASE

Agricultural policy in Norway is sustained by a comprehensive set of policy instruments with domestic prices largely decoupled from world markets through high import tariffs and various payment schemes including acreage support and animal premiums. Contrary to most CAP-payments, subsidies in Norway are based on current commodity output, animal numbers or crop area for which production is required. There are also investment programmes, tax allowances and input subsidies (e.g., diesel). The OECD Producer Support Estimate distinguished 107 different subsidy schemes for Norway in 2021 (OECD 2023). Almost all farms are eligible for subsidies. Most subsidies are not linked to cross-compliance requirements, which is a major element of CAP-payments. The share of payments with an explicit environmental target is below 10 per cent. Payment rates are geographically differentiated with lower rates in regions with fertile soils and favourable natural conditions. In 2021, about 35 per cent of total budget support belonged to payments with regionally differentiated payment rates. Payment rates are also differentiated by farm structure with lower per unit rates for larger farms to counteract economies of scale. The share of farm size-dependent payments was about 25 per cent in 2021.

Norwegian agricultural policies also comprise supply control at market level. Target prices for cereals and milk guarantee a price floor at the producer level. Milk production is regulated by farm-specific milk quotas which are tradable at the county level only. As Norway consists of 18 counties, the quota regime is an important tool to prevent the geographical concentration of dairy farming.

Norwegian policy data are open source and can be freely downloaded from data.norge.no. Several datasets cover activity levels (i.e., agricultural area by crop and animal numbers at counting date), subsidies of various kinds, and production quantities (cereals, milk, meat by type of animal) sold to mills, dairies and slaughterhouses. The data are available for any farm that qualifies for subsidies. Farm are identified by their VAT number, and information about the farm owner's name, postal address, municipality, and cadastre information is stored together with the data on activity levels, subsidies, and production quantities. The database is frequently updated whenever new data becomes available. The datasets start with different years ranging from about 2005 to 2015. Data on subsidies and production quantities are annual data. The activity levels cover all crops and animals for which subsidies are paid, which is basically every production in agriculture. Since there are explicit payments for organic produce, information about organic crops and animals is available also.

5. Estimation approaches to downscale policy information from FADN

5.1. WHY IT IS NECESSARY TO DOWNSCALE

The majority of EU farm-level models utilize a sample of individual farms from the FADN database to bolster their ability to offer scientific support for conducting CAP impact analyses at the micro-level of individual farms (Offermann et al., 2005; Kellermann et al., 2008; OECD, 2010; De Cara and Jayet, 2011; Gocht and Britz, 2011; Gocht et al., 2013; Louhichi et al., 2015; Louhichi et al., 2018; Ciaian et al., 2020). Besides capturing economic impacts, those models also aim to contribute to assessing the environmental impacts of the CAP. Therefore, a set of agri-environmental indicators has been developed to enable the environmental assessment of policy measures. While for some agri-environmental indicators the location is not an issue (e.g., energy use), for some others, accurate information on bio-physical endowments of the farm is necessary (e.g., soil erosion, landscape diversity, or biodiversity or GHG emissions). A strong dependence on environmental conditions such as soil type exists for some indicators, such as N2O emissions from cultivated soils. However, robust databases to develop emission factors by soil types are not yet available. Process-based models introduce further data demand and uncertainties, so that generally simple methods are preferred (Leip et al., 2011a, b).

A general limitation for agricultural models is the non-availability of spatially explicit farm data, particularly for models that simulate spatially dependent ecological-economic relationships or try to capture the decision-making of actors in a spatial context (Uthes and Kiesel, 2020). Although in the monitoring activities of the EU member states, spatially explicit farm data are collected, they are not publicly available due to confidentiality regulations (Schmit et al., 2006). In order to construct an extensive spatial database encompassing agricultural and forest policies and payments, it is necessary to safeguard confidentiality but also delivers a comprehensive spatial database tailored to our specific requirements. No sensitive farm level data will be made public.

5.2. APPROACHES FOR DOWNSCALING

Authors have developed different techniques for downscaling economic model results to lower spatial scales for larger regions, such as the entire EU and smaller regions, such as specific NUTS 3 regions. Kempen et al. (2011) developed a method to link the farms in the FADN sample to their environmental endowment (e.g., climate, soil attributes) at the EU-wide scale using a constraint optimization approach (CO). The locations of farms from the FADN are estimated using small-scale spatial units with homogenous conditions for farming. The resulting spatial allocation of FADN holdings including spatially dependent environmental indicators, extends the analytical capabilities to agri-environmental evaluation and improves the aggregation of the results to more representative environmental zones (e.g. Nitrate Vulnerable Zones, Areas with Natural Constraints). The estimation results for the whole EU were compared with data from FSS to validate the modified allocation procedure. Results showed that the suitability of prior information depends on the characteristics of the farm as the prior information on land use shares improves the allocation results for arable and dairy

systems, which have a strong land dependence and land use share. However, were quite weak for farming systems with low or no link to land-use (e.g. pigs, poultry) or farm types with low UAA per farm (horticulture, permanent crops).

Other EU focused approaches exist, such as Cantelaube et al. (2012) using geographical downscaling to map outputs provided by an economic optimization model AROPAj (Galko and Layet, 2011; Jayet 2020) by estimating FADN farm-group probabilities within EU-15 regions. In contrast to Kempen et al. (2011) focusing on agricultural activities mapping from homogeneous soil mapping units (HSMU) influenced by economic agents, the approach of Cantelaube et al. (2012) focuses on the mapping of economic agents representative of agricultural activities observed at a certain period. However, the approach of Cantelaube et al. (2012) in comparison to Kempen et al. (2011) does not provide information about the quality of results for "land-independent" farm types with low UAA per farm and the approach has not been evaluated with regard to the actual distribution of farm types using the FSS database.

In the literature, many case-specific studies not aiming at developing general spatial allocation methods for farms in the EU exist. Temme and Verburg (2011) proposed a disaggregation approach for assessing changes in agricultural land use intensity for changes in the CAP between 2000 and 2025. In this study, the LUCAS data on nitrogen inputs are related from outputs of the CAPRI model as a first step. Afterwards, nitrogen inputs are spatially disaggregated using 49 environmental co-variates at 1 km × 1 km. In a study by Guiomar et al. (2018), a map of Europe has been developed showing regions where small farms have different degrees of importance in relation to the regional context of agriculture and the territorial characteristics on a NUTS-3 level. In contrast to previous studies estimating the distribution of different farm types in Europe (e.g. Kempen et al., 2011; Andersen, 2017), this study aims at better considering the particular context of each region for small farms in the EU. In a recent study by Uthes and Kiesel (2020), the authors aim to improve the synthetic landscape approach in terms of resolution (25m x 25m) by considering landscape parameters in the allocation of farms as well as allocation quality indicators that allow for an assessment of the overall allocation result. The overall allocation quality was relatively high for the considered German case study region Ostprignitz-Ruppin (NUT3 level). The authors conclude that this approach is well suited for smaller regions with sufficient data quality and suitable to link farm data and spatial data to generate a more realistic synthetic landscape of farm locations for use by agro-economic models, such as mathematical optimization models and/or agent-based models, compared to other studies that used simpler spatial allocation procedures. However, the computational time of this approach is high and it has not been tested yet in other regions.

5.3. LAMASUS APPROACH TO DOWNSCALING

We aim at improving the allocation fit for different farm types and the calculation of spatially dependent environmental indicators for the entire EU. This enables us to better depict European farmers' responses to CAP instruments and market signals and to better assess environmental effects of policy measures in the EU. We extend the constraint optimization approach of Kempen et al. 2011 by using EU-wide spatial data received from Eurostat on the type of farming containing information about the share of UAA (utilised agricultural area) per farm type on a 10km² grid level as prior information. In addition, we use Homogeneous Spatial Units (HSU) (Leip et al. 2016) as the initial unit to define farm mapping units (FMU). To further improve the approach, we allocate the statistical representation factor attached to each FADN

farm to the spatial units instead of allocating a particular FADN farm exclusively to one spatial unit.

In former projects we conducted the analysis for the EU in 2012 and compared the allocation results with the representative Farm Structure Survey data (FSS data). The knowledge of the spatial location and hence the bio- physical conditions of farms allowed us for the first time to identify at the EU level environmentally sensitive areas at high resolution, which were invisible so far, given the assumption of homogenous soil, climate and altitude conditions at NUTS2 or NUTS3. The spatial location and the link to the HSU served not only for improving the environmental indicators for the EU wide single farm models such as IFM-CAP (Louhichi et al., 2015), but also for FADN based statistical analysis and other impact assessment tools based on FADN.

5.3.1. The allocation approach

We developed a model that can be applied to each FADN region and year independently. The FADN farms are mapped to spatial units with a homogenous production mix (crop rotation, grassland shares) and a homogenous yield level (tonnes per hectare). The farm production mix and yields in FADN farms should match with the highest possible consistency with the spatial unit using an optimisation approach by maximising the probability. In other words, a dairy farm recorded in FADN with grass and fodder maize should be allocated to the spatial unit with the same production mix and, of course, dairy cows.

The approach is a two-step procedure: first, we measure the statistical fit using the approach in Kempen et al. (2011) between similar variables (e.g. yields for wheat ($py_{f,su}$), share of wheat ($ps_{f,su}$)) in FADN and the land mapping unit (equation 1). Although we cannot base prior expectations on an empirical model since the exact location of farms is not published, the farm records include some information limiting the number of HSU where the farm might be allocated. For example, from the FADN statistics, it can be exactly derived which farms are located in a certain altitude zone and in a LFA area. This information is taken as fixed and given, i.e. if the FADN farm and the HSU do not belong to the same qualification regarding LFA and altitude zone, we do not allow allocation of the farm in that HSU. The prior probabilities in the objective function ($py^0_{f,su}$, $ps^0_{f,su}$ in Equation 1) can be calculated from the perspective of the farms (to which FMU should a particular farm be allocated) or from the FMU perspective (which farms should be in a particular FMU). Both views were tested.

The second step ensures consistency by maximising the similarity over all farms and the spatial units. For this purpose, a Bayesian highest posterior density concept (Heckelei et al., 2008) is applied allowing to measure “similarity” with respect to several criteria simultaneously satisfying regional consistency constraints. The final result of our allocation procedure is a matrix $p_{f,su}$ indicating the percentage probability of a farm f located in the spatial unit. As a single farm in the FADN represents many similar farms, this percentage can also be understood as the share of these farms being allocated to a specific spatial unit. An obvious constraint in the allocation procedure is that the share for each weighting over all spatial units must add up to 1 indicated in Equation (3).

Another obvious constraint refers to the utilised agricultural area (UAA). The UAA of a spatial unit should be filled exactly with the UAA represented by the farms assigned to it. This is achieved using the Equation (2), where $\boldsymbol{UAA}_0^{f(FADN)}$ is the utilised agricultural area operated by a FADN farm, weighted with the representativity weight ($Weight^{(FADN)}f$) taken from the FADN

record, and UAA (spatial unit) the agricultural area in a spatial unit. The use of the representation factor for the allocation procedure means that we assume that all farms represented by the recorded sample farm have the same production mix, yield levels, LFA and altitude information. As FADN data do not fully represent the agricultural area in a region, consistency with the area derived from other sources cannot be expected. The adjustment factor $a^0_{spatial\ unit}$ (a^0_{su}) is a given and fixed correction factor between the land use statistics in FADN and the spatial unit.

Using the logarithm of this, we obtain the final objective function of our problem in the form of a loss function that minimises the sum of the standardised proportional deviations between our prior expectation (py^0 and ps^0) and the estimates (p):

$$(1) \qquad \min \begin{bmatrix} vec\left(w_y(p_{f,su} - py^0_{f,su}), w_s(p_{f,su} - ps^0_{f,su})\right)' \\ \times \sum^{-1}_{total} vec\left(w_y(p_{f,su} - py^0_{f,su}), w_s(p_{f,su} - ps^0_{f,su})\right) \end{bmatrix}$$

The objective function consists of the true parameters ($p_{f,su}$), where p is the probability of a farm *f* (with f=1 .. N, N being the number of FADN farms) to be allocated to the spatial unit (su), in this study the Farm Mapping Unit (FMU). The prior information enters the objective function in the form of the derived prior probability ($py^0_{f,su}$, $ps^0_{f,su}$). The standard deviation defines the diagonal elements of the covariance matrix **Σ**. The weighting factors w_y and w_s must be set a priori. In our validation, various settings have been tested and compared to find out which setting might produce the best overall results. After the p vector by FMU is estimated, the values are mapped back to the HSU vector.

The objective function is subject to the following data constraint.

$$(2) \qquad UAA^o_{su} = a^o_{su} \sum^c_f p_{f,su} UAA^{o(FADN)}_f Weight^{(FADN)}{}_f,$$

where c are the crops.

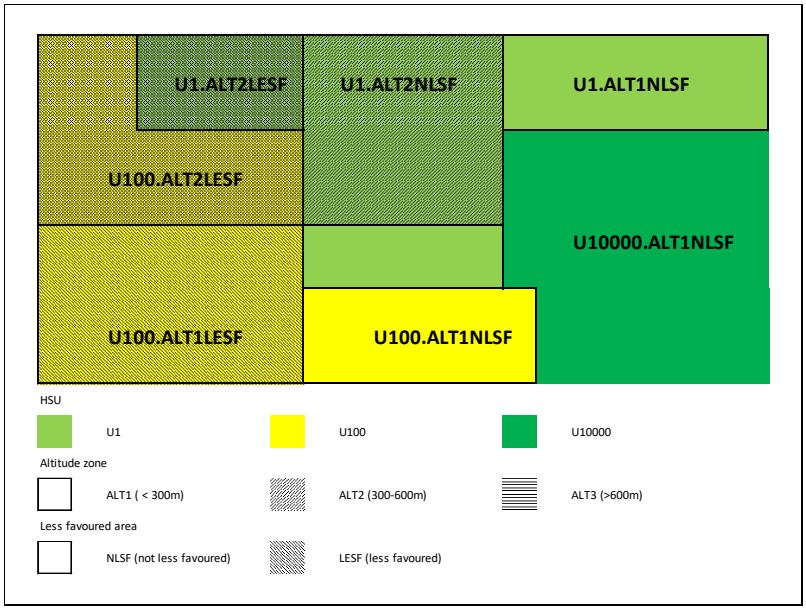
Another constraint in the allocation procedure is the condition that the probability of a farm f sum up to unity over the spatial unit.

$$(3) \qquad \sum_{su} p_{f,su} = 1$$

5.3.2. Construction of FMU based on HSU

The new farm mapping units (FMU) are a subdivision of HSU by altitude and less favoured area class. The FMUs are not created as spatial explicit units, but the data on 1km USCIE grid cells is used to calculate the share of the HSU that belongs to a certain combination of altitude zone and less favoured area class (Figure 1).

Figure 1: Construction of Farm Mapping Units



Source: Own compilation.

These combinations will be referred to as ALTZLESF, which defines six types (Table 4).

Table 4: Definition of ALTZLESF

Code	Description
ALT1LESF	altitude < 300 m and less favoured zone
ALT2LESF	altitude 300-600m and less favoured zone
ALT3LESF	> 600 m and less favoured zone
ALT1NLSF	altitude < 300 m and not less favoured zone
ALT2NLSF	altitude 300-600m and not less favoured zone
ALT3NLSF	altitude > 600 m and not less favoured zone

Source: Own compilation.

It is calculated how many 1km USCIE grids belong to the HSU (total) and how many belong to a specific altitude zone and less favoured area combination. Then, the share of each ALTZLESF class is calculated. The UAA and yield of FMUs are calculated by assuming that the UAA assigned to the HSU is evenly distributed over the ALTZLESF classes and that the yield is identical in all ALTZLESF classes.

Table 5: Calculation of UAA in FMU

FMU or HSU	Km²	% of total	UAA (1000 ha)	Yield (kg)
U100.ALT2LESF	33	35	133,4	6750
U100.ALT1LESF	40	43	161,7	6750

FMU or HSU	Km²	% of total	UAA (1000 ha)	Yield (kg)
U100.ALT1NLSF	21	22	84,9	6750
U100 (Total)	94			
U100 (from capdis)			380	6750

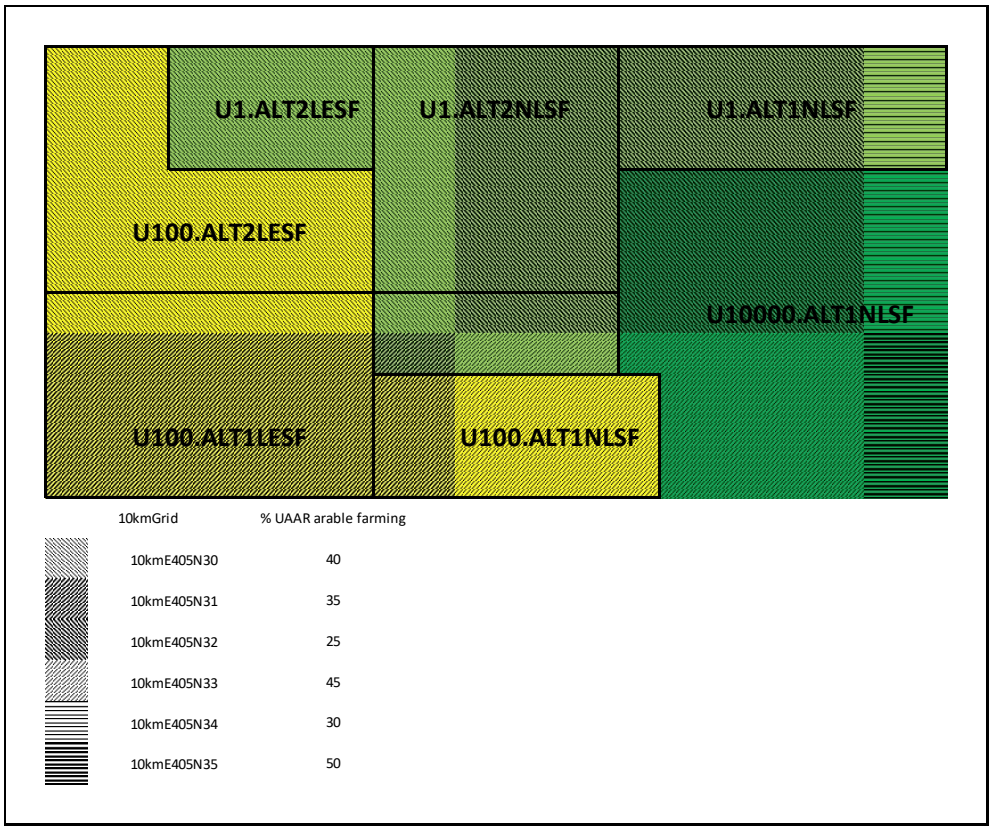
Source: Own compilation.

5.3.3. Prior information on type of farming

To further improve the allocation mechanism particularly for those farm types with lower land dependency (see Kempen et al. 2011), we used data received from Eurostat containing information about the share of UAA (utilised agricultural area) per farm type on a 10km² grid level. Due to confidentiality manipulation of the Eurostat data an adjustment procedure is implemented to minimise the error accounting for the truncation of the UAA of Eurostat.

Therefore, the officially available Eurostat data at the NUTS2 level containing information about UAA by farm types was used. We compared the high-resolution data and the official NUTS2 data from Eurostat and implemented the mentioned adjustment procedure. The share of a HSU overlapping with a certain 10km grid cell is taken from CAPRI/CAPDIS. The principle is illustrated in Figure 2.

Figure 2: Combing 10km grid and FMU data



Source: Own compilation.

The calculation of UAA that can be assigned to a certain farm type is visualised in Table 6. The share of area covered by a farm type in a FMU is calculated as the weighted mean of area shares reported in the 10 km grid data. The UAA covered by a certain farm type is then calculated by multiplying the average share of the farm type with the total UAA assigned to the FMU.

Table 6: Calculation of UAA per farm type

FMU	10kmGrid	Km²	% of FMU	% UAA arable farming	Average % UAA arable	Area UAA (1000 ha)	Area arable farming (1000 ha)
U100.ALT1LESF	10kmE405N30	8	20	40	36	161,7	58,2
U100.ALT1LESF	10kmE405N31	32	80	35			
Total		40			36	161,7	58,2

Source: Own compilation.

5.4. RESULTS FROM FORMER PROJECTS AND DISCUSSION

To illustrate how the methods in the previous subsection would be applied, we present a similar exercise which was carried out in the previous Horizon Europe project MIND STEP [iv], albeit in a much more limited fashion. Nonetheless, this serves to illustrate the key principles behind the methodology. To present allocation results at the European scale, the individual farm data from FADN (data source: EU-FADN – AGRI) have been aggregated to farm types according to their specialization based on the official EU classification (Table 7).

Table 7: Definition of farm types based on EU classification

EU classification			Classification used
1-Digit code	2-Digit code	Label	
1	13	Specialist cereals, oilseed and protein crops	Arable farming
	14	General field cropping	
2	20	Specialist horticulture	Horticulture
3	31	Specialist vineyards	Permanent crops
	32	Specialist fruit and citrus fruit	
	33	Specialist olives	
	34	Various permanent crops combined	

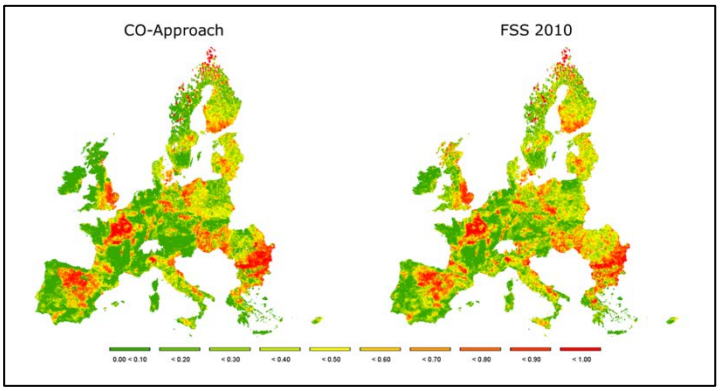
[iv] Grant Agreement No. 817566

EU classification			Classification used
4	41	Specialist dairying	Grazing livestock
	42	Specialist cattle-rearing and fattening	
	43	Cattle-dairying, rearing and fattening combined	
	44	Sheep, goats and other grazing livestock	
5	50	Specialist granivores	Granivores
6	60	Mixed cropping	Mixed cropping
7	71	Mixed livestock, mainly grazing livestock	Mixed livestock
	72	Mixed livestock, mainly granivores	
8	81	Field crops-grazing livestock combined	Mixed crops and livestock
	82	Various crops and livestock combined	

Source: Own compilation.

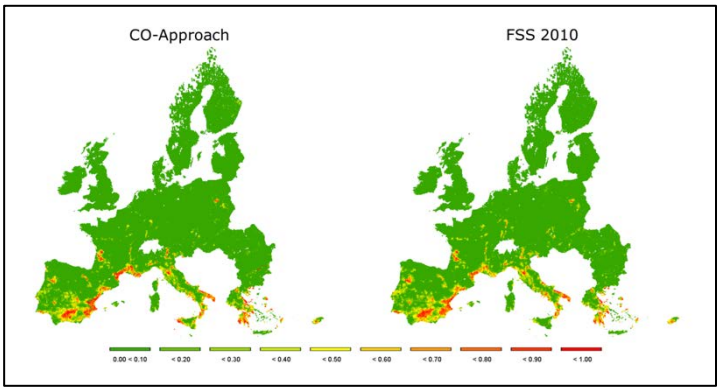
The results are compared with the FSS data to validate the used allocation procedure. The results in Figures 4-10 show the percentage of UAA covered by each of the farm types in the corresponding HSUs. The results of the extended constraint programming model show that for the farm types without livestock (Arable farming, Horticulture, Permanent Crops, Mixed Cropping), the spatial distribution is very similar to the FSS data. However, results for arable farms are underestimated in Austria and Scotland.

Figure 3: Arable farming



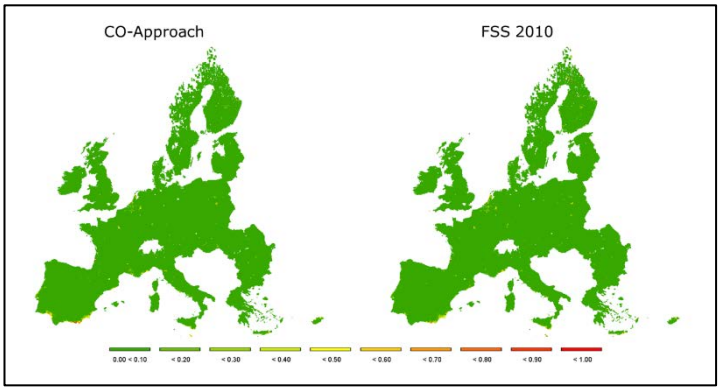
Source: Own compilation.

Figure 4: Permanent crops



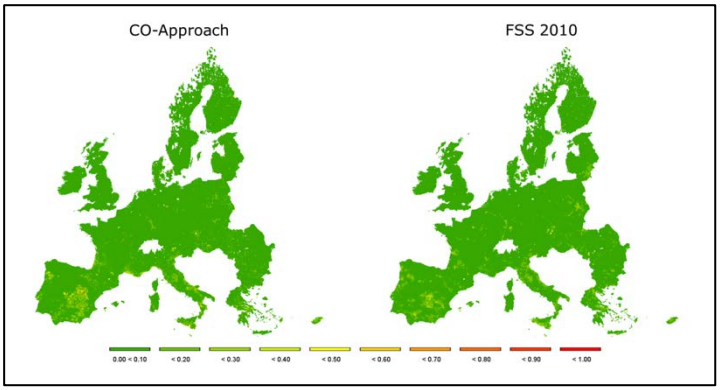
Source: Own compilation.

Figure 5: Horticulture



Source: Own compilation.

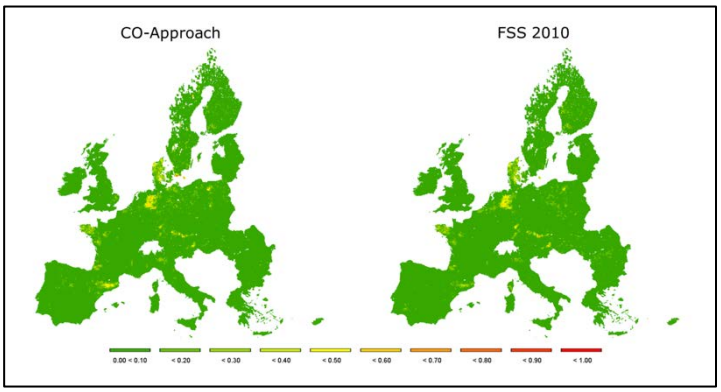
Figure 6: Mixed cropping



Source: Own compilation.

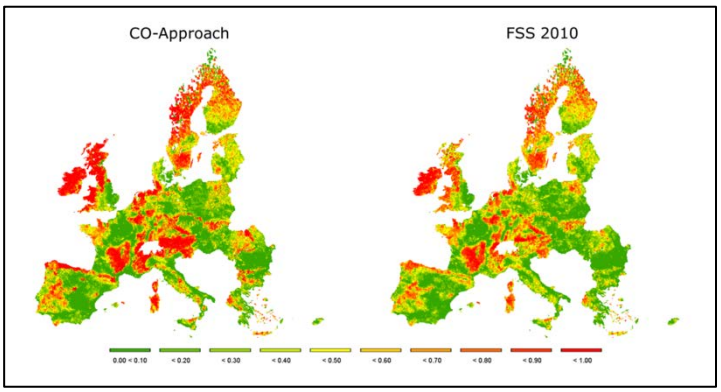
It can be seen that particularly for the farm types with low land-dependency and hence with low UAA per farm (e.g. granivores, grazing livestock) for which the allocation procedure in Kempen et al. 2011 provided weak results the usage of prior information about the share of UAA per farm type on a 10km² grid level resulted in a very similar distribution as in FSS. Particularly for granivore farms using grid data as priors can improve the results of environmental analysis in the EU as they account for a significant share of emissions from animal production.

Figure 7: Granivores



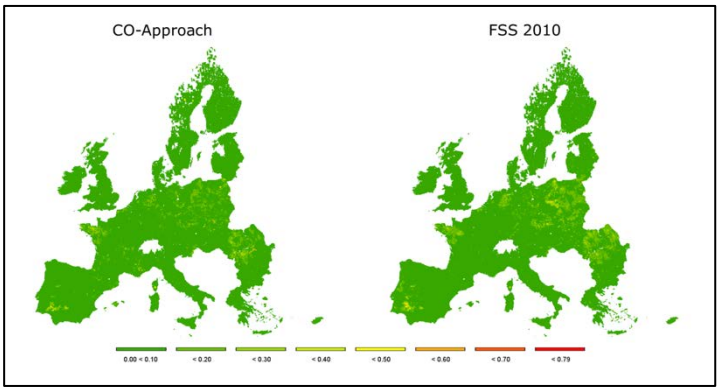
Source: Own compilation.

Figure 8: Grazing livestock



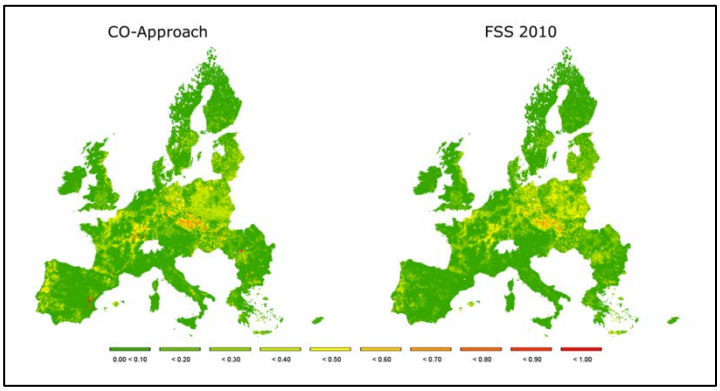
Source: Own compilation.

Figure 9: Mixed livestock



Source: Own compilation.

Figure 10: Mixed crops and livestock



Source: Own compilation.

However, for the farm type grazing livestock the share of UAA is higher than in FSS in some regions (e.g. Northern UK, Austria). These differences may stem from the inconsistency of the data (most likely cut off and rounding criteria for confidentiality reasons in the FSS database and limited FADN sample compared to the FSS comprehensive survey) and to the low frequency of other farm types in these regions. It has to be kept in mind that the FADN sample does not include non-commercial farms and does not sufficiently represent small and part-time farms. This likely implies that farms in the more marginal farming areas are not well represented.

Our findings hold important implications for more efficient and target-oriented agricultural and environmental policy measures in the EU as it extends the analytical capabilities to agri-environmental evaluation and improve the aggregation of the results to more representative environmental zones (e.g., Nitrate Vulnerable Zones, Areas with Natural Constraints). For example, the estimates of our CO approach can be used in the IFM-CAP model (Louhichi et al., 2015) for the precise calculation of various environmental indicators (e.g., soil loss). If we simulate a policy in IFM-CAP which affects a certain activity (e.g., fodder maize and grassland) only for farms which have certain related attributes like the farm specialisation (e.g., grazing livestock), the change, using the estimates of CO- approach, is applied only to spatial units where those farms are most probably located. If the indicator formula depends on the spatial unit, which is the case for the soil loss, then the use of the CO approach compared to the CAPRI downscaling reduces the aggregation error and results in a better spatial representation of the policy effect and hence, in a better indicator calculation.

6. Technical concept to provide and develop the data access in the project

Here, we first present an official and technical summary of the capabilities of GitLab as a tool to provide data access and code sharing in the LAMASUS project. We continue with some experiences we made in other projects that foster the use of GitLab for good collaboration within LAMASUS and the possibilities to share code, data and insights with the public. For further details on the management of the database and technical details, see Deliverable 10.2.

6.1. GITLAB: EMPOWERING TEAM COLLABORATION AND PROJECT MANAGEMENT

GitLab, a comprehensive DevOps platform, stands out as an indispensable tool for teams looking to streamline collaboration and effectively manage projects. From robust version control to efficient issue tracking, GitLab offers an array of features that significantly enhance productivity and streamline the development workflow. Moreover, GitLab allows for seamless project synchronization between different instances, enabling teams to collaborate effectively across platforms.

Streamlined Version Control: GitLab employs Git, a powerful version control system, allowing teams to manage code changes efficiently. This feature enables developers to work simultaneously on different branches, ensuring code integrity and simplifying the process of merging contributions.

Effective Collaboration: GitLab facilitates efficient collaboration among team members by providing real-time code collaboration features. Developers can seamlessly collaborate, share their expertise, and conduct code reviews. This collaborative environment not only leads to improved code quality but also accelerates project progress.

Issue Tracking and Project Management: GitLab's integrated issue tracking system is a game-changer for project management. Teams can document tasks, track issues, and set project milestones. It enables team members to discuss issues, prioritize work, and assign tasks, ensuring alignment with the project's objectives.

Code Reviews: GitLab offers robust tools for code reviews. Team members can propose changes, discuss modifications, and suggest improvements using merge requests. This process promotes knowledge sharing, identifies potential issues early, and maintains high code quality.

Continuous Integration and Automation: GitLab offers seamless integration with a variety of CI and CD tools, allowing for streamlined development through the automation of testing, building, and deployment processes. This is all part of GitLab’s focus on Continuous Integration and Automation. Consequently, code changes are thoroughly tested and deployed rapidly, reducing the likelihood of bugs and enhancing project stability.

Flexible Branching Strategies: GitLab's branching and merging capabilities support flexible development workflows. By working on new features or fixing bugs in isolated branches, teams can prevent any disruptions to the main codebase. This approach helps to maintain an organized codebase that is easier to manage and maintain.

Documentation and Knowledge Sharing: GitLab provides robust features for hosting project documentation. Well-maintained documentation is crucial for onboarding new team members and ensuring that everyone has access to project-related information. It serves as a knowledge repository that facilitates learning and reference.

Project Synchronization Across GitLab Instances: One of GitLab’s most notable features is its capacity to sync projects across multiple GitLab instances. This allows for smoother cross-platform collaboration, even when teams are using different GitLab servers.

Collaboration Between Different Teams: GitLab promotes efficient collaboration between different teams working on related projects. It offers a centralized platform where teams can

coordinate efforts, share resources, and ensure consistency across projects, enhancing overall project cohesion and success.

To sum up, GitLab is an incredibly potent platform that enables teams to work together seamlessly and handle projects with ease. Its extensive range of features, combined with the capacity to coordinate projects between different GitLab instances, makes it an essential tool for teams across all industries and of all sizes. By adopting GitLab, companies can boost productivity, improve code quality, and achieve better project results, promoting a culture of fruitful collaboration and creativity.

7. Conclusion and next steps

This deliverable provides an overview of existing national and sub-national frameworks and publications for funding measures. The results of the questionnaire show the that many partners need that data.

The next steps are broadly two things, first to assemble the comprehensive spatial agriculture and forest policy and payments database and second, this aggregated data will become available in the LAMASUS portal as the results od deliverable D3.2.

More specifically, the next task “Developing the agricultural and forestry policies and payments database” involves the following steps:

- Use the list of databases and policy variables identified in Task 2.1 in the area of agriculture and forestry and compile a time series of data
- Use a downscaling approach as described in Chapter 5 to produce payments from FADN farms to indicators available at NUTS-2/3 level
- Assemble a time series of data at high regional resolution of Natura 2000 and LFA regions and other forestry policies, like EU RDPs and national programs.
- Complement information with data on projects supported by European Structural and Cohesion Funds: This is related to agriculture, forestry, or other land-use or landscape-related purposes. This data will cover the programming periods 2014-2020 and 2007-2013.
- Downscale Data to Different Resolutions Using Appropriate Estimation Techniques: To achieve consistency across scales and comparability.

This next task is led by WIFO with participation from IIASA, RURALIS, Thünen, BOKU, VUA, ZHAW and is expected to be completed between until M24.

At the time of writing, we are waiting for the FADN data application to be successfully approved and the data to be delivered.

8. References

Andersen, E. (2017). The farming system component of European agricultural landscapes. European Journal of Agronomy, 82, 282-291.

Bachtrögler, J., Hammer, C., Schwendinger, F., & Reuter, W. H. (2018). Guide to the galaxy of EU regional funds recipients: evidence from new data. Empirica. https://doi.org/10.1007/s10663-018-9427-5.

Cantelaube, P., Jayet, P.A., Carré, F., Bamps, C., Zakharov, P. (2012). Geographical downscaling of outputs provided by an economic farm model calibrated at the regional level. Land Use Policy, 29, 35–44.

Ciaian, P., Espinosa, M., Louhichi, K., Perni, A., Publique, I. U. E., & Thiverval-Grignon, F. (2020). Farm Level Impacts of Trade Liberalisation and CAP Removal Across EU: An Assessment using the IFM-CAP Model. The German Journal of Agricultural Economics, 69(2), 108–126

De Cara, S. and Jayet, P.A. (2011). Marginal abatement costs of greenhouse gas emissions from European agriculture, cost effectiveness, and the EU non -ETS burden sharing agreement. Ecological Economics, 70, 1680–1690.

Galko, E., & Jayet, P. A. (2011). Economic and environmental effects of decoupled agricultural support in the EU. Agricultural Economics, 42(5), 605-618.

Gocht, A. and Britz, W. (2011). EU-wide farm type supply models in CAPRI – how to consistently disaggregate sector models into farm type models. Journal of Policy Modeling, 33, 146–167.

Gocht, A., Britz, W., Ciaian, P. and Gomez y Paloma, S. (2013). Farm type effects of an EU-wide direct payment harmonisation. Journal of Agricultural Economics, 64, 1–32.

Guiomar, N., Godinho, S., Pinto-Correia, T., Almeida, M., Bartolini, F., Bezak, P., ... & Wästfelt, A. (2018). Typology and distribution of small farms in Europe: Towards a better picture. Land use policy, 75, 784-798.

Heckelei, T., Mittelhammer R., Jansson T. (2008). A Bayesian Alternative to Generalized Cross Entropy Solutions for Underdetermined Econometric Models. Agricultural and Resource Economics, Discussion Paper, Institute for Food and Resource Economics, Bonn. https://ideas.repec.org/p/ags/ubfred/56973.html#download

Jayet, P.-A., Petsakos, A., Chakir, R., Lungarska, A., De Cara, S., Petel, E., Humblot, P., Godard, C., Leclère, D., Cantelaube, P., Bourgeois, C., Clodic, M., Bamière, L., Ben Fradj, N., Aghajanzadeh-Darzi, P., Dumollard, G., Isbăşoiu, A., Adrian, J., Pilchak, G., Bounaffaa, M., Barberis, D., Assaiante, C., Ollier, M., Henry, L., Florio, A., Chidami, I., Gossiaux, E. (2020). The European agro-economic AROPAj model. INRA, UMR Economie Publique, Thiverval-Grignon. https://www6.versailles-grignon.inra.fr/economie_publique_eng/Research-work.

Kellermann, K., Happe, K., Sahrbacher, C., Balmann, A., Brady, M., Schnicke, H. and Osuch, A. (2008). AgriPoliS 2.1 – Model Documentation. Technical Report, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Halle.

Kempen M., Elbersen, B. S., Staritsky, I., Andersen, E., and Heckelei, T. (2011). Spatial allocation of farming systems and farming indicators in Europe. Agriculture, Ecosystems & Environment, 142 (1-2), 51-62.

Leip, A., Busto, M., Corazza, M., Bergamaschi, P., Koeble, R., Dechow, R., Monni, S., de Vries, W. (2011a). Estimation of N2O fluxes at the regional scale: data, models, challenges. Curr. Opin. Environ. Sustain. 3, 328–338. https://doi.org/10.1016/j.cosust.2011.07.002

Leip, A., Busto, M., Winiwarter, W. (2011b). Developing spatially stratified N2O emission factors for Europe. Environ. Pollut. 159, 3223–3232. https://doi.org/10.1016/j.envpol.2010.11.024

Leip, Adrian; Koeble, Renate; Reuter, Hannes; Lamboni, Matieyendou (2016): Homogeneous Spatial Units (HSU) - a Pan-European geographical basis for environmental and socio-economic modelling. PANGAEA, https://doi.org/10.1594/PANGAEA.860284, Supplement to: Leip, A et al. (in prep.): Homogeneous Spatial Units (HSU) - a Pan-European geographical basis for environmental and socio-economic modelling. Scientific Data

Louhichi, K.; Ciaian, P.; Espinosa, M.; Colen, L.; Perni, A. and Gomez y Paloma, S. (2015). An EU-wide individual farm model for Common Agricultural Policy Analysis (IFM-CAP): first application to crop diversification policy. JRC Science and Policy Reports EUR 20910 EN, European Commission. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC92574/jrcreport_jrc92574.pdf

Louhichi, K., Ciaian, P., Espinosa, M., Perni, A., & Gomez y Paloma, S. (2018). Economic impacts of CAP greening: application of an EU-wide individual farm model for CAP analysis (IFM-CAP). European Review of Agricultural Economics, 45(2), 205-238.

OECD (Organisation for Economic Co-operation and Development) (2010). Linkages between Agricultural Policies and Environmental Effects: Using the OECD Stylised Agri-environmental Policy Impact Model. OECD Publishing .Available online: http://dx.doi.org/10.1787/9789264095700-en.

OECD (Organisation for Economic Co-operation and Development) (2023). Agricultural policy monitoring and evaluation. Available online: https://www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/.

Offermann, F., Kleinhanss, W., Huettel, S. and Kuepker, B. (2005). Assessing the 2003 CAP reform impacts on German agriculture, using the farm group model FARMIS. In: Arfini, F. (ed.), Modelling Agriculture Policies: State of the Art and New Challenges, proceedings of the 89th European Seminar of the European Association of Agricultural Economists (EAAE), Parma, Italy, February 3-5, 2005. Parma: Monte Universita Parma Editore, 546–564.

Schmit, C., Rounsevell, M.D.A., La Jeunesse, I. (2006). The limitations of spatial land use data in environmental analysis. Environmental Science & Policy, 9, 174–188.

Temme, A. J. A. M., & Verburg, P. H. (2011). Mapping and modelling of changes in agricultural intensity in Europe. Agriculture, Ecosystems & Environment, 140(1-2), 46-56.

Uthes, S., Kiesel, J. (2020). Creating a synthetic landscape: Spatial allocation of non-spatial single farm data. Agricultural Systems, 177, 102740.

9. Annexes

Table 8: Structure of European Regional Development Fund (ERDF)

Period	Budget (EU + NATIONAL)	Priorities	Co-financing rates
2021-2027 [v]	€312.8 billion	• Innovation and support to SMEs, digitization and digital connectivity • Greener, low-carbon and resilient economy • Enhancing mobility • Effective and inclusive employment, education, skills, social inclusion and equal access to healthcare, culture and sustainable tourism • Supporting locally-led development and sustainable urban development	Less developed regions: 80 or 85% (see Article 112(3) of Regulation 2021/1060 for further details) Transition regions: 60% or 70% More developed regions: 40% or 50%
2014-2020 [vi]	€308.7 billion	• Innovation and research • The digital agenda • Support for small and medium-sized enterprises (SMEs) • The low-carbon economy	85 % for the less developed regions of Member 80 % for the regions of Member States whose GDP per capita used as an eligibility criterion for the 2007- 2013 programming period was less than 75 % of the average of the EU-25 60 % for the transition regions 50 % for the more developed regions

[v] Legal basis: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1058. [accessed 08/09/2023]

[vi] Legal basis: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32013R1301 [accessed 08/09/2023]

Period	Budget (EU + NATIONAL)	Priorities	Co-financing rates
2007-2013 [vii]	€200.0 billion	• Convergence • Regional competitiveness and employment • European territorial cooperation	Less developed regions: 85 % for the Convergence and Regional competitiveness and employment objectives Spain: 80 % for the Convergence and phasing-in regions under the regional competitiveness and employment objective; 50 % for the Regional competitiveness and employment objective outside phasing-in regions Other member states: 75 % for the Convergence objective; 50 % for the Regional competitiveness and employment objective

Source: Own compilation.

[vii] Legal basis: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006R1080 [accessed 08/09/2023]

Table 9: European Social Fund (ESF)

Period	Budget	Priorities	Co-financing rates
2021-2027 [viii]	**€142.1 billion**	Over 13 specific objectives, as listed in article 4, Regulation	Less developed regions: 80 or 85% (see Article 112(3) of Regulation 2021/1060 for further details) Transition regions: 60% or 70% More developed regions: 40% or 50%
2014-2020 [ix]	**€140.9 billion**	Promote sustainable and quality employment and support labour mobility Promote social inclusion, combating poverty and discrimination Invest in education, training and vocational training for skills and life-long learning Enhance institutional capacity of public authorities and stakeholders and efficient public administration	85 % for the less developed regions of Member 80 % for the regions of Member States whose GDP per capita used as an eligibility criterion for the 2007- 2013 programming period was less than 75 % of the average of the EU-25 60 % for the transition regions 50 % for the more developed regions
2007-2013 [x]	**€ 76.6 billion**	As listed in article 3, Regulation (EC) No 1081/2006	Less developed regions: 85 % for the Convergence and Regional competitiveness and employment objectives Spain: 80 % for the Convergence and phasing-in regions under the Regional competitiveness and employment objective; 50 % for the Regional competitiveness and employment objective outside phasing-in regions Other member states: 75 % for the Convergence objective; 50 % for the Regional competitiveness and employment objective

Source: Own compilation.

[viii] Legal basis: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1057&from=EN [accessed 08/09/2023]
[ix] Legal basis: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1304 [accessed 08/09/2023]
[x] Legal basis: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006R1081 [accessed 08/09/2023]

Table 10: Cohesion Fund (CF)

Period	Budget	Priorities	Co-financing rates
2021-2027 [xi]	**€49.2 billion**	• Environment Trans-European Transport Networks (TEN-T)	Less developed regions: 80 or 85% (see Article 112(3) of Regulation 2021/1060 for further details) Transition regions: 60% or 70% More developed regions: 40% or 50%
2014-2020 [xii]	**€72.6 billion**	• Environment Trans-European Transport Networks (TEN-T)	85% for the less developed regions 80% for the regions of Member States whose GDP per capita used as an eligibility criterion for the 2007- 2013 programming period was less than 75 % of the average of the EU-25 60% for the transition regions 50% for the more developed regions
2007-2013 [xiii]	**€69.9 billion**	• Environment Trans-European Transport Networks (TEN-T)	85% for less developed regions; member states eligible for the transitional regime of the Cohesion Fund on 1 January 2007

Source: Own compilation.

[xi] Legal basis: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1058 [accessed 08/09/2023]

[xii] Legal basis: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32013R1300 [accessed 08/09/2023]

[xiii] Legal basis: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32006R1084 [accessed 08/09/2023]

Figure 11: Overall structure of the survey excel file

The **structure of this Excel** is as follows:

1. Overview database: This tab will give you an overview of the variables which will be available in the final dataset. This includes data from
    1. FADN
    2. CATS
    3. Regional Funds (cohesion)

    We've filled in some summary statistics to grasp the size/importance of each variable.

    Most important summary statistics are: Average and maximum values for NUTS 3 and NUTS 2 regions and share of non-zero observations.
2. Cohesion variables: This tab concerns data from regional funds. Please read below.

While the original data sets are on farm/project level, the final data set with land-use relevant payments will be aggregated to the regional level.
The exemplary table below illustrates how the final data from regional funds will be structured. Please note that it only contains fictious values.

NUTS3	Year	Brownfield conversion	Construction: buildings	Construction: energy	Construction: transport	Environment, incl. N2K	Natural risk prevention and management
AT130	2014	15	70	60	79	20	4
AT130	2015	12	80	70	89	10	5
AT130	2016	14	86	58	57	15	6
AT130	2017	10	87	45	80	50	2
AT130	2018	12	67	45	69	32	6
AT130	2019	13	89	69	69	60	4
AT130	2020	13	78	56	100	50	3

Fictitious values, expressed in million EUR.

Regarding the **FADN data**, please note the following points:

1. Information regarding summary statistics is derived from the MIND STEP project FADN data. There we had data from 2007 to 2018 for EU-28 (only NL from 2004 onwards).

Regarding the **CATS data**, please note the following points:

1. Information regarding summary statistics is derived from CAPRI data base for EU-28 at NUTS2, 2006-2013.
2. In the data, there are negative entries! Therefore, mean values are downward biased. Negative entries result through repayments.

Regarding **cohesion data**, please note the following points:

1. Data on cohesion policy for the two funding periods stems from different sources. For the funding period 2007-2013 data availability is rather low.
2. Harmonization of data across the two funding periods is a challenge, as data availability and the legal framework differ considerably. We will make our best effort to propose a way to make values somewhat comparable; however, we would like to note now that these values will have to be taken with a pinch of salt. This especially concerns
    1. Monetary amounts
    2. Categories
    3. Project date
3. On categorization:
    1. We only chose projects which can be associated to land-use relevant categories.
    2. As data sources differ, so do categories across funding periods in the table. Especially the reporting of categories for the period 2007-2013 is not standardized and thus also differs within funding period.
    3. Categorization of projects is preliminary, and will be improved using text mining algorithms.
    4. For 2007-2013, the table only shows data for a subset of countries where the categorization was straight forward and did not require text mining algorithms (BG, CY, DK, EE, FI, LT, LU, LV, PT). We will conduct the text mining analysis over the next months, such that the final data set will also include information of the other countries (where some information on the theme of the project/project description etc is available).
    5. Values of the summary statistics are therefore subject to change.
    6. For 2014-2020, projects were categorized using existing data on intervention category. Intervention categories were grouped together, making sure that the direction of land-use is homogenous within a group (e.g., soil sealing due to construction).
4. The tab cohesion overview variables should give you an overall impression of data availability from the *original data set* of payments/commitments from cohesion funds. There are two tables, one for funding period 2014-2020 and one for the period 2007-2013. They show the relevant variables together with their coverage (values not NA) and the countries for which these values are widely available.
5. For the period 2007-2013, we only have a small subset of projects for Hungary and Greece (Interreg only) available.
6. For the period 2014-2020, data for the UK was not published by the EC and would have to come from a different source. Variables might differ, and availability of certain variables cannot be ensured. If you need this data, please leave us a comment in the tab "Comments".
7. For funding period 2007-2013, the type of monetary variable reported was not standardized, so the availability for each monetary variable is rather low. However, we can compute proxy variables (learning from the other monetary variables available), most easily for the variable "paid_sum". This variable is also used in the overview table in the "overview database",
8. In the tab "overview database", unlike FADN and CATS, averages were calculated only for regions with a payment. Hence, values might be slightly higher.

As we strive to adapt our database to your data needs. Therefore, we would like to look at the subsequent action points.

Source: Own compilation.

The following tables have the full information based on the survey:

The Excel table at iiasahub.sharepoint.com has several sheets. The most important one is “Overview database”, which has the full Tables from the survey among the LAMSUS partners. The tables from this sheet are in Table 11.

Table 11: FADN data on subsidies

Source	Average NUTS 2	Average NUTS 3	Max NUTS 2	Max NUTS 3	Relevance (share of non-zero obs) NUTS 2	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
FADN, monetary, NUTS 2/3, origin: farm level								
SE605 - Total subsidies - excluding on investments	10,598,067	2,630,661	99,018,795	60,277,142	99.94	99.75	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE610 - Total subsidies on crops	353,912	87,848	13,085,049	8,746,030	71.24	59.19	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE611 - Amounts paid to producers of cereals, oilseeds and protein crops (COP crops) and energy crops payments	44,661	11,086	3,311,102	1,306,178	26.97	20.62	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR;Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE612 - Amount of premiums received by COP producers obliged to set aside part of	1,075	267	149,917	92,663	3.56	2.93	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA,

Source	Average NUTS 2	Average NUTS 3	Max NUTS 2	Max NUTS 3	Relevance (share of non-zero obs) NUTS 2	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
their land. Such land may, however, be used for certain non-food crops								BOKU, WIFO; Task 7.1: IIASA; Task 8.2: VUA
SE613 - Other crops subsidies	289,082	71,756	12,875,094	8,659,820	60.78	47.79	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE615 - All farm subsidies on livestock and livestock products	592,817	147,150	15,621,790	9,654,945	71.36	63.25	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE616 - Subsidies dairying	196,306	48,727	8,227,901	5,419,521	34.59	26.14	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE617 - All farm subsidies received for cattle other than dairy cows in production, e.g. premiums for young male cattle, premiums for suckler cows, etc.	234,624	58,239	2,951,940	2,389,030	55.95	43.25	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA

Source	Average NUTS 2	Average NUTS 3	Max NUTS 2	Max NUTS 3	Relevance (share of non-zero obs) NUTS 2	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
SE618 - Subsidies sheep & goats	50,832	12,618	1,330,344	742,637	45.12	31.51	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE619 - Other livestock subsidies	111,055	27,566	14,805,548	9,635,498	35.66	28.81	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE624 - Total support for rural development	1,730,644	429,582	30,752,441	20,129,433	97.89	94.13	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA; Task 8.2: VUA
SE621 - Environmental subsidies	1,026,222	254,730	18,131,343	9,309,131	95.68	89.22	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA; Task 8.2: VUA
SE622 - LFA subsidies.	607,636	150,828	18,727,541	12,631,627	74.45	67.43	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA; Task 8.2: VUA

Source	Average NUTS 2	Average NUTS 3	Max NUTS 2	Max NUTS 3	Relevance (share of non-zero obs) NUTS 2	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
SE623 - Support to help farmers to adapt to standards, to use farm advisory services, to improve the quality of agricultural products, training, afforestation and ecological stability of forests. Including part of the measures of the article 69 of Regulation 1782/2003.	96,772	24,021	6,813,707	2,319,094	78.64	52.48	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA; Task 8.2: VUA
SE625 - Subsidies on intermediate consumption	387,232	96,119	9,032,237	7,717,760	59.42	61.18	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE626 - Subsidies on external factors	84,442	20,960	3,706,239	2,240,864	42.22	38.73	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE630 - Single farm payment and single area payment scheme. Additional aid included	6,629,827	1,645,661	70,805,194	28,183,925	97.98	98.80	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA

Source	Average NUTS 2	Average NUTS 3	Max NUTS 2	Max NUTS 3	Relevance (share of non-zero obs) NUTS 2	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
SE631 - Single Farm payment	3,884,816	964,292	70,805,194	25,829,878	77.47	81.22	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE632 - Scheme only for new Member States; not chosen by Malta and Slovenia.	1,898,616	471,276	43,021,974	26,432,518	20.07	17.22	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE640 - Amount resulting from the application of modulation to the first EUR 5000 or less of direct payments.	6,571	1,631	239,646	104,889	13.45	13.78	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE650 - Support_Art68	108,754	26,995	7,764,900	4,890,824	27.41	22.37	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA
SE699 - Other subsidies	818,342	203,130	29,195,981	15,625,107	86.26	67.35	(2004) 2007-2018	Task 4.1: WUR, INRAE; Task 4.2: INRAE, Thünen, ZHAW; Task 4.3: IIASA, INRAE, WIFO, UV; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.1: IIASA

Source: Own compilation based on FADN data from DG Agri.

Table 12: CATS data on subsidies

Source	Average NUTS 3	Max NUTS 3	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
CATS, monetary, LAU possible if provided by EU Origin: payment level					
Example from CAPRI - NUTS2, 2006-2013, negative entries! mean values downward biased					
LT211-213 - Less favoured areas and areas with environmental r	11.637.860	168.511.838	97,81	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen, VUA
LT214-216 - Agri-environmental + animal welfare payments	16.556.600	198.267.922	99,05	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen, VUA
LT221 - First afforestation of agricultural land	1.243.596	34.481.514	98,83	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen, VUA
LT122/223-227 - Forestry - other measures	2.087.911	150.169.673	98,57	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen, VUA
LT322-323 - Villages renewal and conservation of rural heritage	3.283.098	138.903.308	99,11	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen, VUA

Source	Average NUTS 3	Max NUTS 3	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
LT111 – Training	789.725	13.356.083	99,37	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT112 - Setting up of young farmers	3.040.171	56.755.087	96,9	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT121 - Investment on agricultural holdings	7.834.444	152.862.017	99,12	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT123 - Adding value to products + infrastructure	3.364.287	97.236.160	98,06	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT125 - Improving infrastructure related to agriculture an	3.220.131	86.803.040	99,45	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT311 - Diversification into non-agricultural activities	1.051.853	31.330.395	98,99	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT321 - Basic services for the rural economy and population	2.995.127	55.748.126	98,74	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen

Source	Average NUTS 3	Max NUTS 3	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
LT114 - Use of farm advisory services	312.833	5.639.833	99,02	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT910 - Technical assistance	1.361.151	41.894.526	99,74	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT312-313 - Creation and development of micro-enterprises	1.920.888	93.567.314	98,74	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT331 - Training and information for economic actors in ru	284.553	2.893.058	98	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT341 - Skills acquisition for local development strategy	335.822	2.725.842	98,07	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT126 - Restoring agricultural production potential	2.922.661	43.435.703	97,21	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT115 - Setting-up of farm relief and farm management serv	282.218	3.413.128	98,77	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen

Source	Average NUTS 3	Max NUTS 3	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
LT113 - Early retirement	4.394.799	84.765.908	98,97	2006-2013	Task 4.1: WUR, INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT400 – LEADER	3.393.758	94.066.735	99,19	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT124 - Cooperation for new products	558.554	7.952.527	99,58	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT133 - Promotion of quality products	567.887	5.552.481	98,99	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT142 - Setting up of producer groups	893.522	7.596.752	100	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT132 - Participation in food quality schemes	225.121	9.846.807	99,33	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT131 - Implementing demanding standards	397.622	40.084.145	94,54	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen

Source	Average NUTS 3	Max NUTS 3	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
LT920 - BG RO Direct Payments	5.581.548	135.395.591	59,79	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT143 - Provision of farm advisory and extension services	1.038.356	3.349.051	100	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen
LT141 - Supporting semi-subsistence farms	3.588.856	30.345.623	85,43	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen, VUA
LT222 - First establishment of agroforestry systems on agr	23.134	203.232	91,84	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen, VUA
LT144 - Holdings undergoing restructuring due to a reform	2.689.888	37.856.486	87,65	2006-2013	Task 4.1: INRAE; Task 4.2: INRAE; Task 4.3: IIASA, INRAE, WIFO; Task 6.3: IIASA, BOKU, WIFO; Task 7.2: Thünen; Task 8.2: Thünen

Source: Own compilation.

Table 13: Regional funds

Source	Average NUTS 2	Average NUTS 3	Max NUTS 2	Max NUTS 3	Relevance (share of non-zero obs) NUTS 2	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
Regional funds, Cohesion + ERDF + INTERREG 2007-2013 (paid eu + national funds) *Countries: BG, CY, DK, EE, FI, LT, LU, LV, PT*								
Energy	386.653		2.369.558		2,5		2007 - 2013	Task 4.1: IIASA, WUR, WIFO; Task 4.3: UV; Task 6.1: WUR; Task 7.2: Thünen; Task 8.2: Thünen
Environment	1.072.962		6.206.313		9,8		2007 - 2013	Task 4.1: IIASA, WUR, WIFO; Task 4.3: UV; Task 6.1: WUR; Task 7.2: Thünen; Task 8.2: Thünen
Urban and Territorial Dimension	707.670		8.919.174		4,3		2007 - 2013	Task 4.1: IIASA, WUR, WIFO; Task 4.3: UV; Task 6.1: WUR; Task 7.2: Thünen; Task 8.2: Thünen
Transport	577.771		6.479.774		5,6		2007 - 2013	Task 4.1: IIASA, WUR, WIFO; Task 4.3: UV; Task 6.1: WUR; Task 7.2: Thünen; Task 8.2: Thünen

Source	Average NUTS 2	Average NUTS 3	Max NUTS 2	Max NUTS 3	Relevance (share of non-zero obs) NUTS 2	Relevance (share of non-zero obs) NUTS 3	Years	Tasks and consortia partner
Regional funds, Cohesion + ERDF + INTERREG FP 2014-2020 (total eligible expenditure)								
Brownfield conversion	6,606,390	3,565,542	138,320,176	138,320,176	0.16	0.07	2014 - 2020	Task 4.1: IIASA, WIFO; Task 4.3: UV; Task 7.2: Thünen; Task 8.2: Thünen
Construction: buildings	83,989,223	21,990,086	1,414,050,215	1,093,072,401	0.71	0.61	2014 - 2020	Task 4.1: IIASA, WIFO; Task 4.3: UV; Task 7.2: Thünen; Task 8.2: Thünen
Construction: energy	11,894,873	4,070,447	277,401,751	211,025,114	0.4	0.26	2014 - 2020	Task 4.1: IIASA, WIFO; Task 4.3: UV; Task 7.2: Thünen; Task 8.2: Thünen
Construction: transport	100,741,619	36,798,745	1,966,783,906	1,330,810,455	0.39	0.24	2014 - 2020	Task 4.1: IIASA, WIFO; Task 4.3: UV; Task 7.2: Thünen; Task 8.2: Thünen
Environment, incl. N2K	13,942,613	5,261,036	291,537,013	248,245,482	0.33	0.19	2014 - 2020	Task 4.1: IIASA, WIFO; Task 4.3: UV; Task 7.2: Thünen; Task 8.2: Thünen
Natural risk prevention and management	13,872,869	6,010,350	368,651,733	308,719,622	0.27	0.14	2014 - 2020	Task 4.1: IIASA, WIFO; Task 4.3: UV; Task 7.2: Thünen; Task 8.2: Thünen

Source: Own compilation.

Table 14: Directive and Regulation

Source	Type	Level	Level orginal dataset	Tasks and consortia partner
Directives and Regulations				
Natura2000	Layer			Task 4.1: IIASA, WUR, INRAE, WIFO; Task 4.2: IIASA, INRAE, WIFO, ZHAW, Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 6.2: VUA; Task 6.3: BOKU, Task 8.2: PBL, VUA; Task 8.3: PBL
Natura2000 from FADN	monetary		Farm	Task 4.1: IIASA, WUR, INRAE, WIFO; Task 4.2: IIASA, INRAE, WIFO, ZHAW, Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR
Natura2000 from Regional Funds	monetary	NUTS2/3	Project	Task 4.1: IIASA, WUR, INRAE, WIFO; Task 4.2: IIASA, INRAE, WIFO, ZHAW, Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR
Nitrate directive	Layer			Task 4.1: IIASA, WUR, INRAE, WIFO; Task 4.2: IIASA, INRAE, WIFO, ZHAW, Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 8.2: PBL; Task 8.3: PBL
River Basin Districts (Water Framework Directive)	Layer			Task 4.1: IIASA, WUR, INRAE, WIFO; Task 4.2: IIASA, INRAE, WIFO, ZHAW, Task 4.3: IIASA, INRAE, WIFO; Task 6.1: WUR; Task 8.2: PBL; Task 8.3: PBL
Other conservation areas				Task 4.1: WUR; Task 4.2: ZHAW; Task 6.1: WUR; Task 8.2: PBL; Task 8.3: PBL
Less favored areas (related to FADN)				Task 4.1: WUR; Task 4.2: ZHAW; Task 6.1: WUR; Task 8.2: PBL; Task 8.3: PBL

Landscape elements (related to FADN)				Task 4.1: WUR; Task 4.2: ZHAW; Task 6.1: WUR; Task 8.2: PBL; Task 8.3: PBL

Source: Own compilation.

Table 15: Cohesion overview table FP 2014-2020

Variable	Explanation	Data availability %	Geographical coverage (countries with coverage of over 80%)
Category_Of_Intervention	Intervention category as defined in IR (EU) 215/2014	98.69	AT, BE, BG, HR, CY, CZ, DK, EE, FI, FR, DE, EL, HU, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE
Country	Main country in which operation took place	100	AT, BE, BG, HR, CY, CZ, DK, EE, FI, FR, DE, EL, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE
NUTS3_Code	NUTS 3 location of project (Version 2016)	88.46	BE, BG, HR, CY, CZ, DK, EE, DE, HU, IT, LV, LT, LU, PL, PT, RO, SK, SI, ES
Operation_Start_Date	Start date project implementation	89.62	AT, BE, BG, HR, CY, CZ, DK, EE, FI, FR, DE, EL, HU, IE, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE
Operation_End_Date	End date project implementation	77.66	AT, BE, BG, HR, CY, DK, EE, FI, FR, DE, EL, HU, IE, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE
Operation_Name_English	Project name, translated	99.99	AT, BE, BG, HR, CY, CZ, DK, EE, FI, FR, DE, EL, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE
Operation_Summary_English	Short project description, translated	98.48	AT, BE, BG, HR, CY, CZ, DK, EE, FI, FR, DE, EL, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE
Total_Eligible_Expenditure_amount	Total eligible expenditure allocated to the project	99.59	AT, BE, BG, HR, CY, CZ, DK, EE, FI, FR, DE, EL, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE

Source: Own compilation.

Table 16: Cohesion overview table FP 2007-2013

Variable	Explanation	Data availability %	Geographical coverage (countries over threshold %)
country	Country of project	100	AT, BE, BG, CY, CZ, DE, DK, EE, ES, FI, FR, HR, IE, IT, LT, LU, LV, MT, NL, PL, PT, RO, SE, SI, SK, UK, EL, HU
priority	Variable used for categorization	13.54	CY, CZ, EE, FI, LT, LV, MT, NL, PL, PT, RO
prj_cat	Variable used for categorization	3.48	PT
prj_descr	Variable used for categorization	5.57	CZ, EE, HR, IE, EL, HU
prj_start	Start date project implementation	42	BE, CZ, FI, HR, IE, IT, NL, SK, EL, HU
prj_end	End date project implementation	49.96	BE, FI, HR, IT, NL, SK, HU
prj_name	Variable used for categorization	99.88	AT, BG, CY, CZ, DE, DK, EE, ES, FI, FR, HR, IE, IT, LT, LU, LV, NL, PL, PT, RO, SE, SI, SK, UK, EL, HU
prj_nuts1	NUTS 1 location of project	66.97	CY, CZ, EE, FI, FR, HR, IE, IT, LT, LV, MT, PT
prj_nuts2	NUTS 2 location of project	60.42	CY, CZ, EE, FI, FR, HR, IE, IT, LV, MT, PT
prj_nuts3	NUTS 3 location of project	42.08	CY, CZ, HR, IE, IT
theme	Variable used for categorization	27.79	FR, PT
tot_elig_exp	Total eligible expenditure allocated to the project	38.94	FI, HR, IT, NL, PT
tot_value	Sum of commited EU funds, national funds, and ineligible cost borne by benefciary	14.45	BG, CZ, EE, FR, IE, LT, LU, PL, RO, EL, HU

paid_sum	**Sum of paid EU and national funds**	**62.16**	**BG, CZ, DE, FI, IT, LT, SK**
com_sum	**Sum of commited EU and national funds**	**81.51**	**BG, CY, CZ, ES, FI, IT, LT, LV, MT, SK**

Source: Own compilation

Annex 17: Policy related agricultural driver variables

Number of farms represented, Economic size, Total labour input, Labour input, Unpaid labour input, Paid labour input, Total Utilised Agricultural Area, Rented U.A.A., Cereals. Area, Other field crops, Energy crops. Area, Vegetables and flowers, Vineyards, Permanent crops, Orchards, Olive groves, Other permanent crops, Forage crops, Agricultural fallows, Set aside, Total agricultural area out of production, Woodland area, Total livestock units, Dairy cows (incl. buffaloes), Other cattle, Sheep and goats, Pigs, Poultry, Yield of wheat, Yield of maize, Stocking density, Milk yield, Total output, Total output crops & crop production, Total crops output / ha, Cereals. Value, Protein crops, Energy crops. Output, Potatoes, Sugar beet, Oil-seed crops, Industrial crops, Vegetables & flowers, Fruit trees and berries grown in the open (including tropical fruit), excluding citrus fruit orchards and grapes, Citrus fruit, Wine and grapes, Olives & olive oil, Forage crops (roots and brassicas, other fodder plants, temporary grass, meadows and permanent pastures, rough grazing, fallows and set-aside land), Other crop output, Total output livestock & livestock products, Total livestock output / Livestock unit, Change in value of livestock, Cows' milk & milk products, Beef and veal, Pig meat, Sheep and goats, Poultry meat, Eggs, Ewes' and goats' milk, Other livestock & products, Other output, Farmhouse consumption, Farm use (value of products produced and used on the holding to obtain other final agricultural products or other recorded output), Total Inputs, Total intermediate consumption, Total specific costs, Specific crop costs / ha, Seeds and plants, Seeds and plants home-grown, Fertilisers (Quantity of N in mineral fertilisers used, Quantity of P2O5 in mineral fertilisers used, Quantity of K2O in mineral fertilisers used), Crop protection, Other crop specific costs, Specific livestock costs / Livestock unit, Feed for grazing livestock, Feed for grazing livestock home-grown, Feed for pigs & poultry, Feed for pigs & poultry home-grown, Other livestock specific costs, Forestry specific costs, Total farming overheads, Machinery & building current costs, Energy, Contract work, Other direct inputs, Depreciation, Total external factors, Wages paid, Rent paid, Interest paid, Balance of interest paid and received, Taxes, VAT balance excluding on investments, Balance subsidies & taxes on investments, Subsidies on investments, Payments to dairy outgoers, VAT on investments, Gross Farm Income, Farm Net Value Added, Total assets, Total fixed assets, Land, permanent crops & quotas, Buildings, Machinery, Breeding livestock, Total current assets, Non-breeding livestock, Stock of agricultural products, Other circulating capital, Total liabilities, Long & medium-term loans, Short-term loans, Net worth, Change in net worth, Average farm capital, Gross Investment, Net Investment, Balance current subsidies & taxes, Total subsidies - excluding on investments, Total subsidies on crops, Compensatory payments/area payments, Set aside premiums, Other crops subsidies, Total subsidies on livestock, Subsidies dairying, Subsidies other cattle, Subsidies sheep & goats, Other livestock subsidies, LFA subsidies Environmental subsidies, Other rural development payments, Total support for

rural development, Subsidies on intermediate consumption, Subsidies on external factors, Decoupled payments, Single Farm payment, Single Area payment, Support_Art68, Other subsidies.