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SUSTAINOLIVE

Ontology of agroecological sustainable concepts of interest in olive farming

Deliverable D 2.3

WP2. Synopsis of olive grove farming, including conceptual approaches, methods and STSs identification

Novel approaches to promote the SUSTAInability of OLIVE cultivation in the Mediterranean

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Executive Summary

This document contains a description and ontology of the agroecological concepts of relevance for sustainable olive farming, as elicited within the scope of the SUSTAINOLIVE project. SUSTAINOLIVE is a project funded by PRIMA H2020 Section 1 under the topic: Improving the sustainability of Mediterranean agro-ecosystems. SUSTAINOLIVE aims to enhance the sustainability of the olive oil farming sector throughout the implementation and promotion of a set of innovative sustainable management solutions that are based on agro-ecological concepts, and on the exchange and co-creation of knowledge involving multiple actors and end-users of the olive oil sector.

The document has been prepared as part of SUSTAINOLIVE Work Package WP2 and corresponds to the deliverable 2.3 of SUSTAINOLIVE, and delivers a document to be adapted and updated as required during the whole duration of the SUSTAINOLIVE project. The main agroecological concepts of relevance to identify and characterize Sustainable Technological Solutions are hereby described. The agroecological concepts identified are reported in a database format for easy consultation, with a definition which includes references to official websites and scientific literature. To facilitate transfer to the end-users, links to the application in the olive growing sector are provided where relevant, referring to activities of SUSTAINOLIVE in other WPs. The deliverable describes the process followed to reach the complete database.

The deliverable includes interactive Excel and PDF files as attachments.

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1- Working plan

The Deliverable D2.3 is the main product of SUSTAINOLIVE Task 2.3, SubTask 2.3.1 "Review and adaptation of key agroecological and sustainable concepts", scheduled from month 4 to month 15 in the project. The aim as stated in the project is to:

- collect information on sustainable concepts considered as relevant in the different contexts of SUSTAINOLIVE, and under different conditions

- discuss the descriptions of these concepts, reaching a "taxonomy", i.e. an ontology of defined terms with a glossary for wide distribution, understandable in all countries involved

The explicit purpose of the document is thus to identify and define the most important indicators and concepts for building the Sustainable Technological Solutions (STSs). It is a necessary step to provide the Terms of Reference for developing activities and evaluating sustainability, whilst avoiding misunderstandings. The confusion might derive from the translation of common concepts from English to national languages and vice versa. But additional forms of misunderstanding are possible. For example, one concept of interest could be "cover crops", but the definition of cover crops can be different in different countries, or mean something different to the various types of stakeholders, farmers or administrators.

Based on these indications, the work has been organized following the successive main steps, that are indicated as reported:

1. UNIPR identified, from the Project description and from the relevant literature, the core list of concepts, keywords and terms. This core list was discussed with the project coordinator and WP leaders.

2. UNIPR identified the main international standards and definitions for each concept, where available.

3. UNIPR compiled a database (Excel for easiness of use) where each term or concept is described using the standard definitions; additionally, the table included at least one example of usage of the term in a document written in English (scientific paper, legislation, legal document and similar).
4. UNIPR distributed the document to the leading National partner, inviting for contributions, additional terms, suggestions, references.
5. UJAEN, UEVORA and UNIPR discussed the inclusion of further concepts. UJAEN modified the file format into an interactive Excel-based tool (Appendix 1) and a complementary interactive Pdf-based tool (Appendix 2).
6. Each leading partner, in representation of its own country, has the task of translating the terms into national languages, using the provided examples and references as a guide, with the purpose to ensure that each English term has a corresponding term to be used when dealing with farmers and stakeholders at national level.
7. A 2-day workshop will be organized with the purpose of identifying gaps and redundancies, finishing the translation process with the help of discussion among partners, collaborating to obtain a uniform document describing the database (these workshops have been delayed and reorganized due to COVID-19 pandemics).
8. Completion of the deliverable document will occur via e-mail contacts and exchanges.

The current stage of operations is between stages 5 and 6.

2- Why an ontology in SUSTAINOLIVE?

According to the most widespread definitions, an ontology represents the concepts in a specific domain or field, with their attributes and relationships, in a way that can be interpreted by IT (information technology) machines, decision support systems or similar [Chandrasekaran *et al.*, 1999].

The main tasks performed by ontology users are the following:

(i) Sharing of terms and concepts
(ii) Searching for knowledge
(iii) Implementing interoperability of systems and processes
(iv) Functioning in a decision support systems

In the agricultural and farming sector, it has been demonstrated that ontologies might have a variety of applications, ranging from the classification of agricultural concepts and the development of information and knowledge databases, to the research and development of intelligent search engine and the creation of cooperative information services [Zheng *et al.*, 2012]. One of the main purposes of an ontology is therefore to act as a way for sharing information throughout the world, especially when it becomes necessary accommodating for translations in different languages. This function as "thesaurus" is exemplified by the AGROVOC resource [http://www.fao.org/agrovoc/]. Such a tool can be essential in allowing interoperability and assisting farmers in recovering information. The tool therefore allows for the translation of each concept into the national languages, starting from English, in order to allow a meaningful interaction with farmers in the respective countries.

An additional role for the proposed SUSTAINOLIVE ontology concerns the transposition, rather than translation, of the same agroecological concepts to the olive growing sector, in line with the objectives of the SUSTAINOLIVE project. The effort made by the partners in drafting the tool and the corresponding deliverable implies the following conceptual steps:

(i) Understanding each agroecological concept, using the standard definition provided in English, and the references to sources
(ii) Considering the applicability of each agroecological concept in the context of olive growing and supply chain in the respective countries
(iii) Reporting the information in the database and using it for planning the project activities

The product hereby described may thus not be strictly defined as an ontology because it lacks (at the moment) the tree of relationships connecting each of the entities to each other. It shows however a classification of entities, or concepts, into broad categories related to sustainability issues. This could eventually be transformed into a more formal taxonomic tree.

3- Key sources of information

The starting point of this work has considered commonly distributed ontologies, vocabularies or taxonomies existing in the field of agriculture, food, but also ecology, environmental and sustainability sciences, and socio-economics.

The Agricultural Information Management Standards (AIMS) Portal [http://aims.fao.org/, accessed November 2020] synthesizes the information about the agricultural sector. This Portal is the meeting point for several information sources, first of all the AGROVOC Thesaurus, created in 1980 (see section 2.2). AGROVOC is connected to AGRIS, a bibliographic database for recovering publications on all subjects. Additionally, the AgroPortal [http://aims.fao.org/agroportal, accessed November 2020] is a key resource about agricultural data, also a starting point for accessing several other resources. Several ontologies are cited in the recent literature, but most of those efforts were generated for specific projects and are no longer available. Such examples include ONTAgri, AgriOnto, Chinese Agricultural Thesaurus, OntoCrop.

4- Choice of agroecological concepts and bibliographic search

The terms collected in this glossary are the result of various meetings between the partners of SUSTAINOLIVE. Furthermore, the surveys to farmers and producers (Task 2.1) have been examined to help unveil both apparent and hidden strengths, weaknesses, opportunities and threats (Task 2.2) for each of the olive farm management models and typologies identified, and to assess the diverse sets of solutions that are currently in place in the different regions. The entries collected therefore belonged to different fields, not only strictly related to agriculture but to all those areas (such as socio-economics, computer sciences,

environmental and territorial sciences) that are relevant for this project and play a potential role in the olive sector. Therefore, to fully understand the implications of different practices within the olive domain, it ought to be crucial to integrate information from concepts in various disciplinary fields. The ontology created therefore provides with concepts from the olive system that are semantically catalogued to simplify the interpretation by each of the partners in the project.

The terms and definitions have been selected based on their connections, where possible, to published references and existing databases. The main sources for references are listed in Table 1. The rest of the sources used for translating the agroecological concepts to olive grove sector are compiled in Table 2.

Table 1. List of main sources used to obtain the terms for the database

NAME	URL	DESCRIPTION
AGROVOC	Link	Multilingual controlled vocabulary covering all areas of interest to the FAO
agrO	Link	The Agronomy Ontology (AgrO) coordinated by the CGIAR Research Centers, provides terms from the agronomy domain that are semantically organized and can facilitate the collection, storage and use of agronomic data
GLOSSARY OF SOIL SCIENCE TERMS	Link	Glossary of terms for the various disciplines of soil sciences provided by the Soil Science of America
DICTIONARY OF AGROECOLOGY	Link	Online open source dictionary about agroecology provided by INRA
NATIONAL AGRICULTURAL LIBRARY	Link	The National Agricultural Library (NAL) is one of five national libraries of the United States. It houses one of the world's largest collections devoted to agriculture and its related sciences
Wikipedia	Link	Free online encyclopedia

AGROVOC is the best-known ontology for the agricultural sector, and is managed by the Food and Agriculture Organization of the United Nations (FAO). It works

as a glossary or vocabulary, providing translation in different languages for thousands of concepts. Thus, it is not a real ontology, as has been recently evidenced [Ngo *et al.,* 2018]. The release of February 2021 includes 38,442 concepts and over 801,000 terms covering 40 languages. It is therefore the most important source for information in the agricultural and farming sector.

The database "Agronomy Ontology" (agrO) is hosted in the platform of CGIAR research centers (Consortium of International Agricultural Research Centers) and contains agronomic practices, indicators and technologies. It can be searched online in the website reported in Table 1 (accessed November 2020). The latest version of April 2020 includes 2,266 terms.

The Glossary of Soil Science Terms is a very useful tool for retrieving information on soil properties and definitions, and it is managed by the Soil Science Society of America (www.soils.org accessed November 2020). A glossary for soil related terms is also available in the European Soil Data Centre (ESDAC, https://esdac.jrc.ec.europa.eu; resource-type-glossary accessed November 2020).

The Dictionary of Agroecology is a glossary oriented to the specific concepts and terms of use in agroecology, and therefore similar in idea to the SUSTAINOLIVE ontology. In this Dictionary, each entry has been curated by specific authors to provide a detailed information on the concepts, similar to an encyclopedia. The latest entries date to April 2020 [https://dicoagroecologie.fr accessed November 2020].

The National Agricultural Library Thesaurus (NLAT) is an online vocabulary of agricultural terms in English and Spanish and is cooperatively produced by the National Agricultural Library, USDA and the Inter-American Institute for Cooperation on Agriculture as well as other Latin American agricultural institutions belonging to the Agriculture Information and Documentation Service of the Americas (SIDALC) (https://agclass.nal.usda.gov/).

Table 2. List of sources used to translate the agroecological terms to the olive grove sector

Source	URL	Source	URL
About olive oil (North American Olive Oil Association) Glossary	Link	Messors	Link
Aceite de las Valdesas	Link	Nature Ecoevocommunity	Link
Agronomía y poda del olivar (Junta de Andalucía)	Link	Olimerca	Link
Almazara San Cristóbal	Link	Olive Oil Market	Link
Castillo de Canena	Link	Olive Oil Source	Link
Clarifygreen	Link	Olive Oil Test	Link
CPRAC	Link	Olive Oil Times	Link
Digital CSIC	Link	Olive orchards (FAO)	Link
El Olivar Ecológico (Consejería de Agricultura y Pesca, Junta de Andalucía)	Link	Olive4Climate- Life	Link
Elaiophysis	Link	Production techniques in olive growing (International Olive Council)	Link
Esencia de olivo	Link	PubMed	Link
Esmeralda Project (glossary for ecosystem services)	Link	PV Magazine	Link
Estimación de la huella de carbono en el sector del aceite de oliva en la provincia de Toledo	Link	ResearchGate	Link
FAO	Link	Revista Edafología	Link
Gestiriego	Link	Santagata glossay of oil terminology	Link
Interempresas	Link	Science Alert	Link
International Food Policy Research Institute	Link	ScienceDirect	Link
International Society for Horticultural Science	Link	Seo Birdlife	Link
Journal of Economic Entolomogy	Link	SFGATE Homeguides	Link
Livitaplus	Link	Sustainolive	Link
MDPI	Link	The Olive Press	Link
Mediterranean Garden Society	Link	UC Drought Management	Link

5- Database construction

The choice of Microsoft Excel as the database management program of use for the first collection of entries and their related information was dictated by the ease of use and the feasibility to quickly communicate and easily send updated versions between colleagues and to partners. The next step, once completed the

entries collection after partners meeting in the 2-day workshop, will be to use the data to build a proper ontology, to emphasize attributes and relationships between terms, through specific programs (such as Protege [Knublauch *et al.*, 2001], Figure 1) and in a programming language or coding language (e.g. Python) that will potentially allow the upload to different platforms.

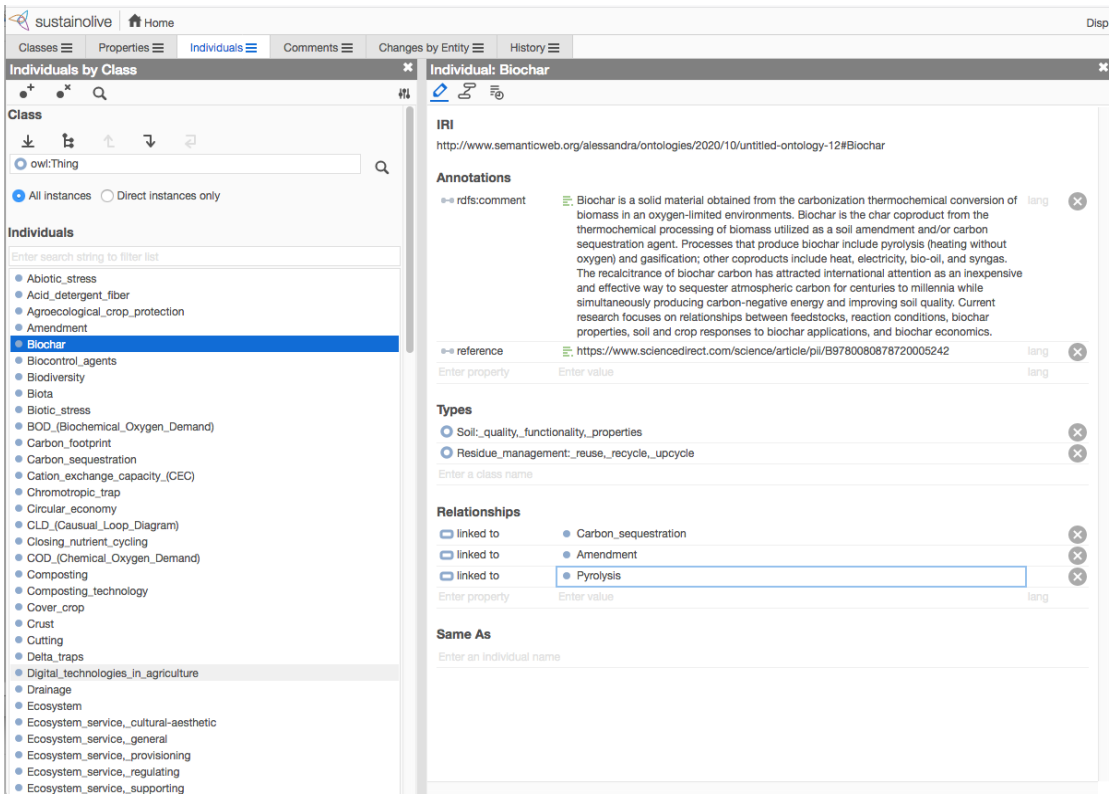

Figure 1: Screenshot of the entries written in Web Ontology Language, the Protege elaboration showing the features of the entry "biochar": it shows the definitions, links to other entries, classification.

5.1- Structure of the database

The ontology constructed for SUSTAINOLIVE aims to fulfill the four main tasks that are expected to be potentially performed by ontology users:

(i) Sharing terms and concepts: each partner has access to all terms and can translate them into their national language; the same can be done in future for additional languages.

(ii) Searching for knowledge: the reference to standards, web pages, repositories and published papers acts as a starting point to look for additional information about each concept or entity.

(iii) Implementing interoperability of systems and processes: the translation into different languages and the transposition to the olive sector is the basis for operations in the different national contexts keeping the connection to the common objectives of SUSTAINOLIVE, and more generically also the connections to sustainability goals.

(iv) Functioning as a decision support system: the information included in the database and gathered by partners in each national context allows for more efficient and coherent decisions to be made in the context of the experimental work planned within SUSTAINOLIVE.

The Excel file has been structured with several "boxes" corresponding to each concept containing the main components of each entry, or concept, as detailed in Table 3.

Table 3. Description of the structure of the database entries.

Feature	CONTENT
Term	The name of the agroecological concept, process or parameter of interest
Definition	Opens a hidden box with the text describing the concept
Sources	One or more sources containing relevant information, mostly with hyperlink to external websites
Olive grove application	Opens a hidden box with the short description, with references if needed, about the application of the term in the olive sector

5.2- Classification of concepts

An ontology always includes a hierarchy, in which the concepts can be grouped in categories [Haverkort *et al.,* 2006]. Table 3 describes the components of the Ontology Excel file devoted to categorization, as reported in the different Excel sheets. For the purposes of the SUSTAINOLIVE project, it is relevant that each term or concept can be linked to the environmental challenges and solutions

towards increased sustainability identified. From these considerations and based on the text of the project description of work, we have identified nine main issues for olive groves and farms which are of direct relevance for environmental impact:

- soil and nutrition
- water
- biodiversity
- diseases and pest management
- by-products management
- olive harvesting and oil production
- ecosystem services
- sustainability
- socio-economic values

For each of these nine issues, a list of corresponding "concepts" has been identified and these concepts are described in separate sheets of the Appendix 1.

By adopting this classification, the agroecological concepts in the Excel database can be linked to the categories of concepts, resulting in the linkage of each term to one or two of the Sustainable Technological Solutions.

For instance, the concept of "biochar" is connected to solutions dealing with soil fertility and improvement, as amendments, but also to the solutions dealing with management of residues from cultivation, since it can result from pyrolysis of the pruning material or pits. This effort for classification, to be improved with the intervention of partners during the lifetime of the project, will be relevant for the activities of WP3 and WP4 in planning and monitoring the activities in the experimental farms and plots.

5.3- Translation of agroecological concepts to olive sector

The process of selection of the farms and groves in the 6 countries involved in the project has been essential for planning all activities on Sustainable Technological Solutions and final evaluation of their effectiveness.

The choice has been guided by the environmental problems and issues discussed in Section 2.5, leading to the consideration that in each country the same problem can manifest in a different way and that the olive growing sector has regionally

and locally contingent characteristics. For instance, the use of cover crops in olive groves is quite different from the use of cover crops in other orchards. Additionally, the cover crops used might vary from country to country, in response to different needs for soil protection, or biodiversity management for instance.

These reasons motivate the inclusion of a specific feature in the database, where the partners will address how the agroecological concept can be applied (or transposed) to olive farms and olive oil production systems. Combined with the future translation in the different languages, this will provide the final operational tool to enable each partner to classify, describe and monitor the key Sustainable Technological Solutions involving local and other pertinent actors.

The process of transposition/translation will be improved along the future months, with the contribution of all partners, and finally discussed in a joint workshop.

6- National and regional heterogeneities, including barriers and opportunities

The Mediterranean area is culturally very diverse, and the partnership of SUSTAINOLIVE reflects a good portion of this diversity. The SUSTAINOLIVE partnership encompasses 6 different Mediterranean countries operating in at least 6 different languages, all of them besides English: Spanish, Portuguese, Italian, Greek, Arabic, French. It has been felt as important to provide the partners with a tool allowing for a definition of the most relevant agroecological concepts to bring everybody towards a common ground.

After the first set of definitions was drawn up by researchers from UNIPR, the template was submitted to all partners, asking for contributions for integrating missing entries and proposing new solutions.

This work will be completed along the final workshop with partners, which was unfortunately rescheduled because of the COVID-19 situation.

7- Subsequent stages and plan forward

According to the Work Description, partners will meet in a (2-day) workshop to validate the descriptions of the agroecological concepts, and agree on a final "taxonomy", i.e. an ontology of defined terms with a glossary for wide distribution, understandable in all countries involved. In the same workshop, the discussion will highlight the most relevant indicators and concepts for building the STSs.

The occurrence of the COVID-19 in 2020 has brought to the cancelling of all live meetings, and the situation is still ongoing in 2021. The discussion needed to finalize the ontology is agreed to require a live meeting and therefore it has been decided to postpone the completion of this Task to future months. Preliminary online meetings involving UNIPR, the WP leader (UNIEVORA) and one partner at a time will be carried out to discuss the current version of the ontology.

Before the meeting, each partner representing the 6 countries involved will conclude the analysis of their list of agroecological concepts, considering the completeness and the transposition to the olive sector. Suggestions for amendments and inclusions will be collected in order to be ready for discussion in the workshop.

The final actions will concern the completion of translation in all languages and the eventual transfer of the data in an online ontology format.

8- Resulting products and results

The main product deriving from the work is the Excel database described in this Deliverable, enclosed as Appendix 1. The Excel sheet includes links to external websites, verified at the date of delivery. It also includes connections with slides to facilitate the transfer of the agroecological concepts to diverse types of end-users (Figure 2). Additionally, all these slides were put together in an interactive pdf guide on basic agroecological concepts targeted to stakeholders of the olive industry (Appendix 2; see also Figure 3).

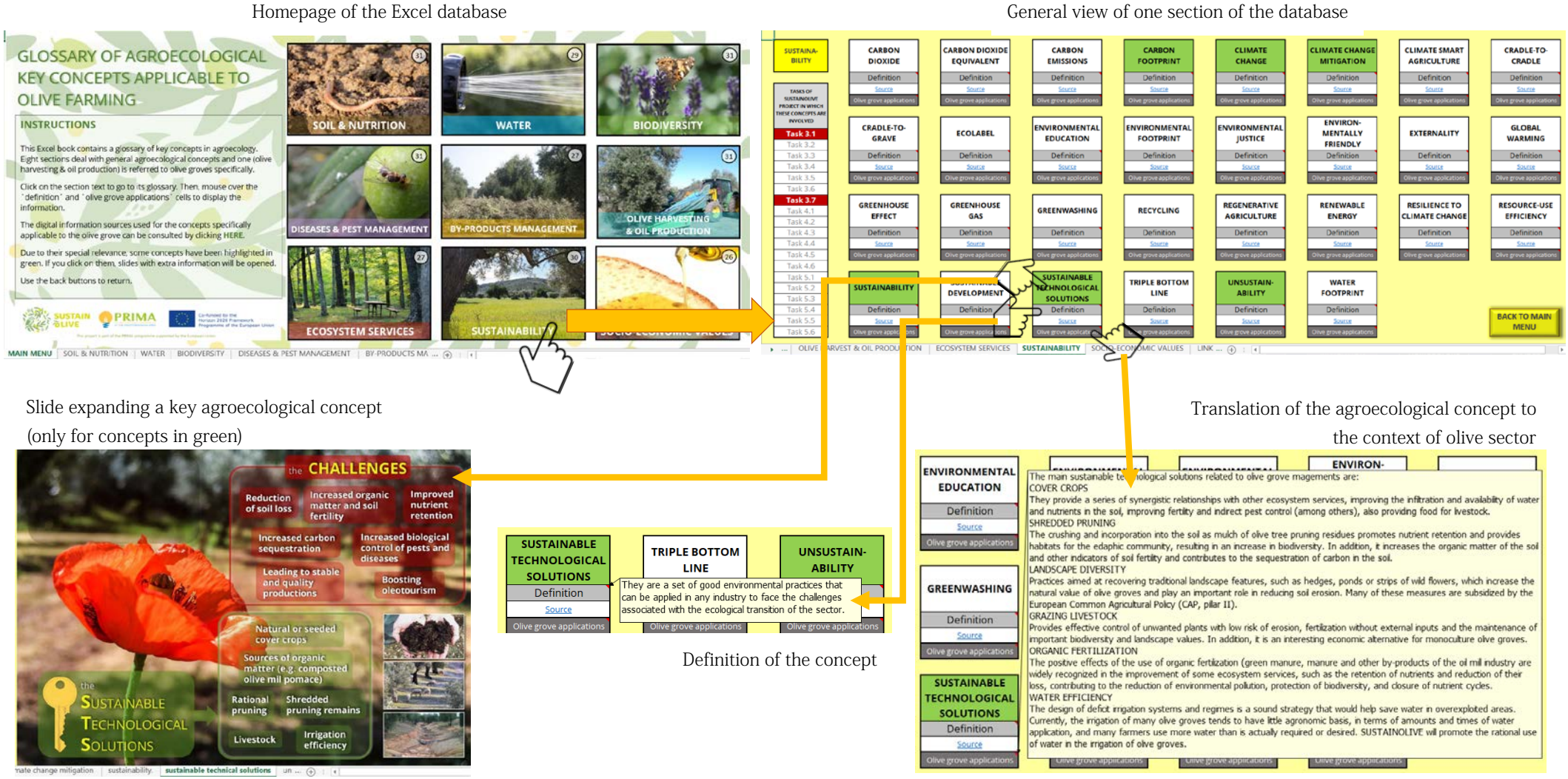

Figure 2. Schematic view of the structure and functionality of the interactive database in Appendix 1

Homepage of the PDF database

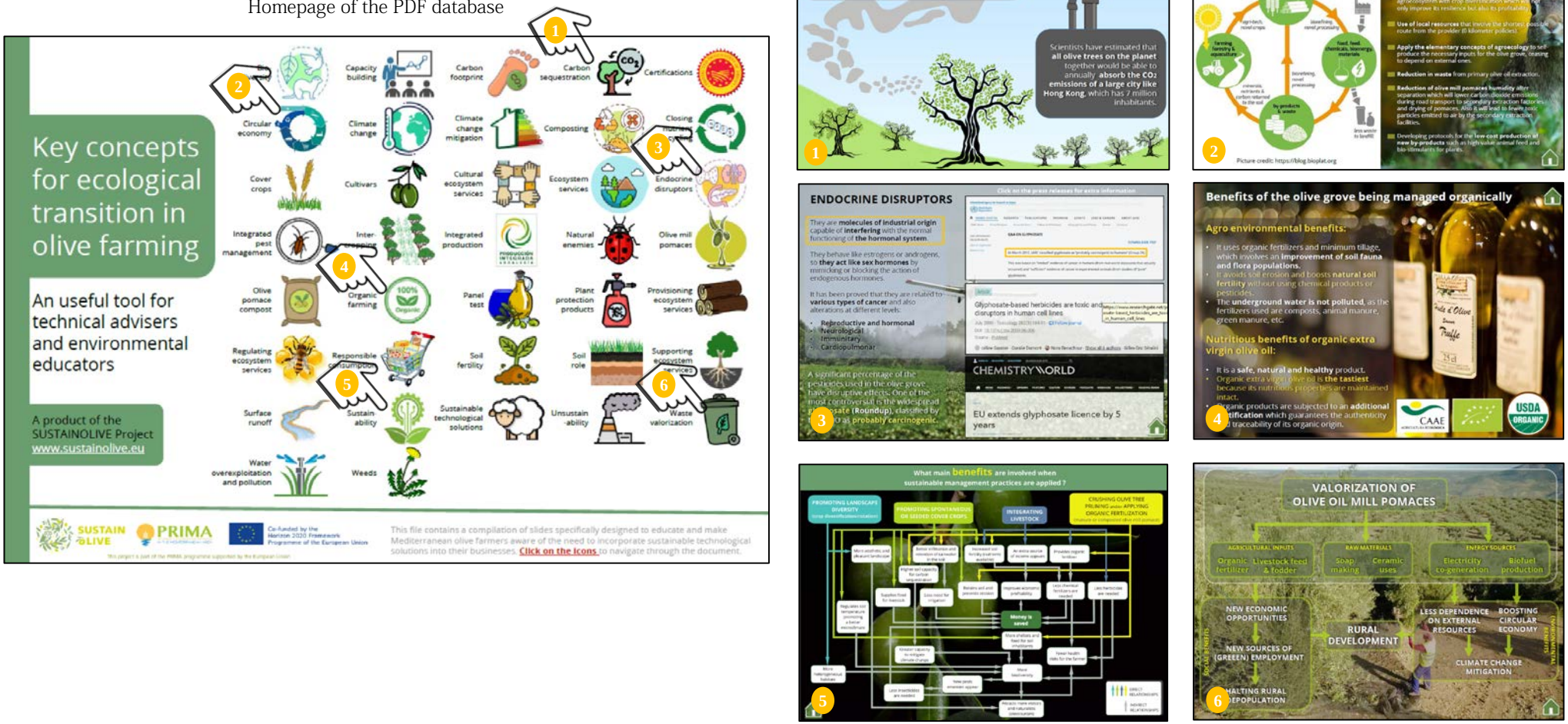

Figure 3. Schematic view of the structure and functionality of the interactive database in Appendix 2

Results in the Appendix 1 will be then refined through the implementation of a discussion workshop, and also translated and transposed to the various Mediterranean regional and national contexts covered in SUSTAINOLIVE.

It is expected that the results will become of direct relevance in WPs 2-6, where the concepts will be applied to the STSs selected across each of the 6 SUSTAINOLIVE countries.

9- Alignment and coordination across WP2 and SUSTAINOLIVE

The SUSTAINOLIVE challenge is to integrate sustainable olive grove practices that maintain or enhance agricultural productivity whilst protecting the environment and the prosperity of local communities, avoiding the overexploitation of natural resources and the spoiling of landscapes. Because of the different socio-economic, ecological and pedoclimatic conditions under which olive is cultivated across Mediterranean countries and regions, every actor involved in the project represents a component in the heterogeneity of locally-based strengths and weaknesses. Moreover, the SUSTAINOLIVE community is not only limited to the farmers, but comprises knowledge from different perspectives, so lexical heterogeneity can exist between different set of actors.
Thus, the creation of a glossary specifically dedicated to a sustainable olive agriculture aims to improve the dissemination and the acquisition of information of sustainable agricultural solutions and practices in olive groves.

The main novelty of our ontology is that the terms are categorised according to classes based on social-environmental problems and sustainability issues, and this connects most terms to the concepts of the sustainable Technological Solutions (STSs) that in SUSTAINOLIVE will be monitored and implemented in WPs 3-6.

According to the scheme of interconnections in the project (Figure 4) the description of agroecological concepts stems from the Synopsis of olive grove farming and, together with stakeholder knowledge, feeds into the identification

of STSs. The STS are then implemented and evaluated in WP3. Results from WP2, including the ontology, are also disseminated and communicated in WP7.

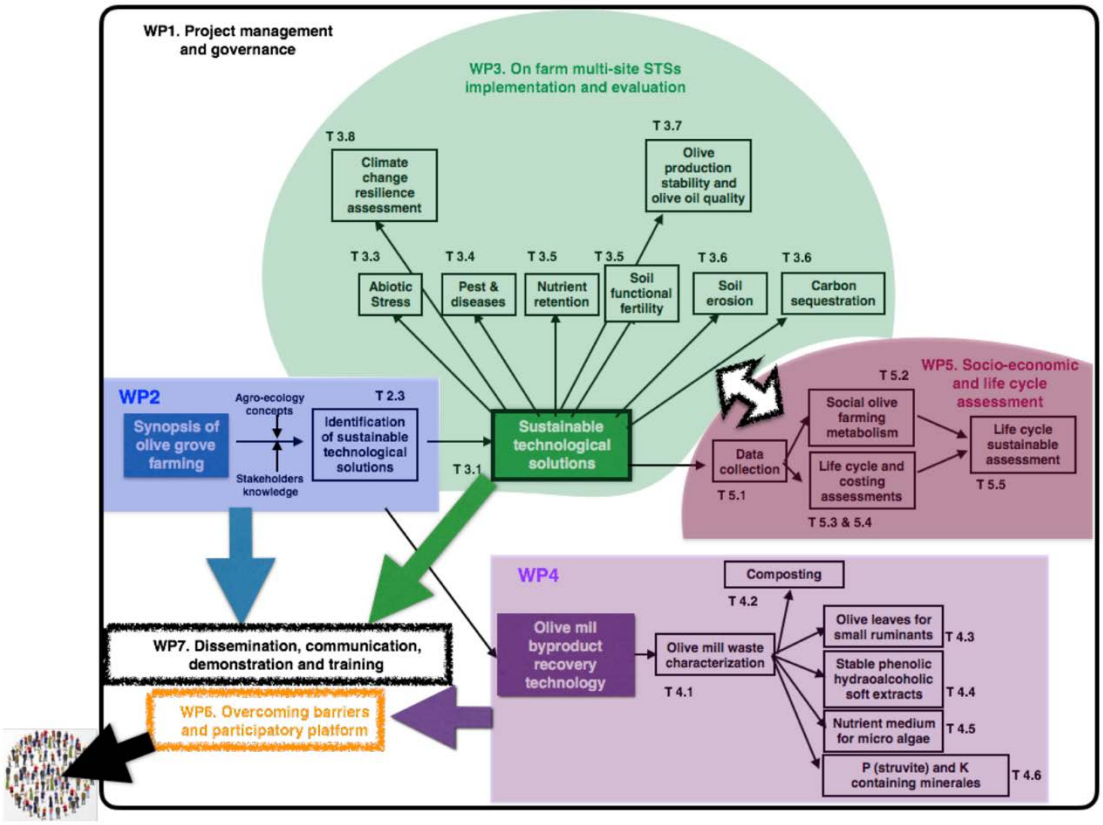

Figure 4: Interconnections between WPs and Tasks of the SUSTAINOLIVE project.

10- Literature and references

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