

Project Report

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D1.3 Guidelines and protocols harmonizing activities across case studies

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Deliverable D1.3

30th October 2020

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BESTMAP

**Behavioural, Ecological and Socio-economic Tools for Modelling
Agricultural Policy**



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Preface

This document is the first version of the *Guidelines and protocols harmonizing activities across case studies* of the H2020 BESTMAP project. It is intended to be updated in month 40 (D1.8).

This deliverable aims at documenting the efforts to harmonize data collection, research and outreach activities across all case studies (CSs). It covers the interaction with stakeholders on national and European levels and the dissemination and communication of project results. It provides guidelines for collection and harmonization of geospatial data. It elaborates on the dimensions and development of farming system archetypes (FSAs). Additionally, the document explains the selection of relevant agri-environmental schemes (AESs) and the ecosystem services (ES) BESTMAP aims to model. It also documents the methodology for stratifying and selecting farmers for the interview campaign and provides guidelines for conducting and analysing the interviews. Finally, the deliverable explains the approach to implement and document the agent-based models (ABMs).

Summary

This deliverable contains several guidelines to harmonize the activities in BESTMAP.

Guidelines for stakeholder engagement at the EU level describe conducted interviews on policy perspectives and a technical workshop with DG-AGRI and JRC. At the national/regional level, the guidelines propose a series of three workshops to identify important policy interventions, discuss the BESTMAP dashboard and validate the ABM output. Overview of the key CS stakeholders and dissemination/communication activities are also provided.

Guidelines on geospatial data document the process of collecting and harmonizing CS-relevant data. These will be stored in the CS base layer database that is managed using the UFZ GeoNetwork application.

Guidelines on farming system archetypes describe the current status of developing and mapping FSAs, including the rationale for selecting FSA dimensions and the envisaged methodological approach of FSA data analysis that is consistent across CS and allows upscaling to European level.

Section on AES and ES documents an ongoing process of selecting schemes and services to model within BESTMAP, based on their relevance and data availability. We also identify the links between AES and ES and propose further steps towards harmonizing modeling procedures which will be specified in the updated deliverable D1.8.

Guidelines on how to select farmers for interviews are based on the use of proto-FSAs for stratifying the CS farms into categories from which a representative sample of farmers was chosen. These were based on environmental stratification, type of farming in FADN and farmer profiles. Following are semi-structured interview guidelines that provided CS teams with

specific instructions on how to conduct the interviews with farmers and subsequently transcribe, code and analyse the collected data. The actual Interview Protocol with all questions and instructions used for farmer interviews is included as Appendix 1.

Finally, the ABM guidelines specify how our ABM models will be implemented in the Python environment using the Mesa modular framework and how it will be documented using the ODD+D standard.

1. Guidelines for stakeholder engagement

The guidelines for stakeholder engagement are based on the 'Plan of Engagement' that has been developed within WP6 - Capacity Building and Dissemination. They provide a plan for establishing strong connections with institutions (at the local, national, and EU level), projects and initiatives relevant to the BESTMAP project.

1.1. Stakeholder engagement in co-design activities

The co-design and co-development activities promoted by BESTMAP have the main objectives of:

- Identifying relevant policy scenarios and indicators at EU level
- Identifying relevant policy scenarios and indicators for the case studies (CS), as to model its impacts in the area
- Consolidating the conceptual framework, design and development of BESTMAP- Policy Impact Assessment Model (PIAM)
- Designing and developing a policy dashboard platform for policy makers
- Developing economic scenarios based on co-designed policy workshops

Initially all co-design activities were planned to be developed through face-to-face workshops involving key stakeholders both at EU level and at case study level. However, due to the restrictions related to the COVID-19 pandemic, different approaches and methodologies have been arranged for each specific activity.

1.1.1. EU level

In order to identify present and future policy scenarios at the EU level, the project envisioned a co-design and co-development phase based on information gathered through several stakeholder/policy-maker workshops and focus groups where relevant policy scenarios and indicators at EU level would be discussed. These discussions would include the promotion of new challenges, such as climate change policies/Paris agreement-COP21, Sustainable Development Goals (SDGs), competitiveness, sustainable management of natural resources, and balanced development of rural areas together with new specific measures of interest defined by the European Commission (EC).

An initial Brussels EU workshop was planned to bring together EC policy-makers, environmental and development agencies, umbrella farmers' organizations, agricultural corporates and researchers. This workshop was originally scheduled at a very early stage of the project implementation, however, the approach was modified due to the following reasons:

- a. The SUPREMA project organized three similar workshops in 2018-2019, including topics and stakeholders that would have been engaged in the BESTMAP workshop, generating an overlap and redundancy.

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- b. In January 2020, case study administrations reported that they were still waiting for post-2020 CAP guidance from the European Commission and as a result, strategic plans were still at a draft stage and could not be discussed at this stage.
 - c. Changing situation in two case studies, UK and Serbia. UK is undergoing Brexit and the scrapping of direct payments implies important new elements which need to be taken into account. Serbia does not currently have Agro-Environmental Schemes (AES) and is negotiating joining the EU.
 - d. There were new policy developments that affect the BESTMAP framework: the Green Deal was announced, including the idea of a climate law, as well as The Farm to Fork and Biodiversity strategies.

Therefore, BESTMAP decided to split the task into two main activities (which format was unfortunately changed due to COVID-19 restrictions of travelling): a) Interviews on policy perspectives at EU level and b) a technical workshop on EC assessment tools.

a) Interviews on policy perspectives

A set of telephone and on-line interviews of key policy influencers and stakeholders at the European level (NGOs, Farmers Unions and Industry lobbying groups) were performed from February to May 2020 to capture the important drivers of change and possible trade-offs of European agricultural policy and to obtain their opinion on the need for improvement of impact assessment tools for policy development. Interviewees were chosen based on 3 criteria:

- Representation of a stakeholder group in the pre-farm-gate aspect of the agri-food value chain or an expert analyst of the European agriculture policy
- Actively following European policy at the Brussels level
- Knowledge to be already active in the debate on the future of European agriculture

The possible candidates were split into 4 groups: Producers (representatives of farmer groups and sector producers), input industry (fertilisers, pesticides, machinery etc.), environmental NGOs working on European agricultural policy and expert analysis (think tanks). The selection allowed for a broad overview of producers' opinions, the main input industries and the environmental and climate concerns of NGOs.

b) Technical workshop with DG-Agri and JRC

An on-line workshop entitled "Improving environmental and social capacity of EC impact assessment tools" was held on the 14th and 15th of July 2020 (virtual meeting). It involved relevant stakeholders from DG AGRI/ENV/CLIMA and JRC with the objective to discuss needs and how to improve the tools used by the EC for agricultural policy impact assessment. The target participants were modellers and technical staff from the DGs and JRC, in particular in the area of environment and social impact. This workshop included discussions on agricultural impact modelling, post 2020 CAP indicators and SDGs indicators and some exploration of upcoming policies, for example the Sustainable Food Framework announced in Farm to Fork. It was organised over two consecutive mornings and implemented through a combination of plenary sessions and thematic breakout groups to facilitate contributions from all participants.

1.1.2. National/regional level

The initial objective of this activity was to identify the local impacts of translating EU level policy scenarios at each of the case studies (CS). That is, how EU policy scenarios would be translated into case study policy strategies. To do this, a co-design process was planned for each CS, using local language and conducted by CS partners.

In particular, three workshops per CS were planned with specific objectives:

Workshop 1: i) to obtain a list of policy interventions/Agri-Environmental Schemes (AES), based on different EU policy narratives/scenarios, ii) to discuss which indicators stakeholders would suggest to be included in the models/dashboard and evaluate including, if possible, the identification of 'acceptable' values for each indicator.

Workshop 2: i) to generate input for the BESTMAP dashboard for each CS, ii) to present the BESTMAP models and gather stakeholder feedback and iii) to present the results of the macroeconomic model DART-BIO.

Workshop 3: to validate the ABM outputs with stakeholders for their CS.

Workshop 1: Contacts and interviews to identify CS important interventions

Due to COVID-19 pandemic and its restrictions of in-person meetings and travelling, the initially planned workshop was transformed to telephone and/or on-line contacts with key policy stakeholders in each CS. The objective of the calls were to collect stakeholders' opinion on BESTMAP pre-selected AES (ELMS in the UK) with the aim to ensure that the AES selected to be modelled per CS are meaningful and relevant for each area. Initial discussions on a relevant list of indicators for each CS were also included as it is also necessary to distinguish the priority biophysical and socio-economic indicators associated with each AES, from those relevant for post-2020 EC CAP regulation (considering which ones BESTMAP can feasibly model) and/or Sustainable Development Goals indicators.

Workshop 2: Workshops for dashboard development

A set of workshops, one per CS, are planned around M22 of the project implementation in order to co-design policy dashboard based on interactions among project partners and external stakeholders and end-users. The specific aims of these activities will require input from all project partners (selection of BESTMAP AES to be modelled per CS, characteristics/type of information to be included in the dashboard) in order to tailor the methodology to the projects' aims and ensure its usefulness for project development. During this set of workshops, BESTMAP model results will be presented (including the macroeconomic model DART-BIO) and stakeholder feedback gathered.

In preparation of these activities, a process of interaction with already identified stakeholders will be developed in each CS. The involvement of stakeholders will be pursued in different ways tailored to the specific CS context and COVID-19 pandemic related developments, such as: phone/online interviews, surveys, structured meetings, co-design workshops, etc. All these interactions will be carried out using local languages and will be conducted by CS partners.

Workshop 3: Workshops to validate model output

A final workshop targeting CS stakeholders and end-users is planned to be developed at the end of BESTMAP implementation (M38) with the objective to validate the project outputs for each CS. This activity was not initially envisioned in the methodology but included at a later stage as a key step in getting feedback from stakeholders and end-users at CS level that have been informed, contacted and involved during the project development.

1.2. Overview of relevant organizations and/or projects on CS level

Each Case Study will establish links with relevant organisations active in the CS region in order to enhance the visibility of BESTMAP and its outcomes, to explore potential common activities and complementarities and to enable knowledge exchange with other projects, institutions, farmers networks/unions, NGOs, etc.

Germany:

Sächsischer Landesbauernverband (SLB) is the Saxon State Farmers' Association founded in 1991. The association represents the interests of around 4,600 members, of which 3,100 are individual members while 300 are organisations, companies or collectives. The Saxon State Farmers' Association offers its members legal advice as well as a support and help with all questions regarding agricultural projects' funding opportunities.

Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (LfULG) is the Saxon State Office for Environment, Agriculture and Geology, responsible for the environment, nature conservation, agriculture, geology and rural areas. LfULG is not only a key data provider for BESTMAP (e.g. access to the LPIS data for the BESTMAP case study was given by LfULG), but also plays a key role in CAP implementation and monitoring at the federal state level. Two face-to-face meetings between LfULG members and BESTMAP scientists already took place as well as several phone calls and video calls (due to the Covid-19 pandemic). Existing collaborations will be intensified during the project phase of BESTMAP and we also see that LfULG will play a key role in the planned policy workshops.

Landschaftspflegeverband Nordwestsachsen e.V. (LPV NWS) is the Association for Landscape Conservation that works on creation of a comprehensive network of natural habitats and integrates them into a Saxony-wide network of biotopes, preservation of the diverse cultural landscape and promotion of environmentally friendly land use and ecologically oriented economic methods. The objective of engaging with this association is to invite their members to participate in policy workshops, to facilitate contact to local farmers and to disseminate project results. So far, the interaction works very well and several meetings or phone calls were already held. The LPV NWS shows great interest in BESTMAP.

Spain:

Espais Agraris. Caracterització dels espais agraris de Catalunya is a national project that carries out the process of characterization of agricultural areas in Catalonia. The knowledge and data exchange is the main objective of engaging with this project.

Unió de Pagesos is an organisation that brings together professionals working in agriculture, livestock or forestry on their own, and who stand in solidarity with the agricultural sector to

improve living conditions. Since this organisation counts over 6000 members, the main objective of the engagement is to help facilitate contact to local farmers and to participate in policy workshops.

Joves Agricultors i Ramaders de Catalunya (JARC) is the Catalan agricultural organization with the most representation in Spain and Brussels thanks to its membership in the Coordinadora de Organizaciones de Agricultores y Ganaderos (COAG). The main objective of linking with this organisation is to involve their representatives in policy workshops and jointly facilitate contact to local farmers.

UK:

Champions for the Farmed Environment (CFE) is a partnership established in 2009 with the aim to support farmers to deliver environmental benefits within a productive farm business. CFE provides guidance and support to allow more farmers to manage their land in a way which works for their business and the environment. CFE promotes good practices in sustainable yet productive farming and is supported by many organisations committed to both agriculture and the environment. The main objective of engaging with CFE with this organisation is to involve their representatives in policy workshops and facilitate contact to local farmers.

Country Landowners Association (CLA) is the membership organisation for owners of land, property and businesses in rural England and Wales. They have been safeguarding the interests of landowners, and those with an economic, social and environmental interest in rural land for more than 112 years. The main objective of linking BESTMAP project and this farming association is to involve their representatives in policy workshops and facilitate contact to local farmers.

The Soil Association is the UK's leading membership charity campaigning for healthy, humane and sustainable food, farming and land use. The Soil Association is registered with the Charity Commission for England and Wales and has a wholly owned subsidiary Soil Association Certification Limited, the UK's largest organic certification body. The main objective of linking the BESTMAP project to the Soil Association is to involve their representatives in policy workshops and facilitate contact to local farmers.

Serbia:

The Serbian Environmental Protection Agency (SEPA) is a public body responsible for the development, harmonization and management of the national information system for environmental protection. The main objective of the engagement is to participate in policy workshops and to disseminate project results.

Chamber of Commerce and Industry of Vojvodina is a gathering place of business people, a place of exchange of contacts, information, ideas and experience. The Agriculture Association of the Chamber of Commerce and Industry of Vojvodina is the basic form of organization and work in the Chamber of those members whose main activity is agriculture, water management and forestry. Since this institution is a contact point of the Agricultural Association, the focus of the engagement is to facilitate contact to local farmers and to disseminate project results.

The Agricultural Advisory Service of the Autonomous Province of Vojvodina enables the Secretariat for Agriculture, Water Management and Forestry to monitor various parameters from the field of financing and implementation of measures for protection and improvement of agricultural land, financing and implementation of selection measures in livestock, with the aim of improving livestock production, financing and implementation of the Fisheries Stocking Program and financing and implementation of the Rural Development Program of AP Vojvodina. The focus of the engagement with this Government Department is to involve their representatives in policy workshops.

Check Republic:

Association of Private Farmers advocate sustainable, multifunctional agriculture and environmentally friendly production. They promote balanced economic and ecological aspects of agricultural production that realistically correspond to the relationship between the demand and supply of private and public goods. The objectives of the engagement are to participate in policy workshops, to facilitate contacts to farmers and to exchange knowledge.

The Agricultural Association of the Czech Republic defends and promotes the interests of its members in the production, marketing and enhancement of agricultural production, strives for agricultural and rural development, assists its members in developing their business activities and provides advisory services and economic education in economic, business, commercial, legal and social issues. The objectives of the engagement are to participate in policy workshops, to facilitate contacts to farmers and to exchange knowledge.

1.3. Overview of dissemination and communication activities

Summary of all dissemination and communication activities of the BESTMAP project on Case Study and EU level will be presented in the Communication and Dissemination (C&D) reporting table. This will be a report of C&D activities that have taken place within the entire H2020 BESTMAP project.

It will include all offline activities such as:

- Organisation of conferences
- Organisation of workshops
- Press releases
- Non-scientific and non-peer reviewed publications
- Exhibitions
- Flyers
- Roll-ups
- Brochures
- Posters
- Booklets
- Newspaper/journal
- Magazine/article
- Communication campaign (e.g. radio, tv)
- Video/film

- Participation to conferences
- Participation to workshops
- participation to events other than conference or workshop
- Brokerage/event
- Pitch event
- Trade fair
- Bilateral meeting (face to face)

It will also include scientific dissemination activities such as:

- Articles in journals
- Publications in conference proceedings/workshops
- Books/Monographs
- Chapters in books
- Thesis/dissertation

Finally, the report will include all digital communication and dissemination activities such as:

- Posts on websites
- Posts on social media
- Participation to on-line conferences
- Participation to on-line workshop/seminar
- Bilateral meeting (online)
- Direct email
- Newsletter

In month 8, D6.3 “Communication Plan and Dissemination Plan” was published as a framework for raising awareness of the project findings and promoting and disseminating the BESTMAP research to stakeholders and the general public. The purpose of this document was to outline the strategy, to define means of communication, tools and actions that will be done within the BESTMAP project in order to reach a wide range of stakeholders. This deliverable also describes communication and dissemination channels, target groups, key messages and defines processes of successful reporting on C&D activities. The update of the Communication Plan and Dissemination Plan will be published in month 24.

2. Types of geospatial data to collect in each CS

2.1. General types of data

For defining modelling, analysis of spatial patterns, and to identify farming system archetypes, BESTMAP relies on a wide range of data. The data predominantly cover three different types. In detail the project requires (geospatial) data for FSA identification (which will be utilized in ABM modelling) and for modelling of ecosystem services (ES), both on case-study level and European level. Additionally, spatially explicit data is required e.g. for model parameterization. A general overview of BESTMAP’s data requirements is given in Table 1. A more detailed description is available in the deliverable ‘Case Study Base Layer dataset’ (D3.1).

Table 1: Data types.

Data	Example	Used for	Notes
Case-study specific spatial data	<ul style="list-style-type: none"> - land use - soil characteristics - species occurrence data 	<ul style="list-style-type: none"> - FSAs (for ABM) - BPM (ES modelling) - model validation 	<ul style="list-style-type: none"> - polygons or raster - ETRS_1989_LA EA
European wide spatial data	<ul style="list-style-type: none"> - land use - soil characteristics - species occurrence data 	<ul style="list-style-type: none"> - upscaling 	<ul style="list-style-type: none"> - polygons or raster - ETRS_1989_LA EA
Non-spatial data	<ul style="list-style-type: none"> - soil carbon content in each land cover/land use type 	<ul style="list-style-type: none"> - parameterization/validation of models 	

2.2. Case Study Base Layer data

The Case Study Base Layer is a harmonised geospatial database across the five case studies. It includes spatial information on climatic and soil conditions, biodiversity, land use/land cover (including crop types), farm structure and socio-economic data. It serves as a base for biophysical ES models as well as socio-economic statistical models. These will feed into the process of mapping Farming System Archetypes (FSAs) and their change in each regional CS. FSAs will be used for building a common ABM framework. In order to facilitate a timely start of the modelling activities, a Preliminary Case Study Base Layer has been compiled including the most essential variables at the highest possible resolution available in each CS. This preliminary base layer was created as milestone MS3 in month 5 and it will be refined as deliverable D3.1 in month 15.

2.3. Geodata Management

Efficient geodata management is ensured by utilizing the UFZ GeoNetwork application (<https://geonetwork.ufz.de>). The software *GeoNetwork opensource* is a catalogue application to manage spatial data. It contains tools to edit, search and report metadata as well as a web map viewer functionality (<https://geonetwork-opensource.org>). As an initial data harmonization effort, CS-specific datasets are named uniformly, clipped to the CS areal extent, and projected to the geographic ETRS89 (Lambert Azimuthal Equal Area projection) coordinate system (EPSG: 3035) (in meters). Metadata is compiled in accordance with the ISO19139 standard. The record includes information on spatial and temporal extent of the dataset, keywords, a contact person and a download link to the data. The data compilation process is still ongoing and will be finalized as D3.1.

2.4. Limitations of harmonizing data across CS

There are several limitations and problems to be considered while collecting spatial data from several case studies. These include different temporal sampling (1) between case studies (e.g. potentially UK land use 2017, CZ land use 2019) and within case studies (e.g. land use 2019, land cover 2017). Besides this, also different definitions (2) of agricultural 'field/parcel' between the case studies have to be overcome. This is documented in the special report by Owen et al. (2016). A third realm of limitation are the data gaps (3) - either spatially or conceptually - of data that might be only available for certain CSs but not for all. And finally different naming of categorical data (e.g. soil types or crops) have to be solved.

A more detailed discussion of these points can be found in D3.1 'Case Study Base Layer dataset for each of the case studies'. How these problems were tackled will be included in the update of this deliverable (D1.8) in month 40.

3. Developing and mapping Farming System Archetypes

A central concept of BESTMAP is the notion of Farming System Archetypes (FSAs). These archetypes are a generalized typology of farming systems defined by e.g. farm size and farm's characteristics and management. These FSAs are assumed to react similarly to policy changes and can be mapped by geospatial relations of existing georeferenced datasets included (see Section 2). Identifying archetypical farming patterns (see Erb et al. 2013) enables an integrative understanding of agricultural systems.

FSAs are a major component of the project's modelling architecture and integrate many aspects of it. They will (1) include characteristics of the agents used in the agent based modelling (ABM) and characteristics of the spatial patterns of agricultural land use in the CS. The FSA will also (2) define the frame for the statistical/biophysical models, working with maps and pixel information to assess biodiversity and ecosystem services.

The defined FSAs will be static and will therefore not change during the course of the analysis/project. However, the biophysical land-parcels classification will also use crop rotation as input, which can change, as well as AES implementation, which will be the ABM output. Therefore, being static does not mean the modelling using the FSAs is 'frozen'. The ABMs will make use of certain attributes e.g. uncertainty threshold, initially chosen from a distribution based on FSA, but be adaptive with 'learning' from an agent's own experience or social interactions. To describe e.g. the social and farm-specific characteristics, we conduct farmer interviews and surveys. To match the selected interview partners with the still-to-be-developed FSAs and to provide a preliminary stratification of farming systems in each CS, prototypes of the Farming System Archetypes (proto-FSAs) were developed in advance to the FSAs, these were mainly based on the Environmental Stratification of Europe and were used to select a representative sample of farmers for our interview campaigns (see also section 5.1).

We will develop a set of FSAs (not more than 5-6 per CS) based on (1) Europe-wide available data (FADN) on a coarser resolution and combine these with more (2) detailed information for each CS area. This will enable us to understand local patterns as well as to upscale to the European level.

3.1. Selecting FSA dimensions

There are numerous aspects to the issue of what dimensions actually define FSAs, including perspectives from the ABM modelling, biophysical modelling, project management and upscaling issues. In the BESTMAP proposal, we envisioned that FSAs will be characterized by (1) dominant environmental conditions (e.g. climate, soil), (2) land-use intensities and management practices (e.g. crop types, crop rotations, mechanization, fertilizer application), but also by (3) socioeconomic factors (e.g. land tenure and ownership, size of the fields/agricultural holding) that would provide a link to farmers' behavioral characteristics.

After further discussions we decided that for defining the FSAs the data should meet certain criteria. The data should be

- mappable for each individual farm in the all CS based on spatial data from public or administration sources (FADN, IACSLPIS)
- mappable from FADN microdata
- based on attributes that farmers can easily and reliably answer in short online survey
- correspond to or be proxies of factors affecting farmers' AES adoption decision

The FADN-based data we will use are farm specialization and economic size. For the first, we choose to reduce TF8 to five types - field crops (area-based rule: $P1 > 2/3$, see definition of P1 below), horticulture ($P2 > 2/3$), permanent crops ($P3 > 2/3$), grazing livestock ($P4 > 2/3$) and mixed. This information will be combined/accompanied with more detailed information from LPIS data. For the second we decided to classify economic size as small or large. Also here we will use a combination of LPIS and FADN information. Economic size is not directly available from IACS/LPIS, but can be calculated using FADN Standard Output coefficients (EUR per hectare for ~90 crop types) available for 2013 in Eurostat¹.

Besides the FADN-based data we will also consider other farmers' attributes. None of these met all objectives (i.e. mappable from spatial data for all farms, mappable to FADN microdata, available in FSS SUF to derive weights, easy for farmers to answer).

We list some of these attributes below, as they may be used in some steps e.g. as attributes assigned to each farm from spatial data that are used in ABM.

- past participation in AES - this is also a known factor differentiating farmers.
- average size of fields - may be a proxy of level of mechanization / intensification
- average distance between groups of fields managed by the same farmer
- average period of crop rotation
- soil quality/agricultural productivity per field - is an important factor affecting farmers' adoption of AES on particular fields and not others
- percent of UAA land under short lease / "field swapping" - may hinder farmers from adopting AES as they have little 'ownership' over the land
- percent of farm area as standing woodland
- percent of farm area as landscape features

A harmonized data request was developed in close collaboration with colleagues from all CS, all work packages and all thematic domains (e.g. interview conductors/developers, ABM modellers, BPM modellers). For information on CS base layers, see section 2.2.

3.2. Data analysis

After defining the essential FSA dimensions and the general overview of data available for each CS (see also [Section 2](#) and D3.1) we started to analyse possible correlations between potential FSA variables. The purpose of this is (1) to understand with data can be used as a

¹ Standard output coefficients are the average monetary value of the agricultural output at farm-gate price, in euro per hectare or per head of livestock. For 2013 SO coefficients per regions calculated using the average of 2011-2015 prices in 2016 Farm structure survey data see <https://ec.europa.eu/eurostat/web/agriculture/so-coefficients>

substitute for others (in case not all data are available in each case study), (2) to limit the number of variables to consider in the cluster analysis and (3) to estimate which variables can serve as a good proxy for others, e.g. farm size as proxy for participation in AES.

Originally, we envisioned defining the FSAs by applying bottom-up (data-driven) cluster analysis. We planned to run different unsupervised classification methods (e.g. self-organizing maps, SOMs) with a varying number of clusters to understand which clustering is most robust and appropriate. This method would utilize several spatial (structural) information and the (cor)relation amongst them in combination with proxies for farmers' behaviour. However, to accommodate the above mentioned criteria for FSA dimensions and to keep a low number of FSA groups in each CS, we may give preference to a top-down approach with user defined thresholds (or categories) for defining FSAs.

Currently, the definition and mapping of FSAs is a work in-progress. We have established a new FSA working group within the project, in which we will further specify the guidelines for FSA definition and mapping in BESTMAP case studies and at the European level. The final set of guidelines/protocols for harmonizing the development of FSAs will be part of the updated Deliverable 1.8 (Month 40).

4. Specification of agri-environmental schemes and ecosystem services

To ensure comparability among all case studies, we decided to focus on agri-environmental schemes (AES) that exist and are relevant (in terms of spatial coverage) in all case studies. Likewise, we selected only ecosystem services (ES) that are of importance in all case studies and are affected by one or several of the selected AES, as explained in more detail below.

4.1. Identification of AES and Ecosystem Services

All models in BESTMAP work towards improving the understanding of how agricultural policy change may affect the entire agricultural sector and its associated ecosystems. Therefore, a set of agro-environmental schemes (AESs) to be modelled needed to be selected as a first step.

CS leads were asked to compile a list of the most common (in terms of implementation area) and most relevant schemes of each CS. As a temporal reference we chose the CAP period 2014-2020. Scheme descriptions were translated into English and organized into one database. This resulted in a total of 43 schemes.

Based on expert opinions of BESTMAP members, for each candidate AESs, a list of associated ES and trade-offs that are targeted by these schemes was developed. In this step we followed the TEEB classification (<http://www.teebweb.org/resources/ecosystem-services/>). Next, in an iterative process, the number of candidate AESs was reduced according to the opinion of local stakeholders (see section 1.1.2) and the following criteria: At first, AESs were excluded if their implementation in the CS agricultural area could not be inferred from remote sensing or from other data available from CS statutory agencies. Subsequently, these schemes were grouped into 12 comparable types:

- Maintaining grasslands (8 AESs in 5 CSs)
- Adding legumes in arable rotation (2 AESs in 2 CSs)
- Catch/cover crops (4 AESs in 4 CSs)
- Buffer areas/Field-margins (5 AESs in 5 CSs)
- Stubble AES (2 AESs in 2 CSs)
- Woodland AES (s AESs in 1 CS)
- Organic/integrated production (5 AESs in 4 CSs)
- Livestock production (2 AESs in 2 CSs)
- Land use conversion (3 AESs in 3 CSs)
- Fertilizer and pesticide application (4 AESs in 1 CS)
- Restoring wetlands/peatland (1 AES in 1 CS)
- Other (4 AESs in 1 CS)

Furthermore, the following aspects of the schemes that are relevant for agent-based modelling were evaluated. These included the following parameters:

- Long-term vs. short-term
- Spatial target of the scheme (feature, field, more than one field)

- Pre-conditions required (yes/no, e.g. presence of certain species)
- Action-based or result-based scheme
- Uncertainty/risk level to the farmer (1 to 5)
- Knowledge required by the farmer (1 to 5)
- Technology required by the farmer (1 to 5)
- Social acceptance of the scheme (1 to 5)

Taking into consideration the ABM-relevant aspects as well as the distribution of similar schemes between the case studies, the following preliminary list shows the AES types selected for modelling:

- Maintaining grasslands (8 AESs in 5 CSs)
- Catch/cover crops (4 AESs in 4 CSs)
- Buffer areas/Field-margins (5 AESs in 5 CSs)
- Land use conversion (3 AESs in 3 CSs)
- Organic farming (1 AES in 1 CS)

This led to the list of CS-specific AES shown in Table 6.

Table 6. Overview of the pre-selected AES in all CS, taking into account area proportions, data availability and relevance for ABMs.

CS	AES code	AES name translated
DE	GL1	Species-rich grassland, result-based compensation
DE	GL5	Special grassland use directed at species conservation, at least 2 uses per year
DE	AL4	Growing of intermediate/catch crops
DE	AL5	a) Annual self-greening fallow b) Perennial self-greening fallow c) Perennial flowered areas
UK	GS2	Permanent grassland with very low inputs (outside SDAs)
UK	SW1	4-6m buffer strip on cultivated land
UK	GS6/GS9	Grassland; maintenance of wet grassland for breeding waders
UK	SW6	Cover crop
UK	TE4	Woodland creation grant scheme
CZ	10.1.4	Grassland maintenance
CZ	10.1.2/1	Integrated grapevine/fruit production
CZ	10.1.5	Conversion of arable land into grassland
CZ	10.1.6	Biobelts (vegetated strips)
CZ	10.1.8	Grassing of concentrated outflow pathways
ES	5	Management and recovery of meadows and pastures
ES	2	Organic Farming
ES	4	Sustainable management of wetlands
ES	-	Improvement of the steppe habitats of the Natura 2000 Network
RS	1	Management of species rich grasslands
RS	2	Management and recovery of meadows and pastures
RS	3	Vegetation strips

RS	4	Conversion of arable land into grassland - increase landscape heterogeneity
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The selection process of the AES in Catalonia deviated slightly from the other CS. Since “Integrated production” will disappear in the new CAP funding period the goal was to rather focus on sustainability (it is planned that, depending on a scoring system, farmers will get more or less subsidies. i.e. results-based). Therefore, the following AES were selected for Catalonia:

- Measures on management and recovery of mountainous meadows since these will continue in future CAP
- Measures on chemicals and wetlands are highly relevant due to storm events in Catalunya. Buffer areas along the coast are increasingly used for coastline stabilization. The wetland measures could be labelled as a land-use conversion scheme: reverting floodplain agriculture (rice, sunflower) to wet meadows (used for grazing), but very few people are doing this (only in restricted area in Girona, close to the the border to France).
- Organic farming has been kept as an important AES in Catalonia.
- “Improvement of the steppe habitats of the Natura 2000 Network” was included since this measure has a requirement that is “keep an area around the field without sowing as a buffer area for biodiversity corridor” thus somehow and partly, it fulfills the AES generic type “buffer areas” (requires to leave buffer areas around fields)

The final selection of the AES to be modeled in BESTMAP will be made based on the possibilities and technical capabilities to run the models. This process is ongoing and described in detail in section 4.2.

By evaluating which ecosystem services are addressed or affected by this reduced list of AES, the most important target ES were identified: Food and Fodder, Fresh water (yield and quality), Erosion, Carbon sequestration and Biodiversity. The envisioned modelling approaches for these different ecosystem services are presented in the following sections.

4.2. Linking ecosystem service models and AES

At the time of writing this deliverable it is an ongoing process among the BESTMAP modelers to identify the best and most appropriate way to include meaningful links between ES models and the pre-selected AES (see section 4.1).

To ensure the selection of AES and ES is meaningful, the BESTMAP modelers are collecting information and expert opinions on the question “Will the model be able to detect a meaningful difference in ES when AES is present or absent?” For each model/ES-AES combination the responsible modelers are currently collecting their expert opinions in a table as exemplified below in Table 7.

Table 7. Collection of experts' opinion on ability of models to estimate ecosystem services depending on AES. Example for one ecosystem service.

Will the model be able to detect a meaningful difference in ES when AES is present or absent?											
		Maintaining grasslands		Catch/cover crops		Buffer areas/field margins		Organic/integrated production		Land use conversion	
ES	Model	Y/ N	Comment/ Explanation	Y/ N	Comment/ Explanation	Y/ N	Comment/ Explanation	Y/ N	Comment/ Explanation	Y/ N	Comment/ Explanation
Example ES	<i>InVest yield model</i>	Y	<i>the model includes variable x which is changed by the AES.</i>	NA	<i>this AES does target agricultural fields, the model only works for grasslands</i>	N	<i>the AES changes variable z which is not accounted for in the model</i>	Y	<i>works theoretically, due to coarse input data the accuracy is very low</i>	N	

The collected information will serve as an input for the final selection of AES/ES combinations to focus on in BESTMAP. Individual AES and or ES may be dropped in this process. Since for some ES there are still ongoing discussions about which models we are going to use, there are multiple model options per service. BESTMAP modellers are aware that the AES are not identical across CS (nor do we consider all AES in all CS) but we rely on these expert judgements/opinions on the model/AES links in general and ignoring the CS context for the most part. In addition, model/AES combinations that are meaningless although technically possible will be identified this way and discussed and potentially removed. The final selection of AES and accompanying models will be included in the update of this deliverable (D1.8) in month 40.

4.3. Additional steps towards harmonizing modeling procedures

Modelling the potential effects of the most important AES on the selected set of ES in all case studies requires a harmonized approach. The additional steps towards harmonizing modeling procedures include:

1. Harmonization of input data in terms of data sources, units, as well as spatial and temporal resolution (see section 2.2 and Deliverable 3.1).
2. Consistent use of the same input information for several ES models, e.g. the same land-use data for crop yield modelling and carbon sequestration modelling, or the same elevation data for water quality modelling and habitat/biodiversity modelling.
3. Consistent calibration/parametrization of ES models and validation of model outputs done by comparative procedures and based on the most recent data to avoid validation data from different years between the case studies.
4. Harmonization of policy scenarios to be applied in all CS.

These challenges were identified during the BESTMAP biophysical modellers meeting held virtually on April 27th-29th 2020. In most cases, we identified the InVEST model as the platform to model the provision of ES and elaborated on the data/calibration/validation needs

for each ES model. These were summarized for internal project documentation in Milestone MS4: Directives for Modelling Approach in Case Studies. However, the harmonization of modelling procedures is subject to change depending on the progress made in individual models. Therefore, the specific guidelines/protocols for harmonizing modelling procedures will be part of the updated Deliverable 1.8 (Month 40).

5. Guidelines on how to stratify and select farmers for interviews

The BESTMAP project uses proto Farming System Archetypes (proto-FSAs) to stratify farming systems in each CS, from which CS interview teams select a representative sample of farmers that are a subject of BESTMAP interview campaigns. The original proto-FSAs proposed in stage 2 of the project proposal included an environmental dimension (climate, soil, topography), production dimension (field size, crop rotation) and land manager/farmer dimension (demography, tenure). Based on discussions in the Consortium Coordination Team (CCT), CS and working groups and the recommendation by DG-AGRI, we simplified the concept and decided on using a combination of (1) the type of farming system as defined by Farm Accountancy Data Network (FADN), (2) the Environmental stratification of Europe and (3) the JRC typology of farmer profiles to define proto-FSAs.

5.1. Environmental stratification of Europe

Each CS area is divided according to the Environmental Stratification of Europe (EnS). This stratification was developed as part of the FP6 SEAMLESS project and provides relatively homogeneous regions suitable for stratified sampling of ecological resources, the selection of sites for representative studies across the continent, and the provision of strata for modelling exercises. The stratification is based on a principal component analysis of climate, elevation and soil conditions in Europe and the dataset is described in Metzger et al. (2012). The EnS has a 1 km² resolution, and consists of 84 strata, which can be aggregated into thirteen Environmental Zones (EnZ). The Czech, German, Serbian and UK case studies are each covered by 2-4 EnS strata (Fig. 1). As the Spanish case study is substantially larger, the coarser EnZ will be used for Catalonia (agreed on by DARP), resulting in 4 zones (Fig 1).

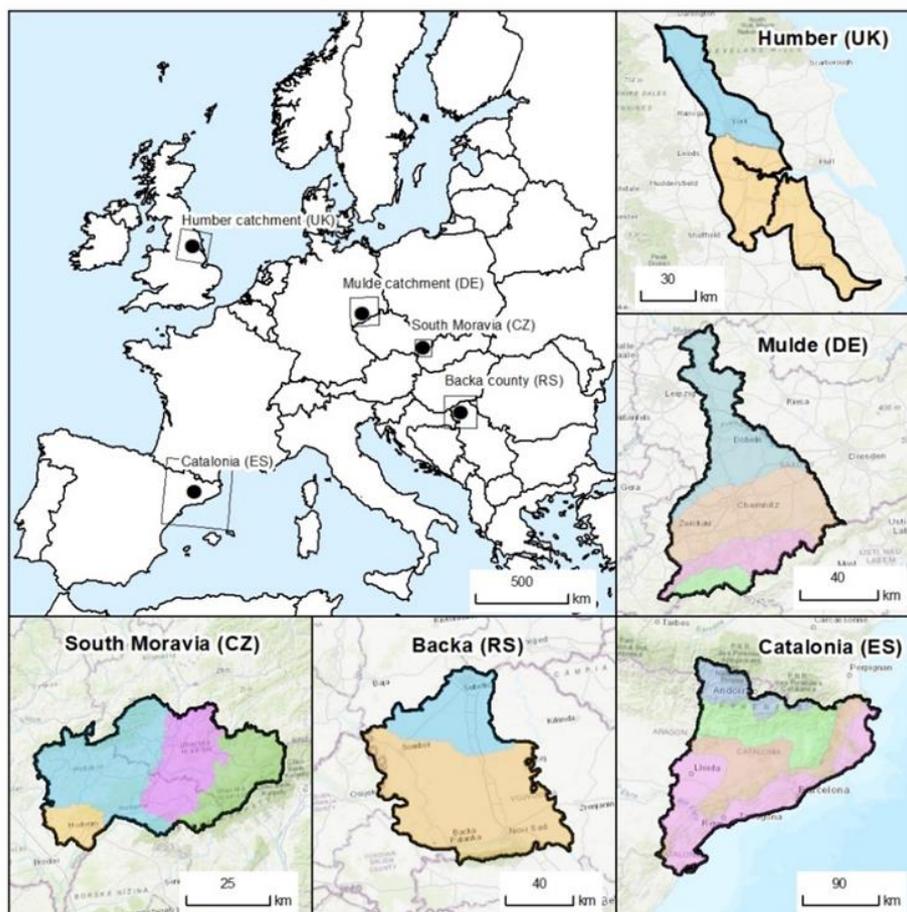


Figure 1: Overview map of BESTMAP case studies stratified spatially into environmental strata (EnS; for UK, DE, CZ and RS) and environmental zones (EnZ; for ES). Colours indicate different EnS/EnZ per CS. However, the same colours in different CS do not indicate membership in the same EnS/EnZ.

5.2. Type of farming in FADN

FADN uses a typology of farming systems which is characterised by the relative contribution of different enterprises to the holding's total standard output (a measure of economic output). Depending on the amount of detail required, there are three nested levels of farming type: 8 general types (+1 for undefinable), 21 principal types and 62 particular types. In BESTMAP we use the general types and decided to limit for the farmers interviews to arable ('fieldcrops' in FADN) and livestock ('Other grazing livestock' in FADN).

5.3. Farmer profiles

Groups of farmers are selected from each CS environmental strata based on their farmer profiles. There is a JRC-led Foresight Study that identifies possible future professional and social roles of farmers in 2040 and explores the resulting potential implications for relevant EU policies. JRC produced 12 profiles of farmers as one of the outcomes of the 'Farmers of the Future' project. From those, 9 are relevant to BESTMAP: (A) 'Diversification; Adaptive', (B)

'Intensive; Production-focused; Specialization', (C) 'Tradition; Family; Heritage', (D) 'Recreational; Non-profit; Hobby', (E) 'Subsistence', (F) 'Corporate; Business unit', (G) 'Regenerative; Conservation; Agro-ecology', (H) 'Social and Health sector; Community; Social-inclusion', (I) 'Lifestyle; Neo-rural; New entrant'. In the interviews, we focus on three profiles – hobbyists (D), professionals (B) and companies (F).

Combining these factors together, we wish to select for BESTMAP interviews farmers that represent four different profiles:

1. Non-professional; non-profit; hobby farmers
2. Professional independent - field crops/arable farmers
3. Professional independent - meat/dairy livestock farmers
4. Company/co-operative appointed managers

5.4. Farmer selection

In each CS, we identified a total of 8-16 proto-FSAs based on the combination of the three datasets described above. The number depended largely on the size of the CS area, resulting in the range 2-4 EnS per case study. Given the combination of EnS and 4 farmer profiles, the CS interview teams were recommended to select 2-3 farmers from each proto-FSA, leading to approximately 25 envisioned interviews per CS.

Note: There are many important factors of farming systems that this stratification does not account for. For example, we include neither farm manager age, nor owner/tenant distinction, nor farm size. Therefore, it is assumed that these factors are not significant compared to the farmer profile and environmental context. However, the BESTMAP team identified and recommended a few other factors that should be considered when selecting farmers: organic/conventional farming, gender, previous participation in agri-environment schemes (AES). Therefore, while not part of proto-FSAs, the selected farmers should ideally be balanced in these categories.

5.5. Contacting farmers

The most effective way for the identification of farmers depends on the existing contacts interviewers have already but also cultural and social conditions (i.e. history of relationship between farmers and scientists).

Starting points for identifying farmers:

1. Local or regional farmer associations/chambers will have contact details (e.g. partners in the project)
2. Local or regional administrations also have contact details
3. Landcare associations, nature or environmental protection organisations are also in contact with farmers and might support you with identifying farmers
4. Colleagues, who worked in projects where farmers were involved.

At the end of the interview a question is integrated: "Can you suggest anyone else who might be interested in BESTMAP, and/or being interviewed by us?". You may show the map with the

zones and ask for farmers that fit the criteria. This so-called snowballing system (asking a farmer for other farmers) is a common approach.

The first step to contact farmers is to write a letter that can be sent by postal mail or via email where the interviewers introduce themselves, the project and the aim of the interview (see Annex 1 as an example). Moreover, it shall state that you will give the farmer a call to fix an appointment and already give information about the period when the interview will be conducted. Between the letter and the phone call not much time should pass (about a week) otherwise, the addressee might forget about it in the meantime.

6. Semi-structured interview guidelines

The aim of the interviews with farmers is to inform the project about the most relevant decision making variables. BESTMAP interviews are explorative, which means that they are used to open up or deepen a new or so far unknown field, which is the motivation of farmers in the CS regions to apply for agri-environmental schemes (AES). The information is gathered to inform the agent-based models (ABM) about relevant elements to be integrated into the model set-up and - beyond the ABM structure - getting a better feel about what the Farm System Archetypes (FSA) should include.

The interviews are designed as semi-structured interviews which means questions are pre-defined but interviewers are encouraged to ask additional questions (if something is not clear or additional questions arise) or change the sequence of the questions when it fits the situation.

In the project proposal we promised interviews with 50-70 farmers in all case areas. We amended this aim at the kick-off meeting for two main reasons:

1. We need to explore the field first to start designing the ABM and afterwards gather the data that will run the ABM
2. For running the ABM, modellers request quantitative data rather than the more qualitative data gathered through the interviews.

However, some quantitative data are required already now, therefore, the **interview protocol** consists of two parts:

1. A part with mostly open questions for the interview – **the interview questions**.
2. A part with closed questions that will be handed to the interview partner to be filled in after the official interview – **the questionnaire**.

The full semi-structured interview protocol (its English version) with all questions and instructions can be found in [Appendix 1](#).

The following guidelines on “conducting the interviews” and “interview analysis” served as detailed instructions for local CS teams to complete the interview campaigns in a consistent manner. They are presented below in the same form as they were provided to the CS teams.

6.1. Conducting the interview

6.1.1. Preparatory tasks

As an interviewer, you do not have to be an expert on agricultural policy or agronomy. However, you need to understand the questions and why they are asked, especially the intention of the question (in case the interview partner asks back what is meant by the question). Moreover, the interviewer is supposed to know about the AES offered in the CS

region to be able to understand the answer and ask back if needed. Moreover, the interviewer has to be able to shortly describe the schemes in case the farmer has a question about a scheme (especially in the questionnaire section).

In the first part, the interview questions, the majority of questions are open questions to allow an open interview situation and avoid the atmosphere of an interrogation. The interview partner should feel free to answer the questions in a detailed way (e.g. by giving examples). Every interviewer should know the questions very well to allow for a good interview atmosphere (keep eye contact and be able to ask back).

It is not requested that more than one person conducts the interview. However, in case the resources allow for it, it is suggested that the interviewer is supported by a second person, who could either be an expert who also asks questions or someone who observes and takes notes. Make sure the roles within your team are clearly defined. For example, is the second person allowed to ask questions or not? And if so, how does he/she give a signal without disturbing the flow of the core interviewer?

What you need for the interview is the interview questions (please fill in the key data in the blue box prior to the interview) either on paper or on a tablet (a laptop is not recommended as it might give the impression you are hiding behind the screen). The advantage of the printed interview question is that you can take notes. For the questionnaire part, it is easier for the analysis if the farmer would answer the questions electronically (on a laptop or tablet). However, please also take a printed version of the questionnaire with you in case the farmer does not want to use the computer/tablet. You should prepare two versions of the questionnaire (for the laptop/tablet but also the paper version), one for the farmer participating in AES and for the ones who don't. In case you are not satisfied with the layout (due to the translation page breaks can occur), you are free to adapt the layout to your needs.

Prior to departure to an interview appointment, make sure you are well prepared for the interview, this includes being on time at the agreed place and have all the relevant documents with you. Being late or forgetting documents will negatively influence the first impression and can also influence the interview atmosphere (the interview partner spared time to talk to you and give you information relevant for the project. His/her benefits are usually low.

Therefore, make sure that prior to departure you

1. Check again directions and account for possible delays
2. Check contact details, such as phone number
3. Check you have all relevant utilities with you (recorder and spare batteries, tablet or computer for the farmer to fill in the questionnaire, interview protocol, consent form).

6.1.2. Getting started

All interviews have to be recorded. *Please do not use a smartphone for the recording*, use an [audio recorder](#) instead. If you use a smartphone, data protection cannot be ensured. Please

ensure the interview takes place in a **quiet surrounding** (prior to the first interview, please check the quality of the recorder by recording a short statement in different surroundings) to ensure good quality of the recording and that both sides are focusing on the interview and are not distracted by noise.

Also make sure that you interview only one person. In case the whole family sits at the table and becomes involved it will be difficult to identify the individual statements. You can explain it this way: When too many people speak, we cannot analyse the data correctly.

At the beginning, interviewers should thank the interview partner for agreeing to participate in the interview and introduce the aim of the interview as well as their role. Also, inform the interview partner about the potential length of the interview. Afterwards please introduce the engagement consent form and inform the interview partner that the interview can be stopped at any time. Also, ask for open questions (to build up trust). Afterwards, hand two copies of the consent form to the interviewee to read and fill in – make sure that you take one home and keep it for your own records. The other copy stays with the farmer. Prior to the first question, please mention that the recording starts now and thank the interviewer that you are allowed to record the interview. Please emphasise that it is a qualitative interview and as such, it is a rather open conversation and that it is about the perspectives of the farmer. It is not a survey.

6.1.3. General rules

The questions should be read out clearly (as with a standardized questionnaire) by you. For several questions, we added brackets that include hints for the direction of the answer. It is important that you read the question without the hints first. Only in cases where there is no answer or the answer covers only one aspects of the hint, you should ask back (i.e. To the question “Did you experience any difficulties while implementing the schemes? Which ones” the farmer mentions only administrative, the interviewer can ask if the farmer also experienced any technical, financial or social).

As an interviewer your basic attitude should be: The interviewed person has taken extra time for me, knows a lot and I am interested in his/her perspective. Even though as an interviewer you have your own opinion and assumptions, it is not relevant in the interview situation and you need to keep it to yourself because otherwise you will influence the answer.

6.1.4. Challenging situations

Conducting an interview for the first time often raises a lot of concerns. We cannot address all of them, but would like to give some guidance for situations that are likely to occur:

The interview does not run smoothly, especially at the beginning

For the farmer an interview is usually not an everyday situation. He/she might require some time to build up trust and feel comfortable answering the question. It means, if something does not go as planned, e.g., the conversation is not very smooth at the beginning, make yourself aware that it is not a mistake, but that it is quite normal. However, you should later on mention it in the postscript.

You don't understand the answer

You are interviewing an expert in the field of agriculture. So, in case you don't understand an answer to your question, don't worry. Not understanding some answers, especially in the first interview, is the rule rather than the exception. In such a case ask back nicely, e.g. as self-revelation: "Could you please explain what you mean by saying xy (or the term xy)". It won't harm the interview atmosphere and can even improve it because the interview partner understands that you are truly interested and are not just asking questions because they are on your list.

A questions was already (partly) answered before

The interviews are explorative and semi-structured, meaning that the interview is a conversation and not an interrogation. We are interested in the viewpoint of the farmer regarding his attitude and experiences towards AES. This requires that your interview partner has the freedom to talk. As a result, he/she might already answer questions, which come later in your guidelines. To avoid that the interview partner gets upset or annoyed, you need to decide if you have the question answered to you satisfaction already. In such a case, you can skip the question. In case you think the question is touched but not answered to you satisfaction, please tell the interview partner (i.e. "You already addressed the next question, which is "xy". However, is there anything you would like to add?"). Please always keep in mind that it is an interview guideline and all questions are relevant however since there will be no statistical evaluation, not every question needs to be answered in the same detailed way.

The farmer is questioning the recording of the interview

Farmers might be skeptical about the recording, which is understandable because everything he/she says can be called. However, for the analysis it is necessary to record the interview. In case the farmer asks why it is necessary to record the interview you can answer that the project requires the input from farmers and that everything he/she says is valuable information, when not recording it, information might get lost. Moreover, the interview will take a bit longer and by taking notes all the time, the interviewer cannot concentrate well enough on what the farmers says. Finally, the farmer does not have to be afraid about recording the data, because the audio recording will be stored on a secure drive to which only the interviewer has access. The transcript of the recording will also be stored on another secure drive and apart from the personal data, which means it will be pseudonymised. So, no one can trace back where the information comes from.

6.2. Interview analysis

After the interview, the data need to be further processed: Documents have to be stored, a report has to be written, the audio-recorded interview has to be transcribed and data to be analysed.

6.2.1. Data storage

All documents (consent form, notes) and the audio recording have to be stored safely either on a secure drive (for digital documents) or stored in a place that only you can access (locked

cupboard). Afterwards the interview has to be transcribed (see 4.3), this document also needs to be stored safely. Make sure that personal data are stored separately from the transcript. This you can do by setting-up a word or excel document (depending on your preferences) where you store personal data of the interview partner and provide codes for each interview (e.g. Guy Ziv (A1); Anna Cord (A2); Nina Hagemann (A3), ...). The code has then to be added to the transcript (and the personal data in the transcript are deleted).

6.2.2. Prepare a report for each interview

A short report has to be prepared for each interview with a focus especially on framework conditions of the interviews, such as the obstacles and challenges of the interview. Each report has a cover page that gives information on the code under which the interview transcript is stored as well as the FSA code (see Annex for information on how to construct the FSA code). The report shall be about one page long and reflect on the following aspects:

1. First contact and appointment setting: How did the farmer react (willingness to participate, possible objections, etc.)?
2. Description of the framework conditions during the interview (duration, location, disruption, etc.).
3. The course of the conversation (discussions about certain questions, resistance to answer any questions, etc.).
4. The post-interview phase: Sometimes crucial things are mentioned off the record after the recording has ended.
5. Did any unusual things happen?

The report should be written as soon as possible after the interview to ensure that no information will be lost. The report is crucial because it is the basis for the deliverable in month 17 ("Summaries of data, obstacles and challenges from interview campaigns") so it has to be prepared in English.

6.2.3. Transcription

A variety of established transcription systems with corresponding guidelines exist. The choice of the system depends on the aim of the interview. In Psychology, researchers are often interested in the behaviour of their interview partner. Therefore, they transcribe paralinguistic elements such as laughter, clearing of throat, interruptions. For BESTMAP we are interested in facts to inform the agent based model (ABM). This means we transcribe literally what was said without capturing side elements such as pauses, volume etc. For the modellers it is important that they understand what has been said in the interviews, so it is necessary to write sentences whenever possible. Because of resource constraints the transcripts cannot be fully translated into English. Therefore, for the analysis the original text (in the CS language) is used. Only quotes/text passages that go into analysis as examples need to be translated into English.

6.2.4. Data analysis

Data analysis of qualitative data (part 1 and open answers of part 2) will be based on a coding frame for qualitative content analysis. To be able to provide a template for the analysis, first results are required. The preliminary coding frame will be prepared by the German team after having conducted and transcribed the first interviews. In general, we will use a combination of deductive and inductive categories to develop our coding frame. The preliminary coding frame will consist of concept-driven categories derived from our interview protocol (main topics and aspects we ask for, e.g. “personal meaning of agriculture” will be such a category). The next step is data-driven: Based on the coding of the first 3 interviews in each CS, we will differentiate the initial coding frame by developing inductive subcategories that capture the variety of what was mentioned in the interviews (e.g. “producing high-quality food” could be such a subcategory). In order to do that, an online meeting will be organized. It is essential that everybody who has conducted the interviews, who has coded them and those colleagues who will do the coding participate in that online meeting (here we need the knowledge of what has been said in the interviews, how it has been said and the experience how the preliminary coding frame worked). Based on this online meeting, the German team will revise and expand the coding frame. This final version then needs to be applied to all interviews. Short guidelines with information on how to do the coding will be provided prior to the online meeting. Since it is unavoidable that some information gets lost, each CS needs to write one short interviews summary report (see Annex) that complements the information in the coding frame and the short reports.

For data analysis of qualitative data, each CS needs to buy, install and get familiar with the software [f4analyse](#). It is a very effective and simple tool that enables us to develop the coding frame, code the interviews and merge our results in the end.

Data analysis of quantitative data (closed questions of part 2) will be less sophisticated, as these can easily be coded. For example, farmer A1 answered the question 5: “How many total years have you been working in agriculture?” as follows: 10-30 years. In the coding system 10-30 years is a “3”.

1 = < 5 years

2 = 5-10 years

3 = 10-30 years

4 = 30-60 years

5 = > 60 years

In the software you will then add a 3 for A1/Q5. Table 8, that will be prepared for all interviewees, is a very simplified approach but gives you an idea of how the template could look like and what you will have to do. The German team will provide an Excel sheet as a template for this part of the data analysis as well.

Table 8: Example of template for coding the interview answers. Here farmers A1-A3, questions Q1-Q6.

Code	Q1	Q2	Q3	Q4	Q5	Q6
A1					3	
A2						
A3						

7. Implementing and documenting ABM using the ODD+D standard

BESTMAP will build the ABMs based on an open-source modelling platform. As the InVEST modelling toolbox that is employed in BESTMAP to model the provision of ES (see section 4.3) is implemented in Python, our first choice is to use an existing open-source Python-based ABM environment. This would allow easy scripting and interchange of data between the two platforms. Our current implementation plan builds on Mesa (<https://mesa.readthedocs.io/en/master/index.html>), a modular framework for building, analysing and visualizing agent-based models. The modules of the package are grouped into three categories:

1. Modelling: Modules used to build the models themselves: a model and agent classes, a scheduler to determine the sequence in which the agents act, and space for them to move around on.
2. Analysis: Tools to collect data generated from your model, or to run it multiple times with different parameter values.
3. Visualization: Classes to create and launch an interactive model visualization, using a server with a JavaScript interface.

There is also an extension to Mesa which allows to incorporate GIS data into models called mesa-geo (<https://github.com/Corvince/mesa-geo>) that will be used in the project. BESTMAP will explore existing open-source Python libraries to perform calibration/validation and sensitivity analysis - for example using SALib (<https://github.com/SALib/SALib>) package. High Performance Cluster resources to perform the analyses are available in several consortium organizations.

If, during the implementation phase, we encounter insurmountable challenges with Mesa, BESTMAP will adopt the more commonly used NetLogo ABM environment (which most ABM modellers, including our own, have experience with). The tight integration with python-based biophysical models can, in that case, be achieved by using the pyNetLogo package (<https://pynetlogo.readthedocs.io/en/latest/>), a library that allows to access and run NetLogo from Python (Jaxa-Rozen and Kwakkel, 2018). As with Mesa, this environment supports the use of python packages to sample and analyze a suitable experimental design for sensitivity analysis and to parallelize the simulations. Additionally, a NetLogo extension is available that provides the ability to load GIS data in NetLogo models (<https://ccl.northwestern.edu/netlogo/docs/gis.html>).

The final ABMs for each CS will be documented using the ODD+D protocol and deposited to an online code repository (e.g. GitHub, CoMSES Net). The ODD+D protocol is an extension of the 'ODD' (Overview, Design Concepts and Details) protocol describing ABMs that include human decision-making (Müller et al., 2013). It consists of three parts. First, it provides an 'Overview' of the purpose and main processes of the model. Second, in the 'Design Concepts' block, the general concepts underlying the model design are depicted. Third, in the 'Details', all of the necessary information is given that would allow for a reimplementing of the model. ODD+D adds elements on decision-making, adaptation and learning to the protocol. The

standardized form of the ODD+D protocol allows to document necessary information about the models to support transparent and complete model description.

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Appendix 1: Semi-structured interview protocol

Attached in PDF.