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INITIATIVE OF FOSTERING CROSS-BORDER KNOWLEDGE EXCHANGE AND CO-CREATION ON SUSTAINABLE SOIL AND FARM MANAGEMENT

Soil-X-Change has received funding from the European Union's Horizon Europe Framework Programme, Coordination and Support Actions under grant agreement No. 101133914

Fostering cross-border knowledge exchange and co-creation on sustainable soil and farm management

Grant agreement number: 101133914

HORIZON Coordination and Support Actions

Deliverable 4.1
A well-developed and documented database including survey results

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TYPE			DISSEMINATION LEVEL		
R	Document, report	☒	**PU**	Public	☒
DEM	Demonstrator, pilot, prototype	☐	**CO**	Confidential, only for members of the consortium (including the Commission Services)	☐
DEC	Websites, patent fillings, videos, etc.	☐			
OTHER		☐	**CI**	Classified, as referred to Commission Decision 2001/844/EC	☐

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Table of content

Table of illustrations

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List of Abbreviations

EJP	European Joint Programme
WOCAT	World Overview of Conservation Approaches and Technologies
CAP	Common Agricultural Policy
EIP	European Innovation Partnership
GDPR	General Data Protection Regulation

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1. Executive Summary

The Soil-X-Change project aims to enhance knowledge exchange and co-creation on sustainable soil and farm management practices across Europe through the development of an integrated data and knowledge sharing framework. This deliverable documents the design, implementation and documentation of a comprehensive database developed between January and November 2024 serving as the foundation for collecting, storing and organizing information about sustainable soil management practices from Operational Groups and project partners.

Through Tasks 4.1 and 4.2, we developed and implemented a robust data collection methodology that captures both survey data and documented best practices. The survey, available in nine languages (Bulgarian, German, Hungarian, Italian, Polish, Slovakian, Slovenian, Spanish, and English), underwent a rigorous translation process. Although the EU Survey tool initially provided automated translations, consortium partners carefully reviewed and corrected these to ensure accuracy and cultural appropriateness, resulting in high-quality, locally validated versions. The initial data collection phase, conducted from August to November 2024, has yielded notable results with 32 ready-to-use practices documented from nine primary (consortium) countries (AT, BG, DE, ES, HU, IT, PL, SI, SK) and two external countries (FR, PT) and 391 survey responses from 13 countries (consortium countries: AT, BG, DE, ES, HU, IT, PL, SI, SK and non-consortium countries: BE, IRL, LT, PT), demonstrating strong engagement from the farming community across Europe.

The database has been designed to manage two distinct but equally important data domains:

1. Documented sustainable soil management practices collected from Operational Groups, national projects and international initiatives and
2. Survey responses capturing farmers' experiences, needs and barriers in implementing sustainable soil management practices.

While these domains are maintained separately within the database structure to ensure data integrity and clear organization, the information they contain will be valuable for integrated analysis and visualization through the project's Dashboard in later stages. The separation at the database level provides flexibility for different analytical approaches while maintaining clean data structures. The correlation and integration between best practices and survey findings will be implemented at the analysis and visualization layer through the Dashboard development, rather than at the database level. This approach allows for:

- Maintaining clean, purpose-specific data structures,
- flexibility in how relationships between practices and farmer experiences can be analysed,
- ability to implement different visualization approaches without compromising base data and
- clear separation between data storage and data analysis concerns.

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The data collection process involved extensive preparation and collaboration among consortium partners. Multiple preparatory meetings were held in early 2024, followed by direct collaboration with Operational Groups through interviews and other forms of engagement. The data collection process revealed certain challenges, particularly our dependence on Operational Groups' availability and willingness to share information within project timeframes. Many partners reported challenges in maintaining consistent engagement with Operational Groups, partly due to Operational Groups' own project timelines and resource constraints. To address these challenges and maximize the value of our repository, the database will remain open throughout the project lifetime, allowing for continuous collection of practices. This approach especially accommodates Operational Groups with ongoing projects that will only have results to share in later project stages.

The database structure accommodates multiple data types including structured practice documentation, geographical information and supporting materials. The implementation features a modular architecture that allows flexible data storage while maintaining strict data integrity and relationships between different components.

The database serves as the foundation for the project's visual Dashboard tool, which will enhance accessibility and usability of the collected information. The Dashboard connection is designed to enable:

- dynamic exploration of documented practices,
- interactive visualization of practice distributions and relationships,
- efficient filtering and searching capabilities,
- automated data management and
- user-friendly interfaces for knowledge discovery.

Key achievements documented in this deliverable include:

- Development of **comprehensive guidelines for data collection and training resources for partners**, including detailed tutorials and documentation guidelines,
- Implementation of a **standardized data collection framework** using an Excel-based template that captures detailed information about soil management practices across multiple dimensions;
- Establishment of a **harmonized categorization system** aligned with established frameworks such as EJP SOIL classification and WOCAT categories;
- Successful **data collection campaign** (September-November 2024) resulting in 32 documented practices from 11 participating countries;
- Collection of 391 **survey responses** from 13 countries through EU Survey platform, demonstrating strong stakeholder engagement;
- Implementation of a **centralized database infrastructure** that ensures:
    - systematic organization of collected practices and survey responses,

- standardized metadata documentation,
- quality control mechanisms and
- secure data storage.

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2. Introduction

2.1. Project Context

The Soil-X-Change project addresses the critical need for improved knowledge sharing and collaboration in sustainable soil and farm management across Europe. Recent assessments indicate that 60-70% of European soils can be considered unhealthy, emphasizing the urgency of implementing effective soil management practices. Our project's timing is particularly crucial, as the European Union strengthens its focus on soil health through various policy initiatives and farming regulations.

The development of a structured repository of soil management practices and related survey data represents a cornerstone of our approach. This repository serves as the foundation for subsequent analysis and visualization through the project's Dashboard, enabling systematic analysis and knowledge sharing about sustainable soil management practices. The database development provides a structured way to store and access both documented practices and practitioner experiences, addressing a crucial gap in current agricultural knowledge systems.

While initiatives such as the European CAP Network provide promising solutions for knowledge sharing, there is often limited attention to knowledge transfer at the field scale where farmers and agriculture practitioners operate. This gap hinders the assessment of practice effectiveness at regional, national and continental scales. By creating a centralized repository that follows clear data organization principles, we enable not only the storage of valuable information but also set the foundation for sophisticated analysis and user-friendly visualization through the project's Dashboard.

The database is designed with two distinct but complementary data domains. The first domain focuses on documented soil management practices collected from Operational Groups and other sources, including detailed technical information, implementation contexts and observed impacts. The second domain captures the experiences, needs and barriers identified through farmer surveys. While these domains are maintained separately within the database structure to ensure data integrity and clear organization, they provide complementary perspectives that will be valuable for integrated analysis and visualization in later project phases.

2.2. Purpose and Scope of the Deliverable

This deliverable documents the design and implementation of the database system developed between January and November 2024. It encompasses both the technical aspects of the database and the methodology framework for data collection and organization.

The deliverable specifically covers:

- the methodology for data collection and documentation,
- database design and implementation and
- data organization and classification frameworks and user guidelines.

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While this deliverable focuses on the database development and documentation, the detailed analysis of survey results will be presented in a separate deliverable (D4.2, M16).

The database system has been designed with several key objectives:

- Providing a **robust and organized storage** solution for documenting soil and farm management practices from Operational Groups;
- Managing **valuable insights** gathered through farmer surveys;
- **Supporting subsequent project activities** through reliable and well-structured data foundation.

2.3. Relationship to Other Project Tasks and Deliverables

This deliverable represents the outcomes of Tasks 4.1 and 4.2:

Task 4.1 focuses on collecting needs and barriers of stakeholders in sustainable soil and farm management through:

- design and implementation of online surveys,
- organization of focus group discussions,
- development of data collection templates and
- implementation of data processing workflows.

Task 4.2 concentrates on identifying, collecting and summarizing ready-to-use farming methods through:

- review of Operational Group research results,
- documentation of project outcomes,
- collection of commercial solutions and
- selection of best practices and use cases.

The database development directly supports:

- the creation of a user-friendly Dashboard (Task 4.3),
- the development of adaptation pathways to facilitate outscaling to other regions (Task 4.4) and
- the integration with other project components (T5.2 Cost benefit and impact analysis; T6.3 Development of dissemination, exploitation and communication material dedicated to farmers and practitioners).

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2.4. Target Audience

This deliverable addresses multiple audiences:

- Project partners involved in data collection and management;
- Technical teams developing the Dashboard and other tools;
- Researchers and practitioners interested in the methodology;
- Stakeholders planning to contribute data.

2.5. Structure of the Document

The remainder of this document is organized as follows:

chapter 3 details the methodology for data collection and database development,

chapter 4 describes the database design and implementation,

chapter 5 provides database documentation and

chapter 6 presents conclusions and next steps.

Supporting materials are included in the annexes, providing detailed technical specifications and templates.

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3. Methodology

3.1. Overall Data Collection Strategy

The methodology for this project was carefully **designed to address the complex challenge of documenting and understanding sustainable soil management practices across Europe while creating a repository that would effectively support both immediate data storage needs and future analytical requirements.** Our approach, developed through extensive consultation with consortium partners in early 2024, recognizes that the database must serve multiple purposes: efficiently storing collected information, ensuring data quality for future analysis and providing a reliable foundation for Dashboard visualization.

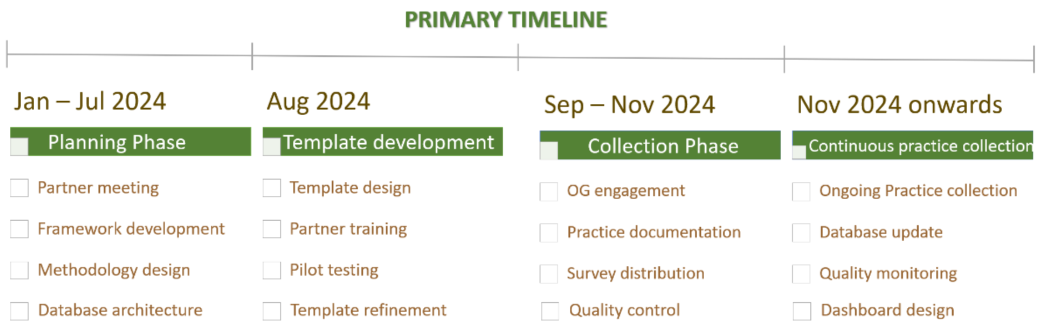

Figure 1 Soil-X-Change Database Development Timeline 2024

To achieve these goals, we developed a **dual-stream data collection and storage methodology** resting on four main pillars. **First**, we prioritize direct engagement with Operational Groups and farmers through project partners, ensuring that knowledge collection is grounded in practical experience and local context. **Second**, we employ standardized documentation using structured templates, enabling consistent and comparable data collection across different regions and practices. **Third**, we implement comprehensive surveys to capture the real-world experiences and needs of practitioners. **Finally**, we maintain rigorous quality assurance through validation procedures, ensuring the reliability and usefulness of collected information.

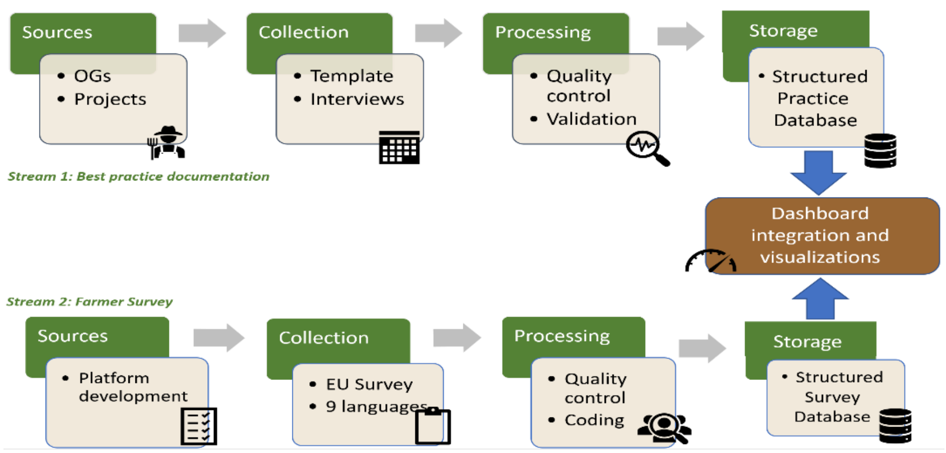

Figure 2 Dual-Stream Data Collection and Processing Framework

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Template Development and Partner Training

The documentation of sustainable soil management practices requires a **careful balance between comprehensiveness and structured organization**. Through a series of collaborative workshops and partner meetings conducted between July and September 2024, we developed a template based on the internationally recognized WOCAT framework, adapting it specifically for European soil management practices. This development process involved extensive consultation with partners to ensure the template would effectively capture both technical details and contextual information while remaining practical for field use.

The template is organized into **six interconnected parts**, each designed to capture specific aspects of the practice. The **first section** identifies the practice, the documenter, and whether it was tested in up to three sites, with distinct contexts or sites where the implementation of the practice lead to significantly different impacts. The **second part** provides detailed practice description, capturing not only technical aspects but also implementation methodology and resource requirements, supplemented by visual materials to aid understanding of complex practices. The **third part** focuses on purpose and classification, where practices are categorized according to their primary and secondary objectives. This classification system aligns with established frameworks while maintaining flexibility to accommodate innovative approaches. Geographic information forms the **fourth part**, going beyond simple location data to include detailed spatial context crucial for understanding practice applicability across regions. The **fifth part** documents specific environmental, soil and socio-economic conditions associated with the site(s) where the practice was implemented, while the **final part** is for ranking the on-site impacts that the practice has shown, including a broad range of environmental, economic, and social outcomes, with attention to aspects of climate resilience as well.

ID	Field name	Input data (Note: please fill in the lined boxes, with the use of the provided formats or information lists if you are asked in the Guidance column)	Guidance
1.1	Name of the SLM Technology		
1.1.1	Name *:		Max 70 characters (constrained box)
1.1.2	Locally used name:		Max 70 characters (constrained box)
1.1.3	Keywords * :		Max 5 words (constrained box) Please use FAO AGROV(list https://agrovoc.fao.org/browse/agrovoc/en/index/
1.2	1.2 Documentors and Resouces Persons/Information		The main Documentor is the person taking care of this
1.2.1	1.2.1. Are you the main documentor? (If yes, please fill below) *		Select from the provided list
1.2.1.1	Full name		
1.2.1.2	Gender :		Select from the provided list
1.2.1.3	Name of institution:		
1.2.1.4	Address of institution		
1.2.1.6	City:		
1.2.1.7	State or District and country:		
1.2.1.8	Tel.:		Country code - phone number
1.2.1.9	E-mail:		
1.2.1.10	Field of expertise 1:		
1.2.1.11	Field of expertise 2 (if any):		
1.2.1.12	Field of expertise 3 (if any):		1st section
1.2.3	Date of filling this form *:		yyy-mm-dd

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ID	Field name	Input data (Note: please fill in the lined boxes, with the use of the provided formats or information lists if you are asked in the Guidance column).	2nd section
2.1	Definition of the SLM Technology * WOCAT:		Max 300 characters including spaces
2.1.1	Definition of the SLM Technology in local language * WOCAT:		Max 300 characters including spaces
2.2	Detailded description of the SLM Technology * WOCAT:		Max 3500 characters including spaces (Note: Key aspects to include in the description are: - Socio-ecological context (natural and human environment) - Purposes of the SLM Technology - Main characteristics/elements of the SLM Technology (technical specifications) - Major activities/ inputs needed to implement and manage the SLM Technology - Benefits/ impacts of the SLM Technology - Factors affecting adoption and incentives that may enhance adoption)
2.2.1	Detailded description of the SLM Technology in local language * WOCAT:		Max 3500 characters including spaces (Note: Key aspects to include in the description are: - Socio-ecological context (natural and human environment) - Purposes of the SLM Technology - Main characteristics/elements of the SLM Technology (technical specifications) - Major activities/ inputs needed to implement and manage the SLM Technology - Benefits/ impacts of the SLM Technology - Factors affecting adoption and incentives that may enhance adoption)
2.3	Illustrative photos * WOCAT:		Max 3 photos, including the technical sketch if possible
2.3.1			Insert a photo
2.3.2	Citation of photo 1		Syntax: Title for the photo. Date taken. Source/author.

ID	Field name	Input data (Note: please fill in the lined boxes, with the use of the provided formats or information lists if you are asked in the Guidance column).	3rd section
3.1	Purposes of the SLM Technology (max. 3 most important purposes) * WOCAT:		
3.1.1	First most important purpose	Improve production (crop, fodder, wood/ fibre, water, energy)	Select from the provided list
3.1.1.1	If the main purose was selected as "Other ...", please specify:		Max 70 letters including spaces
3.1.2	Second most important purpose	Prevent land degradation (soil, water, vegetation)	Select from the provided list
3.1.2.1	If the main purose was selected as "Other ...", please specify:		Max 70 letters including spaces
3.1.3	Third most important purpose	Adapt to climate change/ extremes and its impacts (e.g. resilience to droughts, storms)	Select from the provided list
3.1.3.1	If the main purose was selected as "Other ...", please specify:		Max 70 letters including spaces
3.2	Type of the SLM Technology (max. 3 most relevant SLM types) * MW:		
3.2.1	First most relevant SLM type:	Water harvesting	Select from the provided list
3.2.1.1	If the SLM type was selected as "Other ...", please specify:		Max 70 letters including spaces
3.2.2	Second most relevant SLM type:	Improved ground vegetation cover	Select from the provided list
3.2.2.1	If the SLM type was selected as "Other ...", please specify:		Max 70 letters including spaces
3.2.3	Third most relevant SLM type:	Irrigation management (incl. water supply, drainage)	Select from the provided list
3.2.3.1	If the SLM type was selected as "Other ...", please specify:		Max 70 letters including spaces
3.2.4	Combination of relevant SLM types (formula is used, please do not delete it):	[Water harvesting ( )]+[Improved ground vegetation cover ( )] + [Irrigation management (incl. water supply, drainage)	Auto-generated intergal text
3.3	SLM measures comprising the SLM Technology * MW:	Note: Please only select what is applicable for your situation.	
3.3.1.1	First Type of agronomic measures:	A3: Soil surface treatment	Select from the provided list
3.3.1.2	Concrete agronomic measures for the first type	Microcatchments	Examples for typing
3.3.1.3	Second type of agronomic measures:	A1: Vegetation/ soil cover	Select from the provided list
3.3.1.4	Concrete agronomic measures for the second type		Examples for typing

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Draw **up to 3 polygons**, or clusters of polygons, corresponding to the up to 3 sites of implementation of the SLM Technology indicated in Part_1 sheet.
Name them coherently (Site_1, Site_2, Site_3).
Polygons can be easily drawn using Google Earth app from your laptop or phone (click on the "Add Polygon" icon; see the app Help if necessary)

Add below point coordinates to indicate a reference ("central") point for each site. The point could mark a major farm area or field where the practice has been implemented.
Point coordinates can be easily taken using Google Earth, or using Google Map app for Android on your phone (which could be done directly in the field).

Example: the technology has been implemented in clusters of fields. In some of these sites the implementation resulted in considerably different impacts: these are marked by IDs 1, 2, and 3 in the picture.
Coordinates of approximate central points, or reference fields are indicated below for each site.

	Lat	Long	Geographic reference system
1	y.123456	x.123456	WGS84 (default), UTM
2	y.123498	x.123475	
3	y.123432	x.123481	

The below picture is an example.
The example is a snapshot showing several polygons drawn with the GE app. Each polygon is a field/farm where the documented practice was implemented.
The figure also indicates 3 groups of polygons numbered 1 to 3 that correspond to three sites requiring specific Context (Part 5 Location-Context) and Impact (Part 6 Impacts & Factors) documentation.

Input data: Insert polygon in space below. Remove the example, and upload yours in "Insert"-->"Pictures"

Input data: Please fill in lined boxes according to the stated number of sites in Part 1.

Indicate site coordinates	Lat	Long	Geographic reference system
Site_1			
Site_2			
Site_3			

4th section

ID	Field name	Input data (Note: please fill in the lined boxes, with the use of the provided formats or information lists if you are asked in the Guidance column).	SITE 1 (OR UNIQUE SITE)	Guidance
4.1	**Regions/locations where the SLM Technology has been applied** MW:			
4.1.1	Region *	Andalucia		Select from the provided list in "Lists" sheet
4.1.2	Sub-Region *	Cordoba Province, Finca Canada Navarro, Montilla		Select from the provided list in "Lists" sheet
4.1.3	Country (usually only one, max 2 if well-bordered) *	Spain		Select from the provided list in "Lists" sheet
4.1.4	Province:			Name(s) of adminstrative unit (s), separated
4.1.5	District			Name(s) of adminstrative unit (s), separated
4.1.6	Total area the SLM Technology applied WOCAT:	120 ha		
4.1.6.1	If precise area is not known, indicate approximately			
4.4				
4.4.1	**Biophysical conditions**			
4.4.1.1	Average elevation WOCAT	480		Please specify the unit in m above sea level (a
4.4.1.2	Average slope WOCAT	gentle (3-5%)		Please specify the unit in %
4.4.1.3	Average Annual Precipitation * WOCAT	600		Please specify the unit in mm
4.4.1.4	Average Annual Temperature *	NA		Please specify the unit in °C
4.4.1.5	1st land use main type - BEFORE the SLM Technology was applied * MW	Cropland		
4.4.1.6	Land use subtype-practice - BEFORE the SLM Technology was applied MW	Perennial cropping - rainfed		Max 2 choices. The 2nd choice is below.
	Specify the crop and, if relevant, the crop rotation			
4.4.1.6.1	Land use subtype-practice - BEFORE the SLM Technology was applied MW			
	Specify the crop and, if relevant, the crop rotation			
4.4.1.7	CURRENT land use main type * MW	Cropland		
4.4.1.8	CURRENT land use subtype-practice MW	Perennial cropping - rainfed		Max 2 choices. The 2nd choice is below.
	Specify the crop and, if relevant, the crop rotation			
4.4.1.8.1	CURRENT land use subtype-practice MW			
	Specify the crop and, if relevant, the crop rotation			
4.4.1.9	the 1st local bedrock - major GLiM class	sedimentary rock (consolidated)		
4.4.1.10	Local bedrock - GLiM group (under the major class selected above)	Carbonatic , organic		Max 2 choices. The 2nd choice is below.
4.4.1.10.1	Local bedrock - GLiM group (under the major class selected above)			
4.4.1.9.1	the 2nd local bedrock - major GLiM class			
4.4.1.10.2	Local bedrock - GLiM group (under the major class selected above)			Max 2 choices. The 2nd choice is below.

5th section

ID	Field name	Input data (Note: please fill in the lined boxes, with the use of the provided formats or information lists if you are asked in the Guidance column).	Guidance
6.1	**On-site impacts that the SLM Technology has shown** WOCAT		Please evaluate the aspects if they are applicable. Please note that in the scale, negative and positive are understood in the view of expectation.
6.1.1	**Socio-economic impacts**		
	Production		
	crop production	Positive	Select from the provided list
	crop quality		Select from the provided list
	fodder production		Select from the provided list
	fodder quality		Select from the provided list
	animal production		Select from the provided list
	wood production		Select from the provided list
	forest/ woodland quality		Select from the provided list
	non-wood forest production		Select from the provided list
	reduced risk of production failure		Select from the provided list
	product diversity		Select from the provided list
	reduced expansion of cultivation areas		Select from the provided list
	improved land management		Select from the provided list
	energy generation(e.g. hydro, bio)		Select from the provided list
	Water availability and quality		
	drinking water availability		Select from the provided list
	drinking water quality		Select from the provided list
	water availability for livestock		Select from the provided list
	water quality for livestock		Select from the provided list
	irrigation water availability		Select from the provided list
	irrigation water quality		Select from the provided list
	improved irrigation water use efficiency		Select from the provided list
	Income and costs		
	improved agricultural inputs use efficiency		Select from the provided list

6th section

Figure 3 Illustration from the dedicated excel template

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To support partners in implementing the framework, we developed **comprehensive training materials**, including a **tutorial document and an instructional video**. In August 2024, we conducted **capacity-building sessions** to ensure partners were well prepared to introduce the template to the documenters and clearly explain how to complete it. **Regular follow-up support** was provided to address questions and ensure consistent quality across all documented practices. (Annex 1.)

Figure 4 Illustration from the training material

The data collection template and the instructional material was then shared on an online folder via a shared link, granting access to both documenters and the project team, enabling assistance and monitoring throughout the completion process.

Data Collection Process

The initial **data collection** process, conducted from August to November 2024 **followed a structured workflow** designed to ensure both data quality and analytical utility. The process **began** with systematic mapping of relevant Operational Groups in participating countries, **followed** by careful review of existing documentation on the EIP-AGRI platform to identify potential practices and assess documentation availability.

The process highlighted significant dependencies on Operational Group availability and engagement levels. Partners reported challenges in aligning Operational Group participation with project timeframes, as many Operational Groups are managing their own project schedules and resource constraints. This experience has informed our **approach to data collection, emphasizing flexibility and continuous engagement rather than strict deadlines**.

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Partner engagement played a crucial role in the collection process. Each participating country organized **localized outreach efforts through their established networks**, conducting documentation sessions with standardized protocols. These sessions often involved multiple stakeholders, combining the expertise of researchers, practitioners and farming experts to ensure comprehensive practice documentation. Through the collaborative efforts of the partners, a total of 32 practices were collected in the initial data collection phase. This diverse sample reflects a wide range of approaches, representing various agricultural contexts and practices. The involvement of local partners was key in reaching a broad spectrum of practices, ensuring that the data collected is representative and captures the complexity of farming practices across different regions.

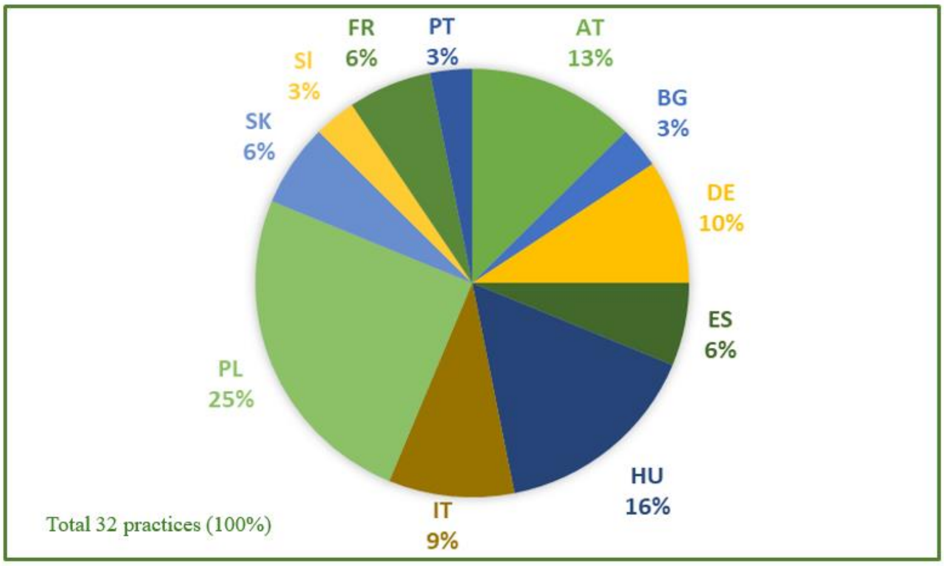

Figure 5 Distribution of collected practices

The process moved through several key phases: initial identification and assessment, engagement and documentation, data processing and standardization, quality control and final storage and organization. Each phase included efforts to uphold quality measures, focusing on completeness of the data documents, data reliability and maintaining the efficiency throughout the collection process.

3.2. Survey Framework Design

Survey Structure Development

Understanding farmers' perspectives, experiences and needs is crucial for effective knowledge sharing and practice adoption. The development of our survey framework, undertaken in parallel with the practice documentation template, emerged from extensive consultation with farming communities and agricultural experts across participating countries during the first half of 2024. Unlike the documentation of best practices, which focuses on technical specifications and proven results, the **survey framework aims to capture the real-world experiences, challenges and needs of farmers** implementing sustainable soil management practices.

A critical aspect of the survey development was the translation process. To ensure accessibility across all participating countries, we implemented a **two-step translation approach. First**, utilizing the EU Survey tool's automated translation capabilities, we generated initial versions in nine languages (Bulgarian, German, Hungarian, Italian, Polish, Slovakian, Slovenian, Spanish and English). **Subsequently**, these automated translations underwent thorough review and correction by native-speaking consortium partners, ensuring not only linguistic accuracy but also cultural appropriateness and technical precision in agricultural terminology.

The survey structure evolved through multiple iterations of testing and refinement, resulting in **four carefully designed sections**. The **first section** establishes respondent context through demographic and operational questions, providing essential information about farm characteristics, location, farming methods and personal background. This contextual information enables meaningful analysis of adoption patterns across different farming contexts. The **second section** explores farmers' knowledge and attitudes toward sustainable practices, investigating familiarity with twenty different sustainable practices ranging from minimum tillage to agroforestry systems. This section examines information access pathways and adoption motivations, providing crucial insights for developing effective knowledge-sharing strategies. The **third section** delves into implementation experiences, where farmers share detailed accounts of their practice adoption journeys. Rather than simply documenting which practices have been adopted, this section explores the full cycle of implementation, including adoption drivers, realized benefits, cost-benefit relationships and both positive and negative outcomes. For discontinued practices, we gather information about usage duration and cessation reasons, providing valuable insights into implementation challenges. The **final section** takes a forward-looking perspective, exploring farmers' plans for adopting new practices and identifying both promising opportunities and potential barriers to adoption. This future-oriented approach helps identify practices generating the most interest and the support mechanisms needed to facilitate their implementation (Annex 2).

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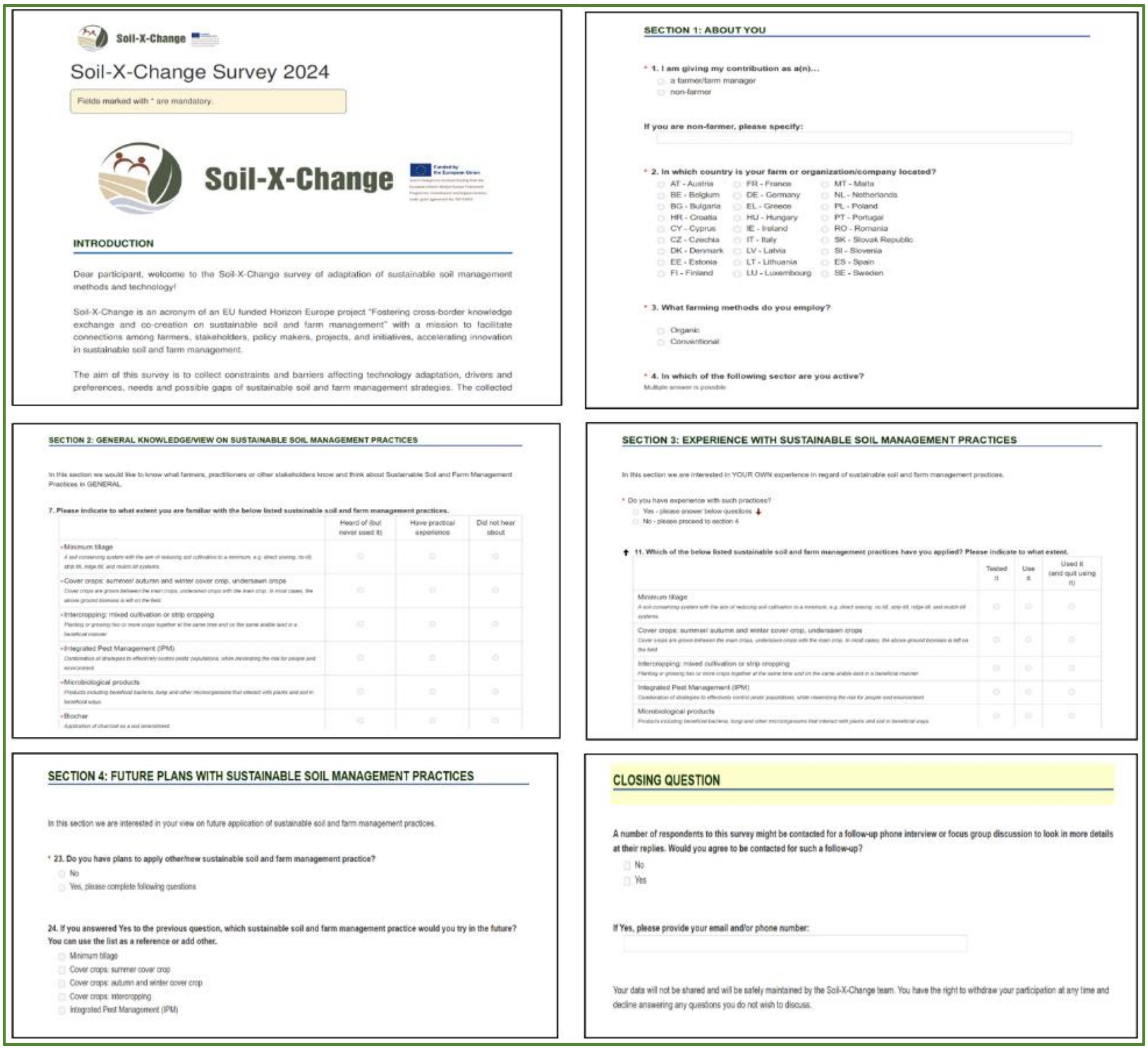

Figure 6 Illustration from the farmer survey template

Survey Implementation Process

The survey deployment, launched in August 2024, utilized the EU Survey platform to ensure accessibility and data security while maintaining response integrity. The survey was made available **in nine languages** (Bulgarian, English, German, Hungarian, Italian, Polish, Slovakian, Slovenian and Spanish) with careful attention paid to maintaining consistency of meaning across translations. This multilingual approach proved crucial in achieving broad participation across different regions.

Our **distribution strategy** operated through the project's partner network, leveraging existing relationships and local knowledge to reach diverse farming communities. Partners promoted the survey **through multiple channels**, including social media platforms, institutional websites and agricultural events, resulting in 385 responses from the consortium countries (391 in total from EU) by November 2024.

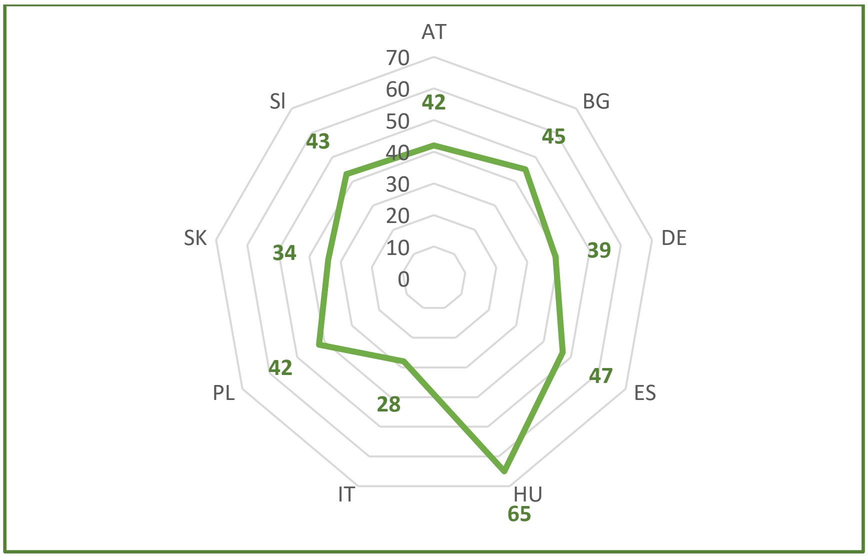

Figure 7 Participation of consortium countries in the Survey

Quality assurance was embedded throughout the survey process, beginning with rigorous pre-testing involving representatives from target groups. This testing phase helped refine question clarity and response options while ensuring the survey's completion time remained within twenty minutes. Regular monitoring of incoming responses enabled early identification and resolution of any systematic issues.

3.3. Data Processing Methodology

Our **data processing methodology forms a crucial bridge between raw data collection and the organized repository supporting future analysis and visualization**. The approach recognizes **two distinct but parallel processing streams** - **one** for practice documentation and **another** for survey responses - while maintaining structures enabling future integration through the Dashboard.

To ensure a robust and reliable dataset, we utilized **KNIME Analytics Platform** for the creation and standardization of our database. To ensure the accuracy and reliability of the dataset, a **Quality Assurance Framework** was implemented within KNIME. This framework focused on systematically identifying and resolving inconsistencies, errors and anomalies in the data. The process involved the following steps:

1. **Automated Data Processing with Loops**:
   - A **loop structure** was created for reading and processing files, ensuring consistency across all datasets.

- Each file underwent the same sequence of quality control steps, minimizing manual intervention and reducing the potential for human error.
- KNIME's *File Reader* and *Loop Start/End* nodes automated file ingestion and processing.

2. **Data Profiling and Inconsistency Detection**:
   - Initial data profiling was conducted to identify common issues such as:
     - Missing values
     - Inconsistent formatting (e.g., "Yes" vs. "yes")
     - Outliers and duplicates
   - Profiling was facilitated using the *Data Explorer* and *Statistics* nodes.
3. **Data Standardization**:
   - Categorical variables were standardized by addressing formatting inconsistencies. For instance:
     - Variations such as "Yes" and "yes" were corrected using *String Manipulation* and *Case Converter* nodes.
     - Lookup tables and regular expressions ensured alignment with predefined standards.
   - Dates, numerical values and text fields were reformatted to a consistent structure.
4. **Error Correction and Validation**:
   - Errors detected during profiling were corrected using conditional lOperational Groupic and transformation nodes.
   - Data integrity was validated through automated checks embedded within the workflow.
5. **Reproducibility and Scalability**:
   - The loop-based design ensured that new files could seamlessly integrate into the pipeline, maintaining high data quality standards.
   - The KNIME workflow was documented to provide transparency and reproducibility for future use.
6. **End Result: MS Access and MySQL Databases**:
   - After the quality assurance and standardization processes were applied, the final datasets were stored in two different database systems:
     - **Microsoft Access (MS Access)**: Used for local, smaller-scale storage and easy retrieval in a desktop environment.
     - **MySQL**: A more robust, scalable database solution used for larger-scale data management and integration into web or cloud-based applications.
   - Both databases were structured to support efficient querying, reporting and further analysis.

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The use of KNIME allowed for a visual and iterative approach to data preparation, ensuring transparency and reproducibility of the workflows. This methodology resulted in a standardized, clean, and analysis-ready dataset.

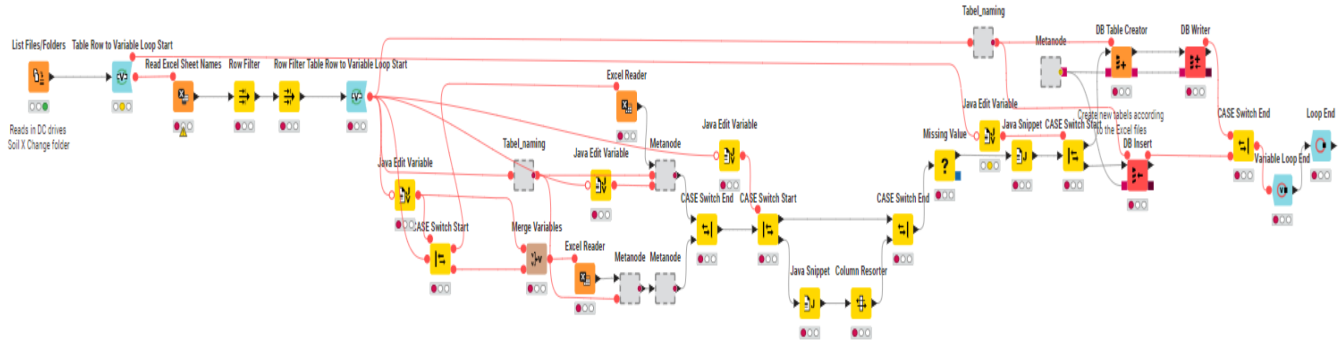

Figure 8 KNIME workflow

3.4. Quality Assurance in Data Processing and Storage

Our **quality assurance approach operates across multiple stages** of the data lifecycle, integrating automated checks through KNIME with structured partner review processes. The foundation of our QA framework was **established during the preparatory phase** through partner training and standardized templates, ensuring consistency in data collection from the outset.

For practice documentation, quality control begins at the data entry stage through our Excel-based template. This template, developed through extensive partner consultation, implements structured data entry fields and standardized categorizations aligned with established frameworks like WOCAT. Partner training sessions conducted in August 2024 ensured consistent understanding of documentation requirements and data entry protocols across all participating countries.

The core of our **automated quality control process is implemented through our KNIME workflow**, which performs systematic checks during data processing. The workflow identifies common issues such as missing values and inconsistent formatting across categorical variables. Through KNIME's Data Explorer and Statistics nodes, we conduct initial data profiling to detect anomalies, while String Manipulation and Case Converter nodes ensure standardization of categorical responses. This automated process is particularly crucial for survey data, where responses across nine different languages need to be consolidated while maintaining data integrity.

For survey responses collected through the **EU Survey platform**, our quality assurance process **leverages both automated and manual validation**. The two-step translation process, involving initial automated translation followed by native-speaking partner review, ensures accuracy of **multilingual survey instruments**. This careful attention to translation quality has been crucial in maintaining data consistency across all participating countries.

The final stage of quality assurance occurs during data storage, where both MS Access and MySQL databases implement **validation rules ensuring data integrity**. Regular monitoring of incoming

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data through KNIME's automated checks helps maintain consistent data quality throughout the collection period.

This multi-layered approach to quality assurance has proven effective during our initial data collection phase, successfully processing 32 documented practices and 391 survey responses while maintaining data integrity and consistency.

4. Database Design and Implementation

4.1. Overview of Database Architecture

The database architecture for Soil-X-Change has been designed to serve as a robust repository supporting both immediate data storage needs and future analytical requirements. Building upon the methodology outlined in Chapter 3, our implementation decisions focused on creating a system that could effectively manage the diverse data types collected through both practice documentation and survey responses. The architecture development, completed in autumn 2024, followed an iterative process involving continuous feedback from consortium partners to ensure alignment with project objectives.

The system implements a dual-domain structure that maintains clear separation between practice documentation and survey data while enabling future integration through the Dashboard layer. This separation emerged as a crucial design decision during early development phases, recognizing the distinct nature of these data types while maintaining the flexibility needed for integrated analysis.

Our database design is guided by several fundamental principles aligned with the project's objectives. Data integrity and quality remain paramount, implemented through strict validation rules and clear data structures. The design maintains flexibility for future analytical needs through comprehensive metadata frameworks and standardized classification systems. Additionally, the architecture supports efficient data retrieval patterns required for Dashboard visualization and analysis.

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The database structure comprises one primary domain, with dedicated tables and relationships reflecting their unique characteristics. The practice documentation domain and survey response manages information related to all 32 currently documented soil management practices, with potential for expansion as new practices are added throughout the project's lifetime. This domain implements a sophisticated structure linking core practice information to supporting documentation, geographic data and impact assessments and managing 391 responses, implements specialized structures optimized for questionnaire data while maintaining respondent privacy and data security. This domain includes anonymized respondent profiles, structured response tables and geographic reference data, all designed to support comprehensive analysis while protecting personal information.

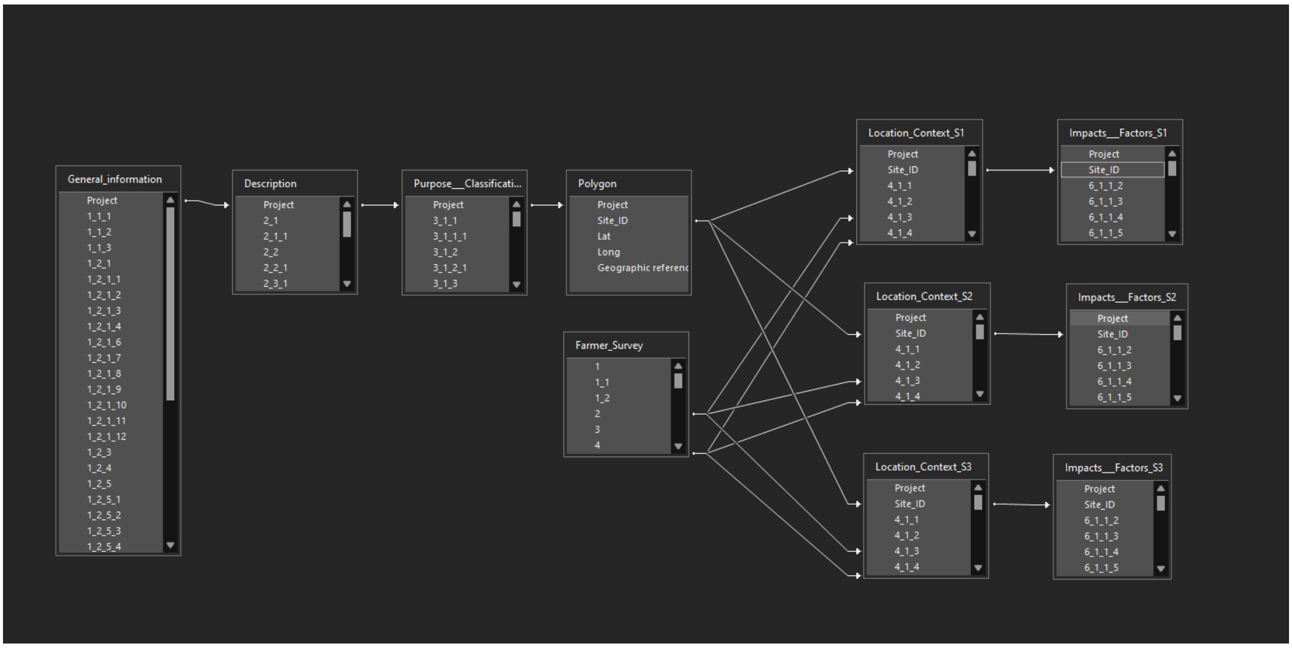

Figure 9 MS Access Database

4.2. Data Storage Implementation

The implementation utilizes Microsoft Access and MySQL as our primary database management systems, chosen for their ease of use, versatility and robust performance capabilities. The decision to use both systems was driven by key requirements: efficient handling of structured data, simplicity of deployment and scalability to manage large datasets as the system evolves.

Microsoft Access is employed for smaller-scale, local applications where quick setup and easy integration with desktop environments are essential. Its user-friendly interface and built-in support for basic relational database management provide an effective solution for light data storage needs, such as managing survey responses and smaller datasets.

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For larger-scale operations and more complex requirements, MySQL serves as the primary database system. Chosen for its high-performance capabilities, MySQL supports more complex queries, enhanced scalability and the ability to handle growing volumes of data, such as geographic data and large user datasets. This choice ensures the system can scale efficiently as the data grows.

To handle large datasets efficiently, both systems use partitioned tables. This approach improves data management by dividing large tables into smaller, more manageable sections, which boosts query performance and ensures smoother handling of the growing volume of survey responses.

4.3. Security and Access Control

The security framework for the Soil-X-Change database emphasizes practical access control measures while facilitating efficient collaboration among project partners. Our approach recognizes the critical balance between enabling effective dashboard development and analysis activities while maintaining appropriate protection for sensitive information contained within our datasets.

Access management is implemented through our shared cloud-based storage solution, with permissions carefully structured to support different partner roles and responsibilities:

Data Analysts and Researchers: Access to both practice documentation and anonymized survey data for conducting analyses and generating insights. These partners can export data for statistical analysis but cannot modify the original database content.

Dashboard Developers: Access to necessary data structures and export capabilities required for creating interactive visualizations. They can extract data through predefined queries but do not have direct database modification rights.

Task managers: Full access to all database components with rights to update practice documentation and manage data organization. They oversee data quality and handle partner access requests.

Field Partners and Practice Documenters: Specific access for adding and updating practice documentation through structured templates, with rights limited to their own contributions.

Database Administrators: Technical access for maintaining database structure, implementing backup procedures, and managing system performance. Limited to key technical team members.

This system ensures that team members involved in dashboard development and data analysis can efficiently access the resources they need while maintaining appropriate boundaries around sensitive information. The framework includes specific provisions for handling anonymized survey responses, protecting farmer privacy while preserving the analytical value of the collected data.

Our collaborative security model includes clear protocols for version control and change tracking, ensuring that partners can work effectively together while maintaining data integrity. The system supports defined access levels based on partner roles, whether in dashboard development, analysis or project coordination. These carefully structured permissions enable efficient workflows between data collection, analysis, and visualization teams while maintaining appropriate controls over data access and modification.

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4.4. Maintenance and Monitoring

Our maintenance framework ensures system reliability through comprehensive protocols covering backup and recovery, performance optimization and continuous monitoring. Automated backup scheduling, point-in-time recovery capabilities and disaster recovery procedures protect against data loss, while regular performance optimization maintains system responsiveness.

The monitoring system provides real-time insights into system health and performance through continuous tracking of key metrics. This includes performance monitoring, resource utilization tracking and error detection, enabling proactive identification and resolution of potential issues. Activity logging maintains comprehensive records of system events, security incidents, and user actions, supporting both audit requirements and system optimization efforts.

The system's maintenance and monitoring capabilities have proven particularly valuable during the initial data collection phase (August-November 2024), successfully handling the concurrent ingestion of practice documentation and survey responses while maintaining system performance and data integrity.

5. Database Documentation

5.1. Overview and Documentation Strategy

Comprehensive **documentation** was created throughout the entire database creation process to ensure transparency, reproducibility and ease of understanding for future users. The documentation included detailed descriptions of each step in the data processing workflow, from data ingestion to final database storage.

Process Descriptions: Each step of the KNIME workflow was documented with specific instructions on its purpose and function. This included explanations of data cleaning techniques, standardization rules (such as handling variations in categorical values), and the transformation processes that were applied to ensure consistency across all data sources.

Error Handling Procedures: Clear guidelines on how errors were identified and addressed were included, detailing the logic used for error detection and the specific nodes or tools employed for data validation.

Database Schema: Detailed descriptions of the MS Access and MySQL database schemas were provided, outlining the structure of each database, including tables, field names, and data types. This also included any relationships between tables, indexing strategies for optimizing queries, and any custom queries used for database management.

Version Control: The documentation tracked any changes or updates made to the data processing workflow and database structure, ensuring that the dataset could be updated or modified without losing consistency.

5.2. Repository Structure Documentation

The database serves as a centralized repository managing two distinct data domains, each requiring specific documentation approaches tailored to their unique characteristics. The practice documentation domain, currently housing 32 documented practices, implements a complex structure

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capturing technical details, geographic information and impact assessments. Our documentation provides detailed guidelines on this structure, explaining relationships between different data elements and the rationale behind various design decisions.

For the survey domain, managing 391 responses, documentation focuses particularly on data privacy and security aspects. Clear protocols outline data handling procedures, anonymization requirements and access controls, ensuring compliance with GDPR requirements while maintaining data utility for analysis. The documentation carefully explains how survey responses are structured to enable meaningful analysis while protecting respondent privacy.

5.3. Technical Specifications

This schema is designed to manage project-related data, including geographical, contextual, and survey information. The primary tables are:

General Information: Stores basic project details and is linked to other tables like Description, Purpose Classification, and Polygon through Project_ID.

Polygon: Contains geographical data (coordinates), linked to contextual and impact factor tables (Location Context S1, S2, S3 and Impact Factors S1, S2, S3) via Site_ID.

Location Context S1/S2/S3: Provides contextual data at different locations linked to the Impact Factors tables via Site_ID.

Impact Factors S1/S2/S3: Captures key metrics influencing the project at various levels, tied to the respective location context tables.

Farmer Survey: Collects feedback from farmers, linked to Location Context tables using Country and Land_Use_Main_Type.

Meta: Stores column names for the practices database to streamline processing and improve query performance.

Farmer Survey Meta: Stores column names for Farmer Survey data to streamline processing and improve query performance.

5.4. Future Development Support

Our documentation strategy includes provisions for future system evolution, maintaining clear records of design decisions and implementation rationale. This forward-looking approach supports continued system development as new requirements emerge and additional practices are documented throughout the project's lifetime. The documentation includes clear procedures for updating both technical specifications and user guidelines as the system evolves. This ensures that all project teams maintain current information about data structures and access procedures while supporting effective long-term system maintenance and development.

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6. Conclusion and Recommendations

Achievement of Project Objectives

The development and implementation of the Soil-X-Change database represents a **significant milestone in our project's mission** to facilitate knowledge exchange about sustainable soil management practices across Europe. Through careful design and implementation during 2024, we have **established a robust foundation for storing and managing two essential types of information**: documented best practices from Operational Groups and comprehensive survey data from farmers and practitioners.

The successful implementation of our dual-stream data collection approach has demonstrated the effectiveness of our methodology. **The database structure successfully accommodates both systematic documentation of soil management practices and valuable insights from practitioner experiences, while maintaining the flexibility needed for future expansion and analysis. The template-based collection methodology, supported by comprehensive training and documentation has proven effective in gathering structured information about practices while maintaining sufficient flexibility to capture diverse implementation contexts**.

Key Achievements and Impact

The data collection phase, conducted from August to November 2024, has yielded impressive results with **32 ready-to-use practices documented from nine primary** (consortium) **and *two external countries*** (AT, BG, DE, ES, HU, IT, PL, SI, SK and *FR, PT*). This initial collection phase has established a strong foundation for continuing documentation efforts throughout the project's lifetime. The database remains open for additional submissions, reflecting our understanding that sustainable soil management is an evolving field with continuous innovation.

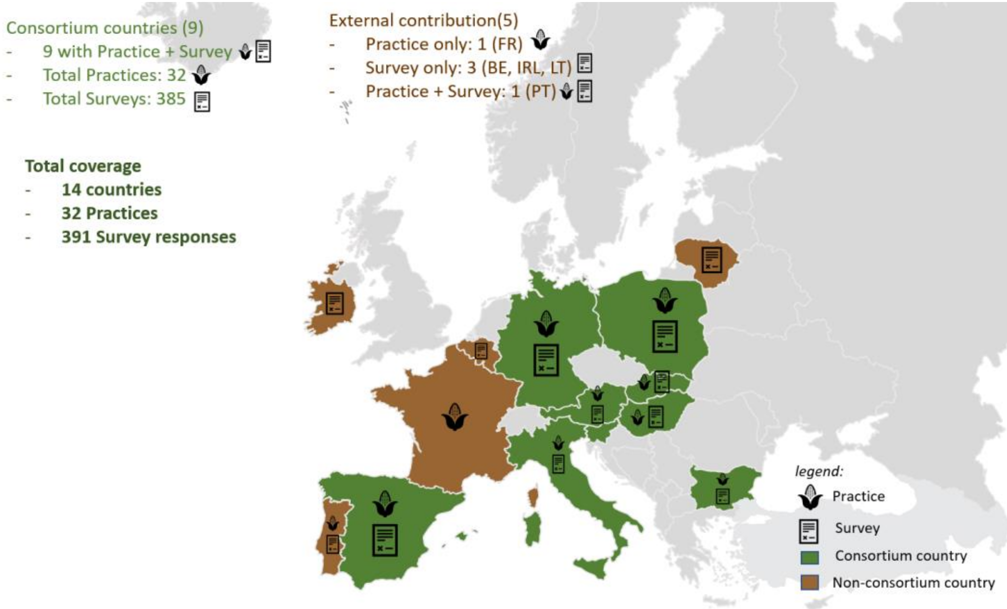

Figure 10 European Coverage of Soil-X-Change Database - Practices and Survey Responses

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The **survey component has exceeded initial expectations, gathering 391 responses across 13 countries.** This success was achieved through effective use of EU Survey for template creation and data collection, ensuring a consistent and accessible platform for respondents. The comprehensive promotion strategy implemented by project partners, including social media platforms, institutional websites and agricultural events has successfully reached a diverse audience of stakeholders.

The **successful multilingual approach**, involving thorough translation and validation by native-speaking partners, significantly contributed to the high response rate and quality of survey data. This investment in language accessibility demonstrated the importance of providing tools in local languages for effective engagement with farming communities.

Our initial analysis indicates that this broad participation has provided rich insights into regional variations in practice implementation, common challenges across different contexts and local adaptation strategies. The geographic diversity of responses has been particularly valuable in understanding how sustainable soil management practices are adapted and implemented across different European contexts.

The **implementation of robust data management system** has proven crucial in handling this wealth of information. Our approach ensures respondent privacy while enabling effective analysis of practice implementation patterns and adoption factors. The resulting data structure not only supports current project needs but provides a solid foundation for understanding barriers and opportunities in sustainable soil management across Europe.

Lessons Learned

Several important lessons have emerged through the database development and initial data collection process. First, the **importance of balancing comprehensive documentation with practical usability** has become clear. While thorough documentation is crucial for understanding practice implementation, we've learned to **consider the time constraints of data providers and maintain efficient collection processes.**

A crucial lesson emerged regarding the nature of collaboration with Operational Groups. Partners across countries consistently reported two key challenges: the **dependency on Operational Groups' availability and timelines for data provision, and the complexity of maintaining long-term engagement with Operational Groups**. These challenges have shaped our approach to data collection, leading to a more flexible and continuous collection strategy rather than a strictly time-bound approach.

Our experience has also emphasized the **value of embedding quality control measures within the data collection process rather than treating it as a separate step.** This integrated approach to quality assurance has helped ensure reliable data while minimizing the need for later corrections. The implementation of standardized terminology and classification systems early in the process has proven particularly valuable for maintaining consistency across different data sources.

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The **collaborative approach to template development and testing**, involving multiple rounds of partner feedback, stakeholder testing **and refinement has contributed significantly to the success** of our data collection efforts. **Partner training sessions and ongoing support have proven essential** in maintaining documentation quality while encouraging consistent engagement from data providers.

Next Steps and Future Development

As we move forward several key activities are planned to build upon this foundation. The database will continue to evolve to support the development of the project's Dashboard, including refinement of data export capabilities, enhancement of query optimization and implementation of additional quality control measures. **The database will remain open for continuous submissions, allowing us to expand our knowledge base while maintaining consistent data quality standards recognizing that**:

- many Operational Groups have **ongoing projects** with results that will only become available in later project stages,
- maintaining **continuous engagement with Operational Groups** requires flexibility in data submission timelines,
- the **Dashboard's purpose** as a dynamic platform necessitates ongoing addition of new practices,
- a **larger pool of documented practices** enables better selection of high-quality examples for the Dashboard.

Key priorities for the next phase include:

- Expanding the practice documentation to reach our target of 60 documented practices;
- Implementing feedback from initial data utilization to enhance system functionality;
- Strengthening integration capabilities to support Dashboard development;
- Enhancing documentation based on user experiences and emerging needs.

Recommendations for Future Implementation

Based on our experience in developing and implementing this database system, we offer several strategic recommendations for future development. **First**, maintaining **regular communication** between database and dashboard development teams will be crucial to ensure that data structures effectively support visualization and analysis needs. **Second**, implementing regular **quality assessment procedures** will help ensure that collected data continues to meet project requirements and supports effective analysis.

We recommend maintaining and updating technical documentation as the system evolves, ensuring all project teams have current information about data structures and access procedures. Continued

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engagement with data providers and future data users will help ensure the system effectively meets their needs while supporting project objectives.

Finally, we recommend establishing a formal feedback mechanism for both practice providers and survey respondents, enabling continuous improvement of our data collection and management processes. This user-centered approach will help ensure the database continues to serve its essential role in facilitating knowledge exchange about sustainable soil management practices across Europe.

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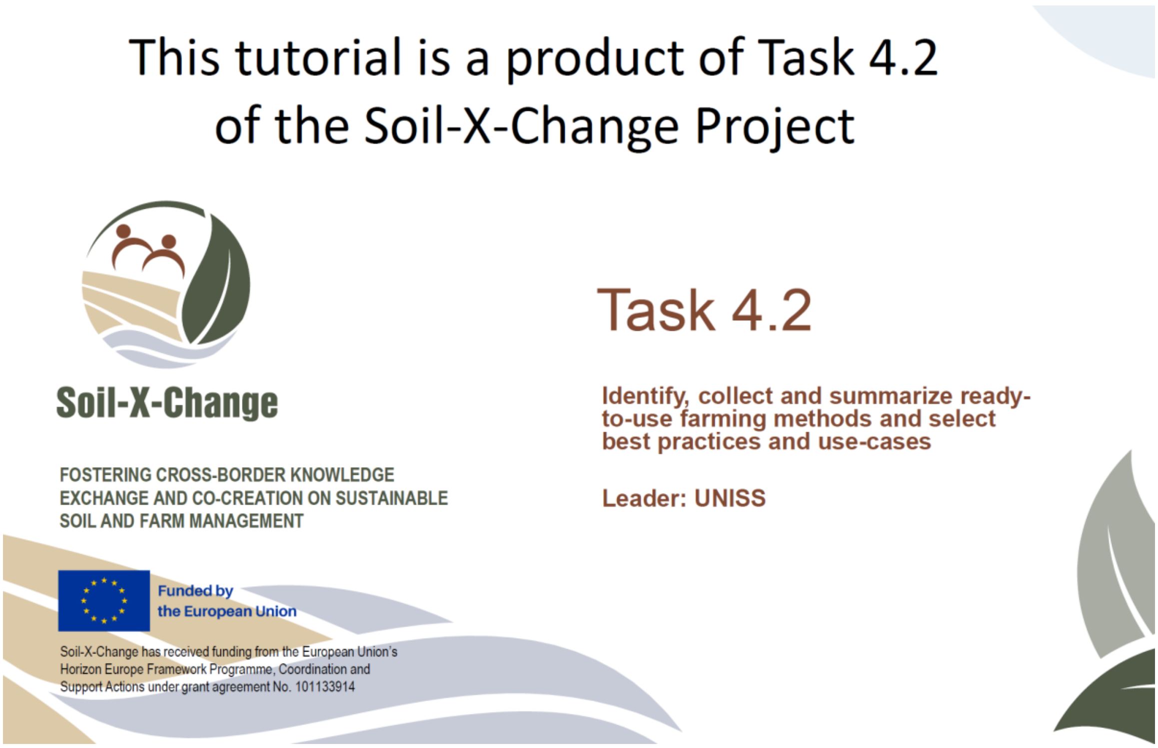
7. Annexes

1. Tutorial for Best Practice data collection



The main objectives of Task 4.2

1. Identify, collect, and summarize representative examples of sustainable and ready-to-use farming technologies that have been shown to improve soil health as well as crop yield in diverse agricultural systems.
2. Conduct a descriptive analysis of different practices and the associated impacts. Data will be organized and harmonized to have common definitions and understanding of the terminology.
3. Based on the above analyses, identify best practices that will be showcased by the project Dashboard and that will become demonstration cases.

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Essential task flow:

Template-based data collection ➡ Database ➡ Dashboard

The project will create an online Dashboard that will showcase information contained in a Database that will be populated by documenting the best sustainable soil management practices implemented by EIP AGRI Operational Groups (OGs) and by some other relevant projects.

What information about practices?

- Practices, categorized into groups based on their nature with a particular focus on innovative practices and on precision farming measures.
- Context factors, including site location, soil types, crop, climate and others
- Impacts, or practical effects for each farming technique on soil properties, soil health, crop yield and ecosystems

For what ?

- To fully understand what we are talking about
- To enable and facilitate future upscaling of the practices to other EU regions and countries
- To assess the expected impact of future upscaling of the practice

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Template tutorial

Purpose: provide guidance for data collection aimed at documenting the practices based on the provided excel template

Basic indications, very important:

1. The excel file includes 6 types of worksheet to be filled, named Part 1, Part 2, Part 3, Part 4, Part 5, and Part 6. Other sheets (Cover page, Lists) must not be modified.

2. No alterations in the template structure can occur (e.g. adding rows, columns or sheets). Only cells in C Column ("input data" field) can be filled. All other cells are locked (except for Part 4).

Locking cells ensures the structure of the template remains consistent across all files – crucial for compiling in the database. Deviations in the structure can disrupt the automation of the data extraction process

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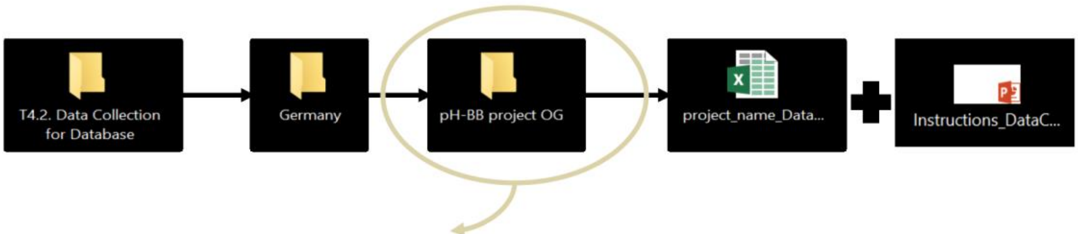
Where will Data Collection take place?

Data collection will happen through the excel template shared with the project on Teams folder. Specific folders will be created per each project.

(example for **Germany** and **pH-BB project**):



Only this link is shared with the project, named after his project name.

National Soil-X-Change Partners have access to the document and are encouraged to follow-up on the filling, assisting the project reference person.

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How to fill the template?

Simplified process with drop-down menus

- Ease of selection;
- Select the most appropriate option

Flexibility in data entry

- **“Skip and return later”** → documenters can skip fields they're unsure about and return later. Template will be available until mid-November.
- **“Ask for assistance”** → require for further clarification? Our team can provide support!
- **”Best estimate option”** → if documenters are uncertain about a particular topic, they should select the option that most closely matches their situation.

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Part 1 General information

Who will fill the Data Collection Template?

- The link to the template will be shared with the OG representative who, in turn, can share it with other OG members: **it is up to the OG to decide who is more suitable to fill in the template, or the “main documenter”.**
- Additional sources of information (“resource persons“) can be credited.

1.2 Documentors and Resouces Persons/Information

1.2.1. Are you the main documentor? (If yes, please fill below) *	yes
Full name	Claudio Zucca
Gender :	male
Name of institution:	University of Sasari
Address of institution	Via de Nicola 9
City:	7100
State or District and country:	Sassari
Tel.:	0039 3292604269
E-mail:	clzucca@uniss.it
Field of expertise 1:	Soil science
Field of expertise 2 (if any):	Land degradation
Field of expertise 3 (if any):	SLM
Date of filling this form *:	18/11/2021
Place of filling this form *:	Italy

Is there any Resouce Person (if different from the Documentor(s))(If yes, please fill below) *	no
Full name	
Gender:	
Name of institution:	
Address of institution:	
City:	
State or District and country:	
Tel.:	
E-mail:	
Field of expertise:	
Field of expertise 2 (if any):	
Field of expertise 3 (if any):	
Stakeholder type:	

- Partners are allowed to fill in some parts as well (**e.g., descriptions on Part 2**). This can streamline the documenter's work, as they will only need to review what has been written and make any necessary changes if desired.

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Part 1 General information

SITES

- The template has been designed to allow documenting multiple sites (up to 3), **IF** the practice being described has been tested/applied in sites that have considerably different context (e.g. different soil type, crop type) that require specific description. This is particularly important if application in different contexts has generated different impacts.
- It is up to the documenter (e.g. the project contact person) to decide if such "considerable" difference is worth to be taken into account: e.g. one practice worked very well on one soil type but partially failed on another; or, conversely, emphasise that a practice was very successful on contrasted soil types or crops.
- If the documenter decides to document multiple sites, the implications are:

Next slide

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Part 1 General information

SITES

If the documenter decides to document multiple sites, the implications are:

- All sites are identified in Part 1 sheet
- All sites are georeferenced in Part 4-Polygon sheet
- Specific Part 5-Location and Part 6-Impact sheets must be filled in for each Site (meaning that, if Sites are 3, both Part 5-Location and Part 6-Impact sheets will be filled 3 times, using the provided duplicates)

Part 1 General information	Part 2 Description	Part 3 Purpose & Classification	Part 4 Polygon	Part 5 Location-Context_S1	Part 6 Impacts & Factors_S1
				Part 5 Location-Context_S2	Part 6 Impacts & Factors_S2
				Part 5 Location-Context_S3	Part 6 Impacts & Factors_S3

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Part 2 Description

Part 2 Description of the practice

- Mainly includes open descriptions of the practice, supported by photos that can be directly pasted into the file cells.
- Differently from the other open text boxes, these descriptions **should be written both in English and in the national language**

> - We encourage the documenter to write the in the respective national language: that piece of information can be later translated into English by Partners
> - If he/she prefers to write in English too, welcome to do.

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Part 3 Purpose & Classification

Part 3 Purpose & Classification of the practice

- The documenters chose among pre-defined categories modified from those developed and adopted by WOCAT, which have proved capacity to cover a very wide range of typologies of sustainable land management (SLM) technologies, or practices, worldwide.

  Such categories are:
  - Purposes of the SLM Technology
  - Type of the SLM Technology
  - SLM measures comprising the SLM Technology

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Part 3 Purpose & Classification

Purposes of the SLM Technology

The primary purpose of a best practice is not always increasing yield or income. For example, it could be adapting to climate change or recovering degraded soils. The documenter should indicate the primary purpose and, if any, the secondary and tertiary ones, picking from the drop-down list (reproduced below).

Improve production (crop, fodder, wood/ fibre, water, energy)
Prevent land degradation (soil, water, vegetation)
Reduce land degradation (soil, water, vegetation)
Restore/rehabilitate land degradation (soil, water, vegetation)
Conserve ecosystem
Protect a watershed/ downstream areas – in combination with other Technologies
Preserve/ improve biodiversity
Reduce risk of disasters (e.g. droughts, floods, landslides)
Adapt to climate change/ extremes and its impacts (e.g. resilience to droughts, storms)
Mitigate climate change and its impacts (e.g. through carbon sequestration)
Create beneficial economic impact (e.g. increase income/ employment opportunities)
Create beneficial social impact (e.g. reduce conflicts on natural resources, support marginalized groups)
Other purpose (specify in the next field)

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Part 3 Purpose & Classification

Type of the SLM Technology

Different groups of practices can be distinguished, depending on the main type of approach and particularly on the component of the farming system that is primarily addressed.

The documenter should indicate the primary type and, if any, the secondary and tertiary ones, picking from the drop—down list (reproduced below).

Besides the drop-down list, explanation are also given for each item (added as comment to the cell).

TREE/VEGETATION-BASED
Natural and semi-natural forest management
Forest plantation management
Agroforestry
Windbreak/ shelterbelt
Area closure (stop use, support restoration)
SOIL-BASED
Minimal soil disturbance
Integrated soil fertility management
Slope change measures
WATER-BASED
Water harvesting
Irrigation management (incl. water supply, drainage)
Water diversion and drainage
Surface water management (spring, river, lakes, sea)
Groundwater management

AGRONOMY/FARM SYSTEM-BASED
Rotational system (crop rotation, fallows, shifting cultivation)
Pastoralism and grazing land management
Integrated crop–livestock management
Improved underground vegetation cover
Integrated pest and disease management (incl. organic agriculture)
Improved crop varieties/ animal breeds
Beekeeping, aquaculture, poultry, rabbit farming, silkworm farming, etc.
Home gardens
NATURAL RESOUCES CONSERVATION-BASED
Wetland protection/ management
Ecosystem-based disaster risk reduction
OTHERS
Waste management/ waste water management
Energy efficiency
Post-harvest measures
Other (specify in the next field)

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Part 3 Purpose & Classification

SLM measures comprising the SLM Technology (1)

Technically, the practice can be based on different types of measures: Agronomic, Vegetative, Structural, or Management measures. Each type includes sub-types.

Different types can co-exist within the same practice, which can be part of an integrated farming system (e.g., introducing agroforestry on terraced land, involving Vegetative and Structural measures at the same time).

For each type of measure that is involved by the practice, the documenter should indicate the primary ("first") and, if any, the secondary types, picking from the drop-down lists (left columns of the below four tables), then indicate concisely the concrete intervention undertaken by farmers (like in the examples in the right columns of the below four tables).

Agronomic measures sub-types	Concrete examples
A1: Vegetation/ soil cover	A1: Mixed cropping, intercropping, relay cropping, cover cropping
A2: Organic matter/ soil fertility	A2: Conservation agriculture, production and application of compost/ manure, mulching, trash lines, green manure, crop rotations
A3: Soil surface treatment	A3: Zero tillage (no-till), minimum tillage, contour tillage
A4: Subsurface treatment	A4: Breaking compacted subsoil (hard pans), deep ripping, double digging
A5: Seed management, improved varieties	A5: Production of seeds and seedlings, seed selection, seed banks, development/ production of improved varieties
A6: Others	

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Part 3 Purpose & Classification

SLM measures comprising the SLM Technology (2)

Vegetative measures sub-types	Concrete examples
V1: Tree and shrub cover	V1: Agroforestry, windbreaks, afforestation, hedges, live fences
V2: Grasses and perennial herbaceous plants	V2: Grass strips along the contour, vegetation strips along riverbanks
V3: Clearing of vegetation	V3: Fire breaks, reduced fuel for forest fires
V4: Replacement or removal of alien/ invasive species	V4: Cutting of undesired trees and bushes
V5: Others	V5: Tree nurseries

Management measures sub-types	Concrete examples
M1: Change of land use type	M1: Area closure/ resting, protection, change from cropland to grazing land, from forest to agroforestry, afforestation
M2: Change of management/ intensity level	M2: Change from grazing to cutting (for stall feeding), farm enterprise selection (degree of mechanization, inputs, commercialization), vegetable production in greenhouses, irrigation; from mono-cropping to rotational cropping; from continuous cropping to managed fallow; from open access to controlled access (grazing land, forests); from herding to fencing, adjusting stocking rates, rotational grazing
M3: Layout according to natural and human environment	M3: Exclusion of natural waterways and hazardous areas, separation of grazing types, distribution of water
M4: Major change in timing of activities	M4: Land preparation, planting, cutting of vegetation
M5: Control/ change of species composition (if annually or in a rotational sequence as done e.g. on cropland à A1)	M5: Reduction of invasive species, selective clearing, encouragement of desired/ introduction of new species, controlled burning (e.g. prescribed fires in forests/ on grazing land)/ residue burning
M6: Waste management (recycling, re-use or reduce)	M6: Includes both artificial and natural methods for waste management
M7: Others	M7: Others

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Part 3 Purpose & Classification

SLM measures comprising the SLM Technology (3)

Structural measures sub-types	Concrete examples
S1: Terraces	S1: Bench terraces (slope of terrace bed <6%); Forward-sloping terraces (slope of terrace bed >6%
S2: Bunds, banks	S2: Earth bunds, stone bunds (along the contour or graded), semi-circular bunds ("demi-lunes")
S3: Graded ditches, channels, waterways	S3: Diversion/ drainage ditch, waterways to drain and convey water
S4: Level ditches, pits	S4: Retention / infiltration ditches, planting holes, micro-catchments
S5: Dams, pans, ponds	S5: Dams for flood control, dams for irrigation, sand dams
S6: Walls, barriers, palisades, fences	S6: Sand dune stabilization, rotational grazing (using fences), area closure, gully plugs (check dams)
S7: Water harvesting/ supply/ irrigation equipment	S7: Rooftop water harvesting, water intakes, pipes, tanks, etc.
S8: Sanitation/ waste water structures	S8: Compost toilet, septic tanks, constructed treatment wetlands
S9: Shelters for plants and animals	S9: Greenhouses, stables, shelters for plant nurseries
S10: Energy saving measures	S10: Wood-saving stoves, insulation of buildings, renewable energy sources (solar, biogas, wind, hydropower)
S11: Others	S11: Compost production pits; reshaping of surface (slope reduction)

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Part 4 Polygon

Part 4 - Polygon

- The purpose is to geo-reference the sites where the practice has been tested and proved to be successful. A spatially explicit delineation of the farms, or farm fields, is necessary to create a robust record and e.g. enable possible further data collection and information gap filling in future.
- The template provides full explanation on how to do this. Data to be provided are:
  - Geographical X,Y coordinates of up to three Sites (reference Site points such as fields), with indication of the reference geographical system (WGS84 can be considered as the default one, either in decimal degrees or UTM-projected, which is available to everybody through common phone-based mapping Apps)
  - A picture showing field/farm delineation polygons around reference points, depicted over a satellite image used as background, having sufficient quality to allow fields recognition.
  - The above polygons as KMZ files, to be provided as attachment to the delivered excel file

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Part 5 Location-Context

Part 5 Location & Context

- Includes minimum, essential contextual information about the sites where the practice has been tested and proved to be successful.
- Answers are mainly given by picking from drop-down menus, based on widely used, consolidated international references.
- Some questions allow the documenters to pick two different options if in their farm land there is variability: for example, if the topsoil texture is “fine” at most locations (which would make this the first choice), but “very fine” in some non-negligile parts.

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Part 6 Impacts & Factors

Part 6 Impacts

- Allows systematic review of the on-site and off-site impacts, or benefits, generated by the practice, along with its exposure and sensitivity to climate change and climate-related extremes/disasters, and its overall benefits versus costs.
- Enable semi-quantitative estimate of each applicable item, by means of scores in the -3 / 0 / +3 range.
- The documenter only evaluates the aspects that are applicable to its practice/case, leaving the others blank.

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Cover page

Data Consent

For GDPR-compliant consent statement for data collection in the template, several points are covered:

- Purpose of Data Collection
- Lawful Basis for Processing
- Dara Subject's rights
- Data Retention
- Contacts for information

Upon filling the template, the documenter consents to the processing and use of data as described.

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Credits

CREDITS: template and tutorial have been prepared in collaboration with UNISS-led PRIMA-funded SOILS4MED project and with ICARDA-led GeOC team. Template fields' content is adapted from templates and guideline material elaborated by GeOC also based on WOCAT

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World Overview of Conservation Approaches and Technologies

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2. Soil-X-Change Farmer Survey Template

Soil-X-Change

Soil-X-Change Survey 2024

Fields marked with * are mandatory.

Soil-X-Change

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INTRODUCTION

Dear participant, welcome to the Soil-X-Change survey of adaptation of sustainable soil management methods and technology!

Soil-X-Change is an acronym of an EU funded Horizon Europe project "Fostering cross-border knowledge exchange and co-creation on sustainable soil and farm management" with a mission to facilitate connections among farmers, stakeholders, policy makers, projects, and initiatives, accelerating innovation in sustainable soil and farm management.

The aim of this survey is to collect constraints and barriers affecting technology adaptation, drivers and preferences, needs and possible gaps of sustainable soil and farm management strategies. The collected information will be used to create solutions that are more closely aligned with farmers' needs, ultimately improving the adoption of beneficial agricultural technologies and practices. The survey lasts maximum 20 minutes. There are no right or wrong answers, we are curious about your views.

Your input is instrumental in shaping sustainable soil and farm management strategies that are better tailored to practitioner's' needs. By participating in the survey, you may influence the development of policies and practices that will affect daily operations. Respondents will gain access to a comprehensive source of best practices and innovative solutions that have been vetted and proven effective. This will help to improve soil health, increase crop yield, and enhance overall farm sustainability.

We offer selected farmers who take part in the survey and the subsequent focus group discussions the opportunity to share their experiences and highlight shortcomings so that recommendations for action can be derived for policy makers. In Soil-X-Change, we are also developing an information platform on which farmers can expand their knowledge of sustainable soil management and its economic benefits. In addition, the exchange between farmers is promoted in practical workshops and discussion rounds.

1

The survey data will be analyzed to compare differences in the adoption of soil and crop management practices across different regions, that can help identify specific factors that influence technology adoption. Advanced statistical techniques will highlight which factors (e.g., financial incentives, access to information, training) are most important in influencing farmers' decisions. By comparing farmers' needs and barriers with available solutions and practices, gaps will be identified. This will help in developing targeted interventions to address unmet needs and remove obstacles to technology adoption. Based on the survey findings, policy briefs and recommendations will be developed to guide policymakers in creating supportive frameworks that encourage the adoption of sustainable agricultural practices.

Do you have any questions or comments? You can contact us: info@soil-x-change.eu or Survey Studies Leader: Discovery Center Nonprofit Ltd. (tgyarmati@drdc.eu).

CONSENT STATEMENT

Rest assured that this study will not disseminate any personal information. The data collected will be presented in an aggregated format and through simple statistical indicators. We ensure anonymity and compliance with current privacy and personal data protection laws (Regulation EU no. 679/2016, known as the "European Regulation on the Protection of Personal Data" - GDPR).

By selecting the consent box below:

- I am voluntarily participating in this activity.
- I understand that my participation involves providing responses to a survey, where I will be asked to share my views and experiences on the barriers and needs of farmers to apply methods of sustainable soil management.
- I have the right to seek clarification about my participation in the survey and receive clear answers before making any decisions by contacting the Survey Studies Leader: Discovery Center Nonprofit Ltd. (tgyarmati@drdc.eu) or the project responsible at info@soil-x-change.eu.
- I reserve the right to decline answering any questions I do not wish to discuss. I am free to discontinue my participation at any time.
- My survey responses will be recorded, and digital copies will be securely stored. Any physical copies made of my responses will be safely maintained by the Soil-X-Change team and will be disposed of when they are no longer necessary, or within five years after the project's conclusion (whichever occurs sooner).

☐ I consent

SECTION 1: ABOUT YOU

*1. I am giving my contribution as a(n)...
- ○ a farmer/farm manager
- ○ non-farmer

If you are non-farmer, please specify:

2

*2. In which country is your farm or organization/company located?

○ AT - Austria	○ FR - France	○ MT - Malta
○ BE - Belgium	○ DE - Germany	○ NL - Netherlands
○ BG - Bulgaria	○ EL - Greece	○ PL - Poland
○ HR - Croatia	○ HU - Hungary	○ PT - Portugal
○ CY - Cyprus	○ IE - Ireland	○ RO - Romania
○ CZ - Czechia	○ IT - Italy	○ SK - Slovak Republic
○ DK - Denmark	○ LV - Latvia	○ SI - Slovenia
○ EE - Estonia	○ LT - Lithuania	○ ES - Spain
○ FI - Finland	○ LU - Luxembourg	○ SE - Sweden

*3. What farming methods do you employ?
- ○ Organic
- ○ Conventional

*4. In which of the following sector are you active?

Multiple answer is possible.

☐ Arable farming	☐ Fruit farming
☐ Animal farming	☐ Olive
☐ Mixed farming (crops and animals)	☐ Agroforestry
☐ Horticulture without green house	☐ Forestry
☐ Horticulture with green house	☐ Other
☐ Viticulture	

If Other, please specify:

*5. What is your farm size? How much land do you farm in total?
- ○ Less than 5 ha
- ○ 6-50 ha
- ○ 51-100 ha
- ○ 101-250 ha
- ○ 251-500 ha
- ○ More than 500 ha
- ○ No land

*6. What is your age range?
- ○ Below 30
- ○ From 30-39
- ○ From 40-49
- ○ From 50-64
- ○ 65 or over

3

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SECTION 2: GENERAL KNOWLEDGE/VIEW ON SUSTAINABLE SOIL MANAGEMENT PRACTICES

In this section we would like to know what farmers, practitioners or other stakeholders know and think about Sustainable Soil and Farm Management Practices in GENERAL.

7. Please indicate to what extent you are familiar with the below listed sustainable soil and farm management practices.

	Heard of (but never used it)	Have practical experience	Did not hear about
* Minimum tillage *A soil-conserving system with the aim of reducing soil cultivation to a minimum, e.g. direct sowing, no-till, strip-till, ridge-till, and mulch-till systems.*	○	○	○
* Cover crops: summer/ autumn and winter cover crop, undersawn crops *Cover crops are grown between the main crops, undersown crops with the main crop. In most cases, the above-ground biomass is left on the field.*	○	○	○
* Intercropping: mixed cultivation or strip cropping *Planting or growing two or more crops together at the same time and on the same arable land in a beneficial manner.*	○	○	○
* Integrated Pest Management (IPM) *Combination of strategies to effectively control pests' populations, while minimizing the risk for people and environment.*	○	○	○
* Microbiological products *Products including beneficial bacteria, fungi and other microorganisms that interact with plants and soil in beneficial ways.*	○	○	○
* Biochar *Application of charcoal as a soil amendment.*	○	○	○
* Mulching *A covering of the soil, usually made of organic materials such as plants or straw. The soil is completely covered with this.*	○	○	○
* Liming *Applying neutralizing agents, such as limestone, basic slag, hydrated lime, or quick lime, to soil or water for the purpose of increasing its basicity (pH and alkalinity).*	○	○	○
* Precision agriculture: site-specific management *Site-specific adaptation of inputs and practices for optimal crop production and resource efficiency.*	○	○	○
*			
Precision agriculture: Use of digital soil mapping technologies *High-resolution soil property analysis through technology to guide precise application of inputs, e.g. soil sensors, drones, variable rate application equipment.*	○	○	○
* Terraces *The soil of arable land or grassland is laid out in stages.*	○	○	○
* Contour farming *Practice that involves growing crops parallel to the land's contours, creating natural barriers, ridges and furrows.*	○	○	○
* Water harvesting and conservation *Collecting and storing rainwater through the construction or use of physical structures (e.g. terraces, check dams, ponds, tanks).*	○	○	○
* Drainage systems *Process of directing excess water to or away from root zones by natural or artificial means.*	○	○	○
* Livestock integration *Practice of combining crop and livestock production systems.*	○	○	○
* Rotational grazing *Practice where livestock is moved between different pasture sections in a planned sequence.*	○	○	○
* Non-rotational grazing *Involves continuous grazing in a single pasture without being moved to different sections.*	○	○	○
* Agroforestry *Practice that involves integrating woody vegetation (trees or shrubs) with crop and/or animal systems on the same land.*	○	○	○
* Bush and tree fallows *Practice where fields are left uncultivated for a period, allowing natural vegetation regrowth, before replanting crops.*	○	○	○
* Buffer strips with woody species *Conservation buffers are small areas or strips of land in permanent vegetation, designed to intercept pollutants and manage other environmental concerns.*	○	○	○

4

Other, please specify:

* **8. Where do you get information about sustainable soil and farm management practices?**

Multiple answer is possible.

- ☐ Other farmers / end users
- ☐ Journals
- ☐ Exhibitions, fairs, expo
- ☐ Advisors
- ☐ Innovation brokers

5

- ☐ Officials at regional / national authorities
- ☐ Input dealers / technology suppliers
- ☐ Researchers
- ☐ My own experience, testing
- ☐ Other

If Other, please specify:

9. What are, in your opinion, the top 3 reasons in general of applying any sustainable soil and farm management practices?
Please rank the main 3 reasons.

(only the top 3 reasons should be chosen, so only 3 rows should be filled)

at most 3 answered row(s)

	1 Most important reason	2 Second most important reason	3 Third most important reason
Improving soil properties	○	○	○
Adaptation to climate change	○	○	○
Increasing agricultural productivity	○	○	○
Reducing effect on the environment	○	○	○
Increasing food security	○	○	○
Adhering to EU agricultural policies and subsidies	○	○	○
Adaptation to consumer demand	○	○	○
Demonstration of success from other farmers / comparison with other farmers	○	○	○
Strategic market position	○	○	○
Increasing profitability	○	○	○
Enhancing welfare	○	○	○

10. What are, in general the barriers of applying sustainable practices in your country?
Please rank by importance, most important barrier on the top, least important barrier at the end.

Use drag&drop or the up/down buttons to change the order or accept the initial order.

- Economic constraints
- Infrastructure and technology limitations
- Policy frameworks

6

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- Knowledge gaps
- Social dynamics
- Climate and environmental risks

SECTION 3: EXPERIENCE WITH SUSTAINABLE SOIL MANAGEMENT PRACTICES

In this section we are interested in YOUR OWN experience in regard of sustainable soil and farm management practices.

* Do you have experience with such practices?

- Yes - please answer below questions
- No - please proceed to section 4

11. Which of the below listed sustainable soil and farm management practices have you applied? Please indicate to what extent.

	Tested it	Use it	Used it (and quit using it)
Minimum tillage *A soil-conserving system with the aim of reducing soil cultivation to a minimum, e.g. direct sowing, no-till, strip-till, ridge-till, and mulch-till systems.*			
Cover crops: summer/ autumn and winter cover crop, undersawn crops *Cover crops are grown between the main crops, undersown crops with the main crop. In most cases, the above-ground biomass is left on the field.*			
Intercropping: mixed cultivation or strip cropping *Planting or growing two or more crops together at the same time and on the same arable land in a beneficial manner.*			
Integrated Pest Management (IPM) *Combination of strategies to effectively control pests' populations, while minimizing the risk for people and environment.*			
Microbiological products *Products including beneficial bacteria, fungi and other microorganisms that interact with plants and soil in beneficial ways.*			
Biochar *Application of charcoal as a soil amendment.*			
Mulching *A covering of the soil, usually made of organic materials such as plants or straw. The soil is completely covered with this.*			
Liming *Applying neutralizing agents, such as limestone, basic slag, hydrated lime, or quick lime, to soil or water for the purpose of increasing its basicity (pH and alkalinity).*			
Precision agriculture: site-specific management *Site-specific adaptation of inputs and practices for optimal crop production and resource efficiency.*			
Precision agriculture: Use of digital soil mapping technologies *High-resolution soil property analysis through technology to guide precise application of inputs, e.g. soil sensors, drones, variable rate application equipment.*			
Terraces *The soil of arable land or grassland is laid out in stages.*			
Contour farming *Practice that involves growing crops parallel to the land's contours, creating natural barriers, ridges and furrows.*			
Water harvesting and conservation *Collecting and storing rainwater through the construction or use of physical structures (e.g. terraces, check dams, ponds, tanks).*			
Drainage systems *Process of directing excess water to or away from root zones by natural or artificial means.*			
Livestock integration *Practice of combining crop and livestock production systems.*			
Rotational grazing *Practice where livestock is moved between different pasture sections in a planned sequence.*			
Non-rotational grazing *Involves continuous grazing in a single pasture without being moved to different sections.*			
Agroforestry *Practice that involves integrating woody vegetation (trees or shrubs) with crop and/or animal systems on the same land.*			
Bush and tree fallows *Practice where fields are left uncultivated for a period, allowing natural vegetation regrowth, before replanting crops.*			
Buffer strips with woody species *Conservation buffers are small areas or strips of land in permanent vegetation, designed to intercept pollutants and manage other environmental concerns.*			

7

Other, please specify:

8

* **12. We would like you to choose a sustainable soil management practice or a combination of some (holistic approach), you have applied and have the most experience with and answer the questions considering the chosen method.**
Please name the practice you will refer to in this section of the survey. Use the definitions from the previous question.
Applied practice or combination of practices (holistic approach):

* **13. Which of the following drivers impacted your adoption of the applied sustainable soil management practice(s)?**
Multiple answer is possible.
(Applied practice means your chosen practice you have defined in question 12)

- Economic factors
- Market Demand and Consumer Preferences
- Environmental Concerns
- Policy and Regulatory Support
- Access to Knowledge and Extension Services
- Farmers' Values and Beliefs
- Risk Management and Resilience
- Community and Social Networks

Other, please specify:

* **14. What are your benefits of applying this/these practice(s)?**
Multiple answer is possible.
(Applied practice means your chosen practice you have defined in question 12)

- Improved Soil Health
- Reduced Soil Erosion
- Water Conservation
- Climate Change Mitigation
- Biodiversity Conservation
- Reduced Environmental Pollution
- Resilient Agriculture Systems
- Enhanced Crop Yields
- Increased profitability
- Economic Benefits
- Better market position
- Social advantages

Other, please specify:

9

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15. How do benefits of the chosen applied practice(s) compare with the establishment cost?
Please indicate your answer by adding ratings as 1-Negative; 2- Neutral; 3-Positive.

	Ecological benefits (in terms of soil health, soil preservation, increase soil quality)	Economic benefits (cost savings, increased yields)
Direct costs (financial investment)		
Indirect costs (labor, time)		

10

*16. How effective is/are the practice(s) you used regarding soil health?**

- Not effective
- Neutral
- Effective
- I do not know

17. Please explain the positive effect of the chosen applied practice(s) you experienced on soil health!

18. Have you identified any negative consequences in general and regarding soil health of applying such practice(s)? Please explain the negative effects you experienced!

Negative consequence in general:

Negative consequence regarding soil health:

If you have used different sustainable soil management practices but stopped, please answer below questions:

19. Which practice(s) did you apply but decided to quit?

20. How long did you use this/these practice(s)?

21. What was your main reason to quit?

22. Would you suggest and recommend to other farmers to use the method(s) you applied?

- Yes
- No

Please explain why:

11

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SECTION 4: FUTURE PLANS WITH SUSTAINABLE SOIL MANAGEMENT PRACTICES

In this section we are interested in your view on future application of sustainable soil and farm management practices.

* **23. Do you have plans to apply other/new sustainable soil and farm management practice?**

- No
- Yes, please complete following questions

24. If you answered Yes to the previous question, which sustainable soil and farm management practice would you try in the future?
You can use the list as a reference or add other.

- Minimum tillage
- Cover crops: summer cover crop
- Cover crops: autumn and winter cover crop
- Cover crops: intercropping
- Integrated Pest Management (IPM)
- Microbiological products
- Biochar
- Mulching
- Liming
- Precision agriculture: site-specific management
- Precision agriculture: Use of soil testing technologies
- Terraces
- Contour farming
- Water harvesting and conservation
- Drainage systems
- Livestock integration
- Rotational grazing
- Non-rotational grazing
- Agroforestry
- Bush and tree fallows
- Buffer strips with woody species

Other, please specify:

* **25. What were your barriers for applying this practice till now?**
Please rank from least to most important.

Use drag&drop or the up/down buttons to change the order or accept the initial order.

- Financial Constraints
- Short-Term Economic Pressures

12

- Infrastructure and Technology Limitations
- Scaling up limitations
- Land Tenure and Property Rights
- Policy and Institutional Barriers: Inadequate policy support, regulatory frameworks
- Knowledge and Awareness Gaps
- Cultural and Social Factors
- Climate and Environmental Risks

* **26. What are your expected benefits of applying this new practice?**

Multiple answer is possible.

- Improved Soil Health
- Reduced Soil Erosion
- Water Conservation
- Climate Change Mitigation
- Biodiversity Conservation
- Reduced Environmental Pollution
- Resilient Agriculture Systems
- Enhanced Crop Yields
- Increased profitability
- Economic Benefits
- Better market position
- Social advantages

Other, please specify:

* **27. Which of the following could aid you in adopting new sustainable soil management techniques?**

Multiple answer is possible.

- Other farmers/end users
- Advisors
- Innovation support service
- Regional/national authorities
- Living Labs
- Collaboration with researchers
- Subsidies for environmentally friendly farming
- Supporting financial incentives
- Policy coherence
- Access to equipment
- Targeted projects
- Publications/toolboxes (newsletters, flyers, booklets, guidelines) of results of national or European projects

13

- Dedicated events organised by successful project
- On-farm demonstration of alternative methods
- Increased availability of easy to reach and understand information
- Peer to peer learning and knowledge exchange
- Personal coaching and advice
- Training courses for practitioners
- Project's digital product/app for practitioners

Other, please specify:

CLOSING QUESTION

A number of respondents to this survey might be contacted for a follow-up phone interview or focus group discussion to look in more details at their replies. Would you agree to be contacted for such a follow-up?

- No
- Yes

If Yes, please provide your email and/or phone number:

Your data will not be shared and will be safely maintained by the Soil-X-Change team. You have the right to withdraw your participation at any time and decline answering any questions you do not wish to discuss.

14

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