BESTMAP
BEHAVIOURAL, ECOLOGICAL & SOCIO-ECONOMIC TOOLS FOR MODELLING AGRICULTURAL POLICY

Data Management Plan (update 2)

Deliverable D1.6

31st August 2022

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BESTMAP

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

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Table of contents

Preface

This document is the third version of the Data Management Plan of the H2020 BESTMAP project. The original Data Management Plan was submitted in month 6 (D1.2) and is intended as a living document. The second version was submitted in month 18 (D1.4). Many of the data described in the previous update (D1.4) have now been collected and the following update shows how the data was utilised.

The scope of the Data Management Plan is to describe the data management life cycle of all data sets that are collected, processed or generated by the BESTMAP project, what methodology and standards are applied, whether and how this data will be shared and/or made open, and how it will be curated and preserved.

It also outlines any data that can not be made open, due to confidentiality or personal data protection rules. This document outlines how research data is handled during the BESTMAP project, and after the project is completed. Moreover, the document presents the different aspects of making data Findable, Accessible, Interoperable and Re-usable (FAIR).

Summary

Data is in use in several work packages and also in the five case studies;

WP2, Co-design and co-development, has collected qualitative data on the functionality and appearance of the dashboard through the co-design workshops at CS level. An EU level workshop is planned for late 2022/early 2023.

WP3, Farming System Archetypes, has created case study and European base layers using existing data. In addition, the modelling work on biodiversity, ecosystem services, socio-economic models and FSAs has collated and generated geospatial data. WP3 also produced novel R codes, developed to run the models at the case study level, and model factsheets containing the model specifications for each CS.

WP4, Agent-based modelling, in addition to the data from farmer interviews collected in the first year of the project, has conducted an online questionnaire in the form of a discrete choice experiment through which further quantitative data has been collected.

WP5, Upscaling, is currently working with spatial data to create models of how land management options affect ecosystem services at European level. Also, transferability analysis is being undertaken using FADN data, to determine how transferable CS regions are across the rest of the EU, linking CS models to European-wide ABMs and ecosystem service models.

WP6, will only work with data in terms of code for the implementation of the dashboard.

1. Data Summary

1.1. For each work package using data, please find below;

- a) Types and formats of data to be generated/collected;the purpose of data collection/generation; and its relation to the objectives for the project.
- b) Reuse of existing data.
- c) Origin of the data.
- d) Expected size of the data.
- e) Data utility (who might the data be useful to).

Work Package 2: Co-design & Co-development

a) Data type, collection/generation & purpose
Qualitative data was collected from the discussions that took place during March 2022 as part of the co-design workshops at CS level. A compendium of the co-design session outputs (report) was submitted in month 32 (D2.1). This report is confidential, (only accessible to members of the consortium, including Commission Services).

b) Reuse of existing data
Co-design workshops at CS level (WP2): H2020 SUPREMA scenarios and existing CAP strategies report (since the new CAP has not yet been implemented) have been used as baseline material for preparing the workshops.

c) Origin of the data
Co-design workshops at CS level (WP2): Public reports and scientific publications together with new materials generated by BESTMAP have been used to prepare the workshops.

d) Size of the data
Co-design workshops at CS level (WP2): 500 Mb

e) Data utility
The data collected is being used in WP6 during the further development of the dashboard. The dashboard itself will be of use to project stakeholders, researchers, management authorities in the agriculture sector, decision makers, national and international governments and non-governmental organisations.

Work Package 3: Farming System Archetypes

a) Data type, collection/generation & purpose

- Two harmonised geospatial databases, one across the CSs (Case Study Base Layer) and another on the European level (European Base Layer) that are being used throughout BESTMAP.
- Biodiversity, ecosystem services and socio-economic models (including their code and parameterization for different CSs). The outputs of these models are described in detail in deliverable D3.3 which was submitted in month 33. The specifications of the input, output and parameters used in the models in each CS are described in the model factsheets that are stored in the UFZ GitLab page (https://git.ufz.de/), together with the codes developed to run the models. The outputs of the models will be made publicly available via the UFZ GeoNetwork (https://geonetwork.ufz.de) at the end of the project.

- Farming System Archetypes (FSAs) for all CSs (typology and geospatial data), including the proto-FSA for interview stratification to select a representative sample of farmers for the interview campaign. The outputs of the FSAs are described in detail in deliverable D3.5 which was submitted in month 22.

b) Reuse of existing data
Base layers are based on existing data sources that are harmonised within BESTMAP (e.g. soil inventories, weather recordings, biodiversity, land use/land cover and farm structure data at the national and European level); see MS3, D3.1 and D3.2 for detailed information on the data sources used in the Case Study Base Layer, and in the European Base Layer. Moreover, Farm Accountancy Data Network (FADN) data will be used to upscale the model outputs from the CSs to the European level.

Models: Existing models (e.g. InVEST, R, statistical models, etc.), were implemented and adapted to model ecosystem services, biodiversity and socio-economic outputs in the CSs. The BESTMAP models are described in detail in deliverable D3.3.

c) Origin of the data
Base layers: A combination of case study-specific and European datasets are used. These are described in detail in the deliverables D3.1 and D3.2.
The input data for the biodiversity, ecosystem services and socio-economic models are described in deliverable D3.3. These include geospatial data collected in the base layers, as well as parameters, coefficients and other information extracted from the literature.

d) Expected size of the data
Thus far, hundreds of GB of data have been compiled for the CS and the European base layers. Similarly, the ESS, biodiversity and socio-economic models produced hundreds of GB of spatially-explicit outputs (e.g. rasters and shapefiles), whereas the codes used for modelling and the relative model factsheets are only a few MB in size.

e) Data Utility
Base layers and models provide essential inputs for the CS scale ecosystem service and agent based models (WP4) as well as for the European scale ecosystem service and agent based models (WP5). Base layers will be used as input information for the biophysical and socio-economic models and for the development and mapping of the FSAs. Model outputs will be translated into indicators and incorporated in the BESTMAP dashboard (WP6); moreover, they will be used in WP4 to analyse trade-offs and synergies across ESS, biodiversity and socio-economic outputs within and across CS. Model outputs from WP3 will also feed into WP5, as the policy indicators will be upscaled to European level, based on the FSAs and additional information from FADN data.

<u>Work Package 4: Agent-based Modelling & Analysis</u>

a) Data type, collection/generation & purpose
- ABM: qualitative and quantitative data from interviews and questionnaires with farmers in the form of interview transcripts and textual analyses; Data from Discrete Choice Experiments, ABM parameters additionally from literature.

- Spatial data on bundles of ecosystem services, biodiversity and socio-economic characteristics (standard data formats: (shapefiles/geodatabases for vector data, csv/txt for text files, geotiff/ascii for raster)
- As part of the dashboard implementation task, code will be produced.

b) Reuse of existing data
   - ABM: modelling framework and parameters adapted from available literature
   - Bundles and trade-off analysis will use data from ESS models developed for each CS in WP3
   - Indicators: database of existing CAP and SDGs indicators will be used as a starting point for translating bundles into policy indicators.

c) Origin of data
   - ABM: Input data is collected from the qualitative farmer interview campaign and subsequent quantitative questionnaires (including the discrete choice experiments)
   - ESS model outputs from WP3; CS-specific datasets from CS Base Layers harmonised within BESTMAP

d) Expected size of the data
   - In the order of tens/hundreds of GB
   - Indicators: depending on the number of indicators selected to be computed (around 2 Gb)

e) Data Utility
   ABM predicted changes will be used to infer changes in ESS, biodiversity and socio-economic outputs. The results of bundles and trade-off analysis will be translated into policy indicators. Data from individual CS will be synthesised to develop policy notes for policy-makers.

<u>Work Package 5: Upscaling</u>

a) Data type, collection/generation & purpose
   Data will be collected so that it can be used within various ecosystem service models at the EU-scale. The data generated will be for the purpose of allowing any stakeholders/policy-makers to see how land management options may affect future ecosystem service provisions. Data generation and collection relates mainly to objectives 2 and 4 of the BESTMAP proposal: '2. To operationalize the BESTMAP-PIAM modelling architecture, using co-design workshops, existing georeferenced datasets, farmers interviews, modelling and analyses and impact-focused dissemination.' and '4. To synthesise results in the regional CSs, demonstrate the potential of the approach at EU/Global scales, and build a road-map to upscale the approach to European-wide and international applications'.

   Data collected: spatial data relating to climate and weather, agricultural products, soil, biodiversity, and social-economic variables.

   Data generated: spatial data (most likely rasters) relating to different ecosystem services.

b) Reuse of existing data
Most of the data will be derived or taken directly from previous EU datasets. These include datasets from the JRC, Copernicus, FADN, and ESDAC. FADN data for transferability and European-wide ABM.

c) Origin of the data
Various origins, recorded at various scales, but mostly from EU data sources.

d) Expected size of the data
Several to 100s of Gb depending on the particular dataset.

e) Data utility
Ecosystem services modellers within the project initially, followed by policy-makers once the data is displayed via the online dashboard.

Work Package 6: Capacity Building & Dissemination

a) Data type, collection/generation & purpose
As part of the dashboard implementation task, a list of suggestions will be generated for new indicators that will fill existing gaps. Creation of spatialized outputs of the indicators developed during the modelling process will be made available through the dashboard (D4.3).

b) Reuse of existing data
Dashboard implementation: Data and tools generated in WP3, WP4 and WP5 will be linked to the dashboard. Existing independent and reusable modules open standard modules (such as MiraMon Map browser) and APIs will be used.

c) Origin of the data
Dashboard implementation: Results from previous projects (H2020 Ecopotential / PhenoTandem) available at GitHub.

d) Expected size of the data
Dashboard implementation: depending on the data that will be displayed (around 10Gb)

e) Data Utility
The data presented will be of use to project stakeholders, researchers, and management authorities of the agriculture sector, decision makers, national and international governments and non-governmental organisations.

2. FAIR Data

2.1. Making data findable, including provisions for metadata

The project has adopted a single ‘OpenBESTMAP’ identity (e.g. username) across multiple community websites to develop a link to the project during and after its lifetime.

Work Package 3: Farming System Archetypes

Case Studies and European Base Layers: Efficient data management is ensured by utilising the UFZ GeoNetwork application (https://geonetwork.ufz.de). Access to the BESTMAP instance of the UFZ GeoNetwork requires a registered account. 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). 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. A unique dataset identifier code is generated automatically. Details on the storage, access, meta-data curation and handling of the geodata can be found in the reports accompanying the base layers, D3.1 and D3.2.

Naming conventions have been followed as below;

- For the CS base layer: $CSCountryCode_$Year_$DatasetName.$FileExtension, e.g. DE_2018_SoilOrganicCarbon.shp
- For the European Base Layer: $EU_$Year_$DatasetName.$FileExtension, e.g. EU_2013_TopsoilOrganicCarbon.tif
- For interview transcripts CS_case code _FSA code_interview date, e.g. DE_A1_DE1N01CON05COCM_2020-02-06 For details see guidelines for interview analyses.

For the CS base layer these keywords are provided: CS Country, CS Name, “BESTMAP”, “Case Study Base Layer”, and a selection among the categories: Soil, Climate, Land Use/Land Cover, Terrain, Biodiversity or Agriculture. For the European Base Layer, the keywords used will be “EU”, “European Base Layer”, and a category equivalent to those used for the CS base layer records.

Using the UFZ GeoNetwork will establish long-time data availability since BESTMAP’s GeoNetwork instance will be continued beyond the running time of the project. Weekly backups ensure data security. Data can be retrieved through UFZ data search and further improving discoverability through geonetwork’s API is currently being discussed by UFZ IT staff.

Sensitive data which cannot be shared among the whole BESTMAP team are instead stored in password protected Google GSuite drives, visible only to a sub-group of BESTMAP members, or in network drives with restricted access and that are hosted at the institution which has access rights to the data.

The ESS, biodiversity and socio-economic models developed in WP3 are based on open source softwares (e.g. InVEST, R, Python), and all novel codes developed for this task are stored in the UFZ GitLab (https://git.ufz.de/). The outputs of the models will be permanently stored in the UFZ GeoNetwork and made freely accessible at the end of the project. The policy indicators based on the model outputs will also be uploaded to the BESTMAP dashboard.

Work Package 4: Agent-based Modelling & Analysis

The data will be stored and managed in 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). Metadata is compiled in accordance with the ISO19139 standard.

Different versions of the ABM models will be documented for internal purposes. Only the final ABM model will be made available online.

All metadata for the ABM models will be documented in detail using the standard ODD+D protocol (cf. Müller et al. 2013 EnvModSoftw).

Other data sets will follow the metadata standards implemented in the UFZ GeoNetwork application in accordance with the ISO19139.

Work Package 5: Upscaling
Most data that will be used as inputs to WP5 can be found on EU websites. All of these data will be stored and managed in the UFZ GeoNetwork application (https://geonetwork.ufz.de). See the WP3 section for details. Data produced will have metadata, which will follow metadata standards implemented in the UFZ GeoNetwork application, including dates, assumptions and original data used. All data will also have DOIs.

Keywords will be provided that optimise possibilities for re-use. For the final output, keywords will be provided that relate to the ecosystem service provided, together with keywords such as the bioclimatic variables that were included in the analysis (e.g. soil, climate, land use).

WP5 will follow their own naming convention, which suggests that names should be short, with no spaces or special characters, and will reflect the content. Naming conventions will follow: $EU_$Year_upscaling_$EcosystemService.$FileExtension,
e.g. EU_2017_upscaling_Biodivesity.tif. Clear version numbers will also be provided.

2.2. Making data openly accessible

Work Package 2: Co-design & Co-development
As per DoA, the project outcomes will be integrated with European knowledge hubs and initiatives such as GitHub, Zenodo, OpenAire, OPPLA and RIA. Dashboard code is deposited in the GitHub repository (https://github.com/grumets/MiraMonMapBrowser). The dashboard is developed under JSON.

It will be possible to access the data using any general GIS software. No documentation is needed to access the dashboard data, and D2.3 provides a guideline of data and functionalities implemented. It will be possible to include the relevant software.

Work Package 3: Farming System Archetypes
Biodiversity and ES models: code produced in BESTMAP is deposited in in the UFZ GitLab (https://git.ufz.de/); whereas model outputs will be made publicly available on the UFZ GeoNetwork at the end of the project. FSA results are already available at BESTMAP dashboard (https://www.ogc.grumets.cat/bestmap/)

Work Package 4: Agent-based Modelling & Analysis
The final ABMs for each CS, including their conceptual framework, parameterization and implementation, will be clearly documented using the ODD+D protocol. The protocol and model codes will be made open access and deposited to an online code repository, e.g. GitHub, CoMSES Net (https://www.comses.net/).

Work Package 5: Upscaling
Used data will already be available from EU websites. Produced data will be made openly available via deposition in CEH's repository. No software tools will be needed to access the data. It will be possible to include the relevant software (e.g. in open source code), if required.

Data and associated metadata, documentation and code will be deposited in CEH's repository. Access will be provided via request form entry. There will be no need for a data access committee. There are well described conditions for access. The identity of the person accessing the data will be attained using their name, email address, and organisation.

2.3. Making data interoperable

Work Package 2: Co-design & Co-development
The dashboard user interface is developed using as many OGC web services and OGA API standards as possible, with standard protocols. In fact, one of the partners of the project, Dr. Joan Masó from CREAF, is an expert in interoperability, quality and certifications; member of the Technical Committee of the Open Geospatial Consortium (OGC) and editor of standards and Spanish representative of ISO19115-1 and ISO19157.

Work Package 3: Farming System Archetypes
For the Case Study Base Layers, CS-specific datasets were named uniformly, clipped to the CS areal extent, and projected to the geographic ETRS89/Lambert Azimuthal Equal Area projection coordinate reference system (EPSG: 3035) (in metres). Standard data formats are used (.shp for vector data, .csv for text files, .tif/.grd/.asc for raster) in order to facilitate data exchange and compatibility with standard open source software such as R.

The same harmonisation process is applied to the data collated for the European Base Layer. The Case Study Base Layer provides the base for the biophysical and socio-economic models, and for mapping the Farming System Archetypes in each of the CSs. Model outputs have the same formats and coordinate reference system of the data collected in the base layers, and follow the same standardised naming convention.

Work Package 4: Agent-based Modelling & Analysis
Interoperability of developed ABMs will be secured through the standard documentation of ABM models using the ODD+D protocol. This protocol describes decision-making, adaptation and learning of the agents in a comprehensive and transparent way. The ODD + D protocol will also incorporate a section on 'Theoretical and Empirical Background' to ensure that model design and model assumption are closely documented in relation to general theories, which other ABMs may build on.

Work Package 5: Upscaling
Data produced in WP5 will be interoperable, with defined metadata vocabularies, in accordance with the ISO19139 standards. Standard vocabularies for all data types present in the data set will be used. If it is unavoidable to use uncommon or to generate project specific ontologies or vocabularies, mappings to more commonly used ontologies will be provided.

2.4. Increase data reuse (through clarifying licences)

Work Package 2: Co-design & Co-development
The dashboard code is distributed under the GNU AFFERO GENERAL PUBLIC LICENCE. We encourage reuse of our code. We will appreciate a reference in the acknowledgements of any modified code.

Work Package 3: Farming System Archetypes
Data will be licensed to permit the widest re-use possible. Data will be made available for reuse at the end of the project plus any embargo periods. Licensing for every dataset will be reported in the metadata record in the UFZ GeoNetwork. Data will be usable by third parties but given it is based on 2019 LPIS/IACS data, will become obsolete in 4-5 years.

Work Package 4: Agent-based Modelling & Analysis
Data will be licensed to permit the widest re-use possible. Data will be made available for reuse at the end of the project plus any embargo periods. Data will be usable by third parties but given it is based on 2019 LPIS/IACS data, will become obsolete in 4-5 years.

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Data will be licensed to permit the widest re-use possible. Data will be made available for reuse at the end of the project plus any embargo periods. Data will be usable by third parties but given it is based on 2019 LPIS/IACS data, will become obsolete in 4-5 years.

3. Allocation of Resources

For all work packages, no additional costs are expected compared to how all beneficiaries currently store data as part of their normal work. Resources for long term preservation will be decided in due course.

4. Data Security

Provisions in place for data security (including data recovery as well as secure storage and transfer of sensitive data). How the data is safely stored in certified repositories for long term preservation and curation.

Work Package 2: Co-design & Co-development
Sensitive data generated during the Co-design sessions, such as minutes, is stored in BESTMAP G-Suite.

Dashboard code is stored at GitHub repository and data ingested is mainly stored at CREAF facilities or at other secured repositories of the project such as UFZ GeoNetwork. Data

recovery at CREAF is guaranteed by regular back-ups. Data stored at CREAF facilities will be preserved for at least 5 years after the end of the project.

Work Package 3: Farming System Archetypes

Base layers: Geodata for the base layers and model outputs are securely stored in the UFZ GeoNetwork. Data, and recovery will be guaranteed by regular backups from the server. R codes developed to run the ESS, biodiversity and socio-economic models are stored in the UFZ GitLab. Access to sensitive data is restricted either through password protected Google GSuite drives or network drives with restricted access. Encryption softwares (e.g. BoxCryptor, BitLocker) will be used to ensure high safety standards for sensitive data storage. Furthermore, it is planned to create a repository where versioning of data is granted. The curation process is under development and will be fully implemented in the future.

Interviews: Personal data such as contact information are stored in a protected data cloud at UFZ Leipzig. Personal data from farmer interviews have been pseudonymized before the transcription of audio recordings; only transcripts without personal data will be used for further analyses; the original audio records are stored on local hard-drives secured in locked office shelves.

Work Package 4: Agent-based Modelling & Analysis

Geodata for CS and European base layers will be securely stored in the UFZ GeoNetwork. Data recovery will be guaranteed by regular backups from the server. Access to sensitive data will be restricted by implementing a user and group management with varying access rights. Furthermore, it is planned to create a repository where versioning of data is granted. The curation process is under development and will be fully implemented in the future.

Data from farmer interviews and questionnaires (including discrete choice experiments (DCE)) have two levels of security. First, they are pseudonymized, so no sensitive data can be associated with specific individuals or companies. Second, only transcripts of interview or coded data as well as aggregated data from the DCE are used for the development of ABMs. The actual interview recordings are saved on local (off-line) hard drives stored in locked shelves at project partner institutions.

Codes for ABM models and scripts for bundles and trade-off analyses will be deposited in a certified online repository (e.g. GitHub).

Work Package 5: Upscaling

CEH has back-up servers, and has high security measures. Transfer of sensitive information is strengthened by CEH's encrypted emails and level of security.

WP5 will also use FADN data for transferability analysis and for upscaling to the European-wide ABM and BPMs. The FADN data will be used by the five beneficiaries (University of Leeds, TU Dresden, Helmholtz UFZ, UKCEH, and Biosense Institute) and will be stored by each of these partners on a secure network drive which is protected by a firewall, further encrypts the data both at rest and in transit to industry standard AES256, and is only accessible to named members of the research team.

5. Ethical Aspects

Any ethical or legal issues that can have an impact on data sharing. Can also be discussed in the context of the ethics review.
Informed consent for data sharing and long term preservation included in questionnaires dealing with personal data.
Personal data protection refers to protection of information that relates to an identifiable natural person—a person who can be identified by referencing a name, id number, location data or other identifier. Protection of personal identifiable information is regulated by GDPR

Case studies
Interviews: All data gathered during face-to-face interviews has been stored and processed in compliance with the General Data Protection Regulation (GDPR), and following ethical approval procedures in the relevant partners. Refer also to D7.1 H - Requirement No.1 which describes ethical procedures regarding the case study interview campaigns in detail.

Data collected via the interview was subsequently pseudonymised and stored in the project's G-Suite for Education, (specifically Drive for data storage), which encrypts data using the TLS standard, (the HTTPS connection standard), on local machines. The data is then unencrypted then re-encrypted using 128-bit AES when stored on the cloud storage server. The AES encryption keys that were used to encrypt the data are also encrypted with a rotating set of master keys.

Work Package 2: Co-design & Co-development
For the co-design sessions, a consent form was distributed among the attendees prior to the workshops. All data gathered during the sessions has been stored in the project G-Suite for Education.

Work Package 4: Agent-based Modelling & Analysis
WP 4 uses anonymised, aggregated data from farmer interviews and questionnaires. See paragraphs above on their handling and security measures. No other personal or sensitive data will be used.

Work Package 5: Upscaling
WP5 will use FADN data for transferability analysis and for upscaling to the European-wide ABM and biophysical models. We will use FADN data mainly for (a) developing statistical regression based models; (b) as input to an agent-based model whose outputs are aggregated at NUTS3 or coarser level. We plan to link FADN records with environmental data, and may use NUTS3 and elevation bands for this purpose. However, in all use cases for FADN data, we will not de-anonymize FADN farms.

Work Package 6: Capacity Building & Dissemination
An important part of the BESTMAP communication effort is dedicated to Social Media Networks. BESTMAP project is actively present on three different platforms – Linkedin, Twitter and Facebook. The strategic goal of BESTMAP activities on Social Media is to inform the audience about project activities, to attract people to join and to disseminate project results.

Posting content on Social Media has many ethical concerns from how to adopt transparency to how to protect private data of either followers or participants of the project. In the process of collecting and analysing data for other activities of the BESTMAP project, some information might be interesting for sharing on Social Media. Nevertheless, in order to

respect ethical codex, none of the personal or confidential data will be shared on BESTMAP social media accounts under any circumstances. Information such as general conclusions or aggregated statistics will be considered for sharing if their content might be useful for a wider community or if they may contribute to better understanding BESTMAP project results.

6. Other Issues

No further issues are foreseen at this time.