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VISION SCENARIOS, REQUIREMENTS AND INNOVATIVE GOVERNANCE MODELS, V1

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Acronyms and Abbreviations

Acronyms and Abbreviations	
AGINS	AgroInsurance International
AI	Artificial Intelligence
AoI	Area of Interest
API	Application Programming Interface
APSIM	Agricultural Production Systems sIMulator
ATB	Institut für angewandte Systemtechnik Bremen GmbH
AUTh	Aristotle University of Thessaloniki
BioPAR	Biogeophysical PARameters
CA	Consortium Agreement
CSA	Coordination and Support Action
DA	Data Act
DES	Deimos Spain
DGA	Data Governance Act
DMA	Digital Markets Act
DME	DEIMOS ENGENHARIA SA
DMK	DMK Deutsches Milchkontor GmbH
DSA	Digital Services Act
DSSC	Data Space Support Center
EC	European Commission
EEAB	External Expert Advisory Board
EGM	Easy Global Market SAS
EO	Earth Observation
EOD	Earth Observation Data
EURAC	Accademia Europea di Bolzano (Eurac Research)
EV ILVO	Eigen Vermogen van het Instituut voor Landbouw en Visserij Onderzoek
ExBo	Executive Board
FEU	Farm Europe
FMIS	Farm Management Information System
fPAR	fraction of absorbed Photosynthetically Active Radiation
GA	General Assembly

GAEC	Good Agricultural and Environmental Conditions
GDPR	General Data Protection Regulation
GHG	Greenhouse Gas
GIS	Geographic Information System
GPU	Graphics Processing Unit
HE	Homomorphic Encription
HPC	High Performance Computing
ICCS	Institute of Communication and Computer Systems
IFAPA	Instituto Andaluz de Investigación y Formación Agraria, Pesquera y Alimentaria
IoT	Internet of Things
IPR	Intellectual Property Rights
KO	Kick Off
KPI	Key Performance Indicator
KUVA	Kuva Space Oy
LAI	Leaf Area Index
LCA	Life Cycle Assessment
LUE	Light Use Efficiency
LUKE	Natural Resources Institute Finland
MARS-OP	Monitoring Agricultural ResourceS – Operations
MIGAL	MIGAL Galilee Research Institute
ML	Machine Learning
MPC	Multi-Party Computation
MS	Microsoft
MST	Management Support Team
NDVI	Normalized Difference Vegetation Index
NGSI-LD	Next Generation Service Interface with Linked Data
NP	Neuropublic SA
NPP	Net Primary Productivity
OHB DS	OHB Digital Services GmbH, Bremen, Germany
PBA	Professional Business Analysis
PEF	Product Environmental Footprint

PET	Privacy Enhancing Technologies
PMI	Project Management Institute
PO	Project Officer
PSNC	Instytut Chemii Bioorganicznej Polskiej Akademii Nauk
RACI	Responsibility Assignment Matrix
R&D	Research and Development
RIL	Research and Innovation Lab
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
SME	Small and Mid-size Enterprise
SOC	Soil Organic Carbon
TRL	Technology Readiness Level
UAV	Unmanned Aerial Vehicle
UGent	Universiteit Gent
VITO	Vlaamse Instelling voor Technologische Onderzoek
VRA	Variable Rate Application
VRI IES	Foundation "Institute for Environmental Solutions"
VTT	Technical Research Centre of Finland Ltd.
WODR	Wielkopolski Osrodek Doradztwa Rolniczego w Poznaniu
WP	Work Package

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1 Introduction

This section, to support the reader to follow and understand WP2 relevant activities, briefly mentions the relevant project objectives and describes the RILs and WP2 objectives and activities.

1.1 Project overview

ScaleAgData is a response to the call HORIZON-CL6-2022-GOVERNANCE-01-11 Upscaling (real-time) sensor data for EU-wide monitoring of production and agri-environmental conditions. The ScaleAgData project will run from January 2023 till December 2026 and consists of a consortium of twenty-six partners from fourteen countries. The vision of ScaleAgData is two-fold. On the one hand, it wants to obtain insights into how complex data streams should be governed and organised (governance call). On the other hand, it aims to develop the data technology needed to scale data collected at the farm level to regional datasets, agri-environmental monitoring, and agricultural production management.

To do so, ScaleAgData has five objectives:

- Developing **innovative approaches** for collecting in-situ data and applying data technologies.
- Enabling and promoting **data sharing** along the entire data value chain.
- Demonstrating how the **sensor data** can be **scaled to agri-environmental data products** at the national, regional or European level.
- Demonstrating the benefit of improved **monitoring capacities** in a precision farming context.
- Demonstrating the benefit of **upscaled regional datasets** for the agricultural sector in general.

During its lifecycle, the project will explore **seven innovation areas:** innovative sensor technology, edge processing, data sharing architecture and data governance, satellite data augmentation, from data assimilation to service development, privacy-preserving technology, and data integration methodologies.

1.2 RILabs

Six Research and Innovation Labs (RIL) have been identified within the project across various bio-geographical regions of Europe, where different data upscaling and integration models or approaches will be evaluated and demonstrated. The six RILs are water productivity, crop management, yield monitoring, soil health, grasslands and sustainable dairy.

Recommendations will be formulated on how such integrated datasets can be capitalised to help national and regional policy-making to strengthen both the competitiveness and sustainability of European agriculture.

1.3 Agile approach and iterations

The ScaleAgData concept is based on an agile and iterative approach that brings together the various actors to identify and align the different needs and concerns, co-create methodological frameworks and solutions, and demonstrate and evaluate the usability and relevance of the outcomes.

The multistep agile development approach of the project is illustrated in Figure 1. It consists of two cycles of two years each, with each cycle having four steps:

- Phase 1: co-design the building blocks with the RIL (WP2)
- Phase 2: development of methodological frameworks and prototypes (WP3, WP4)
- Phase 3: technology implementation and validation in a testing environment (WP3, WP4)
- Phase 4: demonstration and evaluation in the RIL (WP5)

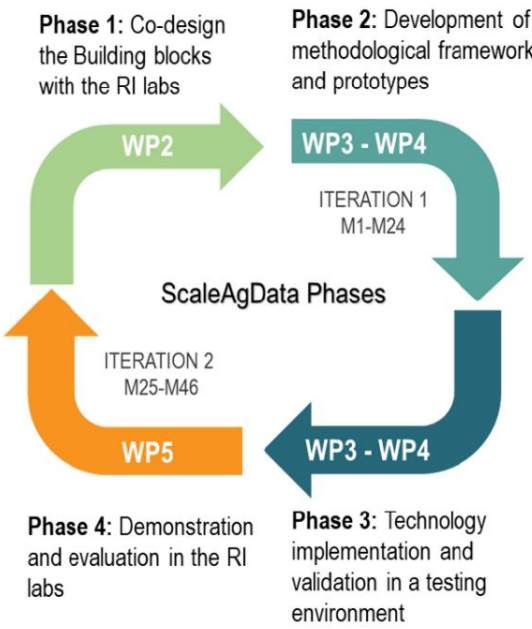

Figure 1: ScaleAgData's multistep agile development approach

1.4 WP2 Objectives, timeline and activities

WP2 will co-design the building blocks of the ScaleAgData innovative approaches with RILs. Specific objectives of WP2 are to i) deliver the needed input, as a way to support the development, technology validation of the methodological tools and data products. ii) deliver a high level prototype architecture of ScaleAgData. iii) deliver innovative governance framework that support the development of trusted and interoperable data spaces at the vertical domains of the RILs. iv) to manage the project rolling plan activities for adaptation.

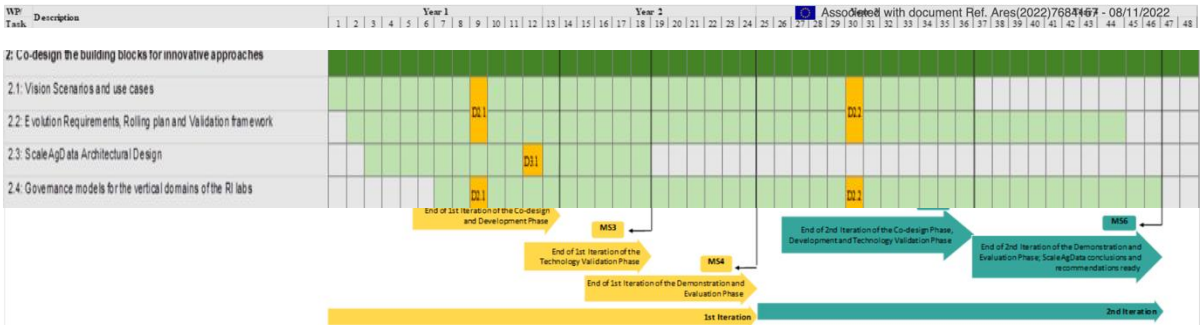

Figure 2. WP2 tasks, deliverables and timelines.

WP2, has four tasks. Tasks T2.1 and T2.2 perform the planning, elicitation and modelling within the co-design phase and with their results and deliverables (D2.1, D2.2) provide valuable inputs for the definition of the ScaleAgData architecture design in task T2.3. Additionally, task T2.2 delivers the validation framework and defines a governance allowing a steady adaptation of the work schedule of the project rolling plan). Task T2.4 makes use of many project results to initiate the development of innovative governance frameworks within or cross the verticals of the RILs.

1.4.1 Task 2.1: Vision scenarios and use cases

Within Task 2.1, we will:

- Analyse the current state of each RIL.
- Understand what is necessary to attain the desired future state.
- Identify and analyse potential users who have an interest in the results of ScaleAgData.
- Plan and prepare the elicitation process.

Task 2.1 activities include:

- Organising RILs workshops.
- Break down, synthesise and clarify collected information from the workshops, improve it, and then report it using tools like user stories and use cases.
- Capture the user's fundamental interactions with ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3 stakeholders' view and industrial demand.
- Elaborate the results, if needed, with other EU projects selected under the same call, relevant EC initiatives, and external stakeholders like policymakers using as a gate the ScaleAgData interactive stakeholder network established in task T6.2.

1.4.2 Task 2.2: Evolution requirements, Validation framework and Rolling plan

Within Task 2.2 we will:

- Define and elaborate stakeholder, functional, non-functional, and transition requirements to describe, for example, the behaviour or quality of the ScaleAgData methodological frameworks, prototypes, and data products with features and functions
- Elaborate on the requirements first with RIL actors and after with other stakeholders following the iterations of phases.
- Define a validation framework to support the traceability and monitoring of the ScaleAgData results. This framework will be used in task T4.4 and will include for example, metrics, KPIs, acceptance criteria, verification and validation of requirements, depending on the conditions (for example the maturity level of each use case). As described in WP4, task T4.4, for each of the needs identified in WP2, a number of solutions will be available in the RI environment, enabling the RILs and supporting partners to thoroughly validate, finalise and tailor them to fit the needs of each RIL. Task T4.4 will follow an iteration approach aiming to reach a TRL5. Based on these validations, the RILs will have a clear understanding of which data and methods to implement in their RIL in WP5.
- Define the plan and manage the rolling plan activities together with the ScaleAgData Research Coordinator and the WP leaders, aiming to adapt the work to the most recent developments and innovations in the field of sensors and sensor data in the public and private domain, also considering input from task T6.2.

1.4.3 Task 2.4 Governance models for the vertical domains of the RILs

Task T2.4 makes use of many project results to initiate the development of innovative governance frameworks within or cross the vertical domains of the RILs (project expected outcomes). Within Task 2.4, we will:

- Identify, analyse, and map the current status and level of governance frameworks[1] in the data ecosystem of the vertical domains of the RILs.
- For this, task T2.4, which started on July 23 (Month 7), is planning to use initially the results of tasks T2.1 & T.2.2 (D2.1) that reveal existing legal, operational and functional agreements as

[1] To align with the DSSC glossary developed in 2023, we will use the term framework and not model.

well as technical standards [2] widely adopted by RILs actors, stakeholders and potential users of the ScaleAgData results, together with evaluation outcomes of task T5.3 (Deliverable D5.3 on M24).

- Support the RIL actors, to proceed to the development, tailoring, adoption of a governance framework within the second iteration and short term after the project (outcome), considering the DSSC Starter Kit, Glossary and Blueprint and the results of the AgriDataSpace project as way to support the project objectives for effective data sharing and innovation within and cross the vertical domains of the RILs.

1.5 Scope of the document

This document describes the activities performed, methodologies used, and results obtained related to the requirements, the validation framework and the rolling plan during the project's first iteration. It additionally describes the approach that can be applied for the development of innovative governance frameworks for the vertical domains of the RILs, considering the current developments in data spaces, as those coming from the DSSC.

The document will be updated if necessary due to changed circumstances that require alterations to the approaches presented herein. And it is planned to submit an updated version of this document in the third year of the project.

1.6 Document structure

This document is structured as follows:

- Section 1 provides an overview of the project and WP2 objectives and tasks T2.1, T2.2, T2.4 relevant activities.
- Section 2 describes the ScaleAgData framework for the co-design process, the activities performed within the planning and the elicitation processes of the co-design phase (first iteration) and describes the developed approach which will be followed for the initiation of the governance framework activities within task 2.4.
- Section 3 provides the results of the analysis and modelling processes for each RIL lab.
- Section 4 delivers the requirement documentation and the validation framework.
- Section 5 covers the rolling plan activities and developed matrix.
- Section 6 covers the conclusions and the next steps.
- Section 7 includes the different annexes.

1.7 Evolution of the document

Version 1.0 of this document summarizes the activities, methodologies, and results from the project's first iteration and outlines an approach for developing governance frameworks for RILs, considering advancements in data spaces like those from the DSSC.

The current version, 1.1, submitted on 27 January 2025, includes minor revisions in Section 6 (Conclusion), where we have provided additional clarification on the validation process, the developed acceptance criteria, and planned activities, addressing feedback from the EC and external reviewers.

An updated version of this deliverable, version 2.0, is foreseen for June 2025. Additional updates will take place if necessary.

[2] Using the definition as exists at SITRA Rulebook for a fair data economy.

2 Activities performed

In this section, we will list all the activities (in a time order) we performed to support the scope of this deliverable. The first step was the planning, which included all preparation activities before the start of the elicitation process. In the Annexes at Section 7, we will include the material created and provided to support the workshops at the Kick-off meeting. Partly this section describes our approach.

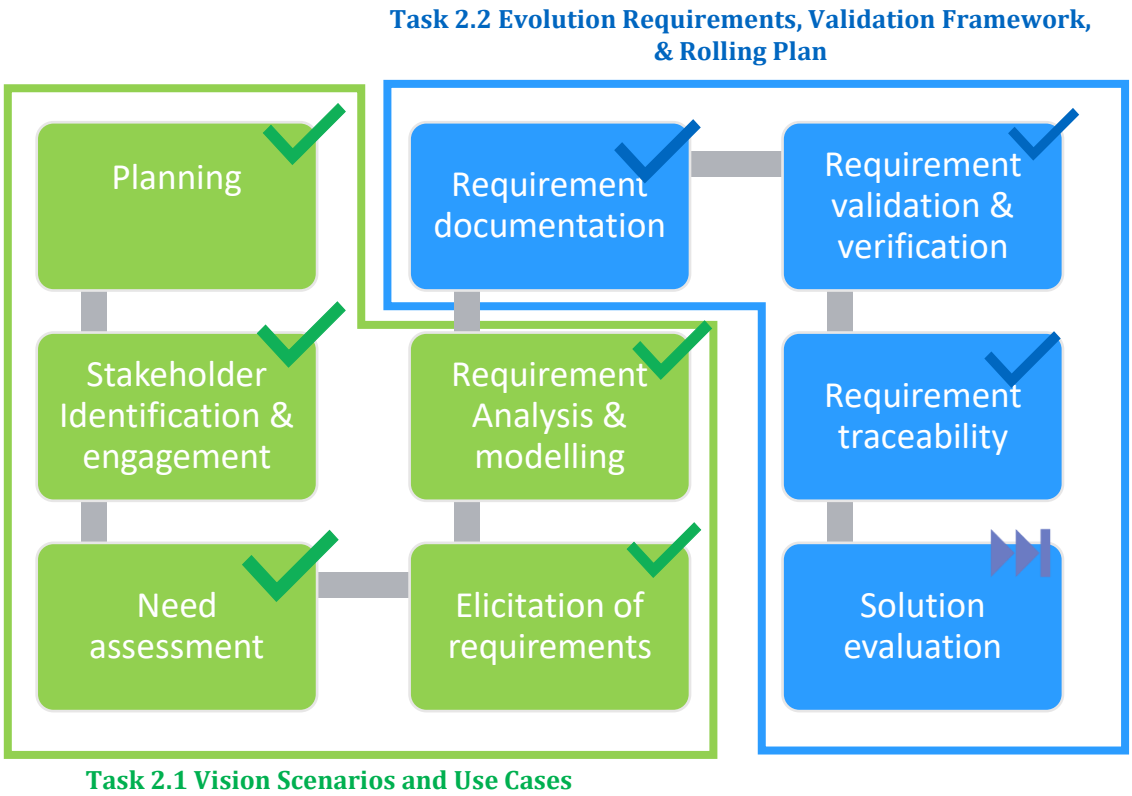

Figure 3. Presents the tasks 2.1 & T2.2 scope of activities in line with the identified methodological framework for eliciting and documenting requirements for ScaleAgData's innovative approaches.

2.1 Co-design Planning

For co-design processes, understanding the project's life cycle, context, objectives and expected outcomes is crucial for choosing and tailoring activities appropriately. As a first step we performed planning and preparation activities to adapt suitable co-design framework for the ScaleAgData innovative approaches and also to support the elicitation activities. This effort started with reviewing and analysing existing resources as well as the ScaleAgData project documents that describe the project's goals, work plans, intended outcomes and insights from RILs. After we proceeded with the mapping of the project goals, innovation areas and activities with the RILs objectives and activities (see section 2.1.1).

During the planning process we started by analysing the lab and project objectives and the problems the labs were targeting; we focused on both the RILs' and end users' perspectives. We began the requirement elicitation process by looking at the business problem or opportunity. We also assessed the current and anticipated conditions to identify the necessary elements for developing solutions that deliver value and effectively meet business requirements.

Furthermore, we developed and provided the following materials to support elicitation activities:

- A glossary with clear definitions of terms used in co-design to ensure common understanding and clarity, so that we have a solid foundation for our collaborative efforts in WP2 (see Annex 7.1).
- Documentation on mapping the project's innovation areas and related activities with RILs' deployment scenarios (see Annex 7.2).
- Stakeholder mapping templates (see Annex 7.3).

2.1.1 Tailoring the Co-design framework

The activities within tasks T2.1 and T2.2 are the described need processes (Figure 4) of the PMI-PBA[3] globally standardised framework, which aims to deliver requirements for products or solutions. Tailoring this framework in the planning phase, means defining the needed activities and tools for each process aiming to elicit, document and manage requirements of the building blocks of ScaleAgData innovative approaches (see Figure 4).

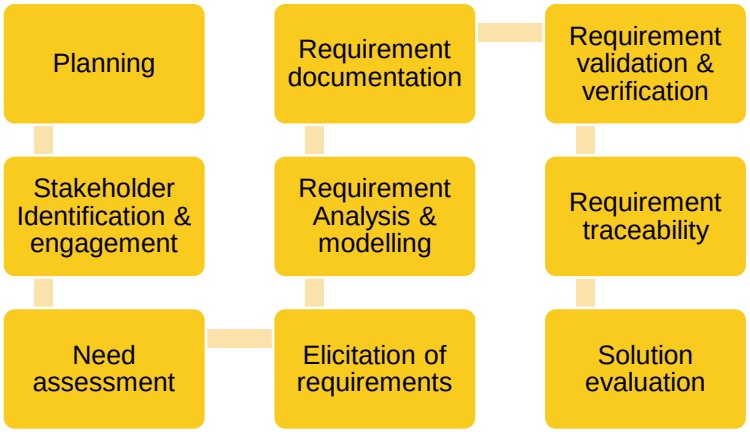

Figure 4. Processes and their order of the applied Co-design framework

Following this PMI-PBA framework, and tailoring it according to the needs of the specific project, it is possible to end up with requirements but also to achieve the aim for continuous stakeholder engagement, evaluation & monitoring (see Figure 5). Additionally, this framework can be applied to adapt the project life cycle, because:

- Design decisions can be taken after gathering feedback from the stakeholders.
- It allows to synthesize feedback from target users into insights.
- It allows to develop solutions or products based on feedback.

Important steps related to the applied co-design framework are the following:

1. Identify the different stakeholders and their roles, especially the primary actors, per deployment scenario (see Annex 7.3).
2. Proceed with the requirements elicitation (drawing out of information, not collection), starting with the need assessment means to analyse a current business problem or opportunity, the causes of the business problem or the reasons for addressing a current opportunity, as well as the information that will eventually be used to derive a sufficient level of requirements to enable solution development and implementation.

[3] https://www.pmi.org/certifications/business-analysis-pba

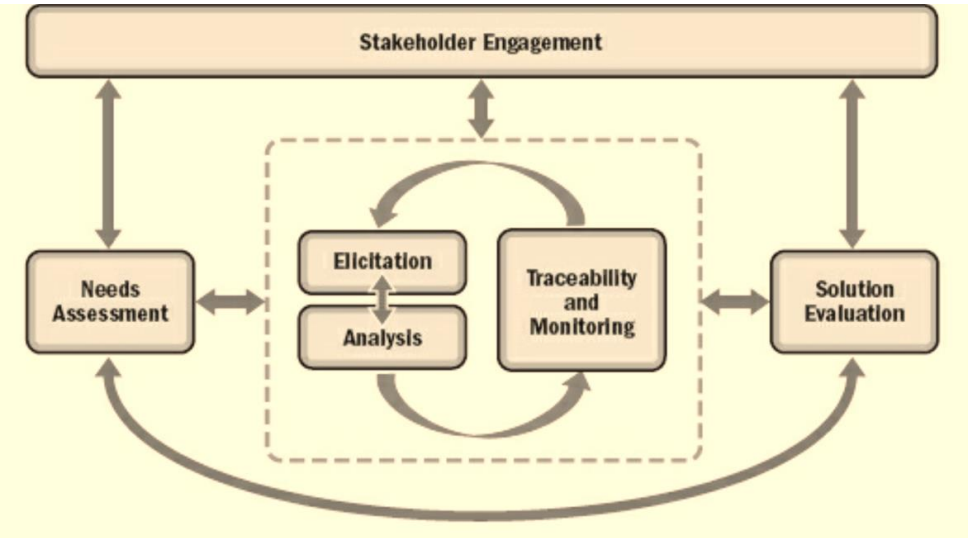

Figure 5. Interlinks between different knowledge areas of the applied framework.

Within those two steps we use the RILs deployment scenarios (see Annex 7.2) as a primary material/ starting point for the development of the vision scenarios. The deployment scenarios have a direct link/connection with the ScaleAgData innovative approaches and the methodological frameworks, prototypes and data products. Additionally, different elicitation techniques were applied to increase the effective drawing out of information (for more information related to the elicitation please see Annex 7.1).

2.1.1.1 Requirements

Requirements are defined as "a condition or capability that is required to be present in a product, service, or result to satisfy a contract or other formally imposed specification."

Within this framework, the requirement are classified on the following types:

- Business Requirements, which describe the higher-level needs of the organization as a whole, such as business issues or opportunities, and reasons why a project has been undertaken.
- Stakeholder Requirements, which describe the needs of a stakeholder or stakeholder group, where the term stakeholder is used broadly to reflect the role of anyone with a material interest in the outcome of an initiative, and could include customers, suppliers, and partners, as well as internal business roles.
- Solution Requirements, which describe the features, functions, and characteristics of a product, service, or result that will meet the business and stakeholder requirements. Solution requirements are further grouped into functional and non-functional requirements.
    - Functional Requirements. Describe the behaviours of the product.
    - Nonfunctional Requirements. Describe the environmental conditions or qualities required for the product to be effective.
- Transition Requirements, which describe temporary capabilities, such as data conversion and training requirements, and operational changes needed to transition from the current state to the future state.

2.1.1.2 Stakeholders

Stakeholders are at the centre of the design process where they collaborate equally, at which the information is concisely modelled using simple and understandable tools and remain available.

Stakeholders are then classified in the following groups:

- Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors):
- Stakeholders who will implement (build) the methodological frameworks, prototypes and data products.
- Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products.
- Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products.
- Stakeholders who may regulate or otherwise constrain part or all of a ScaleAgData methodological frameworks, prototypes and data products.
- Stakeholders who will support the ScaleAgData methodological frameworks, prototypes and data products.

2.1.1.3 Modelling tools

Vision scenarios, use cases and user stories are tools that can be used for the modelling of the information. These scenarios describe how stakeholders envision the solution, i.e. a series of activities, actions and reactions that take the primary actor from initiation to successful completion of the goal.

Both use cases and user stories use the actors, so it is important to start by identifying actors and their roles. Knowing the specific stakeholders is critical to support the planning of the elicitation process (personas/formulate the RACI table)

2.1.1.4 ScaleAgData innovation areas and deployment scenarios

To reach the project ambitions, ScaleAgData aims to develop innovative approaches using sensors, data sharing, edge computing, satellite imagery, privacy-preserving and data integration technologies (*for details see ScaleAgData GA section 1.1.3*). These will be applied to support and enable smart farming and agro-environmental monitoring in various thematic areas through a number of well-chosen research and innovation labs (RILs), where different data upscaling and integration models or approaches will be evaluated and demonstrated. These RILs were carefully selected to meet several of the identified challenges and to implement and evaluate a number of the proposed innovations with their own specific deployment scenarios.

Within the ScaleAgData project, the identified deployment scenarios have a direct link with the ScaleAgData innovative approaches and the methodological frameworks, prototypes and data products. Deployment scenarios describe where and how the project innovation areas and solutions will be applied and used.

Therefore, we considered the project's innovation areas and RIL's deployment scenarios in all steps of the co-design process. We started by mapping the project's innovation areas with the corresponding project activities (Tasks) and project partners involved, and later, we linked those to defined R&I Lab deployment scenarios. The resulting matrix was provided to the RIL partners as workshop materials (see Annex 7.2).

By doing this we:

- Ensure that the developed data products and methodological frameworks are aligned with the project's goals.
- Ensure that the developed products and solutions accurately align with their intended use and address the actual needs for their development.
- Identify the stakeholders/partners per deployment scenarios for each lab.
- Ensure alignment between the labs and their partners from the beginning. By mapping out the innovation areas, deployment scenarios, and partner roles, the co-design team can operate knowing that everyone is on the same page and working towards the same goals.

- Identify potential risks and challenges with regards to the use of resources. The co-design team can identify and address potential risks and challenges, such as efficiently allocating resources to ensure each partner contributes their unique skills, expertise and utilizes their technical equipment effectively for the project's success.

2.2 Co-design Elicitation Workshops

After the planning and preparation work, the next step was to proceed with the requirements elicitation. This means we started pulling out the needed information instead of just gathering it. In this section, we will describe the activities related to the co-design workshops, providing the needed info, for example, workshops performed, participants, period, which tools we use etc.

The planning activities have shown that throughout the RILs different levels of maturity are present in terms of services to the farmers, available sensor technology, data products, organizational and data governance. That usually leads to specific research focus and use of the innovations in each lab, with different goals in product development and targeted TRLs. For example, some RILs will focus more on developing new data products that can provide information on agri-environmental conditions that were not available to this date, while other labs will have a higher emphasis on organising the data streams to ensure the sensor data is available for the incorporation in European-wide monitoring tools.

To accommodate these differences in level, experience and needs of the RILs, we adapted an interactive approach in the early stages to collect the information within the elicitation phase from the RILs. More specific, as the project progresses, in line with the developments taking place within these labs, the used elicitation tools will be dynamically adapted to better reflect the specific needs and characteristics of these labs. With this iterative approach, the requirements gathered naturally evolve over time to become increasingly comprehensive, finely tuned, and closely aligned with the developments within each laboratory. The co-design activities adapted to this needs, using in parallel new collected knowledge, for example the evolvements in the building of data spaces or new EU legislation in the use of data and AI, to get the best possible outcomes.

To support stakeholder engagement and given the differences in the maturity level of the RILs, in the first iteration we chose to organize more workshops and not use the interviews and surveys as a tool to support the elicitation process and focused more on working with primary actors and internal stakeholders. In the second iteration, we will reduce the number of workshops and support the elicitation and validation process with interviews and surveys, involving external stakeholders (see section 2.2.3) in the process.

In total three series of workshops where designed and executed for each RIL:

- **Workshop series one (I1S1)** to **identify stakeholders and their roles**. This was a physical workshop during the KO meeting, mainly focussing on identifying the stakeholders and their roles (please see section 2.2.1).
- **Workshop series two (I1S2) to develop epics and user stories:** Six online workshops were held (one for each RIL) in the last week of March 2023 to generate and prioritize business, stakeholder and functional requirements in the form of user stories (please see section 2.2.3).
- **Workshop series 3 (I1S3) to identifying high-level dataflows of the desired solutions.** The outcomes were used to generate non-functional requirements**.** Six online workshops were held (one for each lab) on May 15, 16, and 17 2023 (please see section 2.2.4).

In the preparation phase for both physical and online workshops, essential tasks have been completed, including defining objectives and planning agendas, organizing participant lists, setting up venues or online platforms, readying workshop materials and sharing with participants, communicating key details to participants, conducting thorough testing to ensure a successful and smooth workshop experience.

The online workshops series were hosted using MS Teams and using an online, collaborative whiteboard (Mural). These collaborative sessions facilitated collective efforts in designing the intended services of each RIL by fostering open communication, encouraging diverse perspectives and ensuring different relevant parties collaborate in the design process.

2.2.1 Workshop series one – first iteration (I1S1)

Stakeholders are at the centre of the co-design process, acting as equal collaborators in the design process, ensuring that target users are involved in solution design. Additionally, the identification of the different stakeholders and their roles, especially the primary actors within the RILs, is a crucial starting step for the elicitation activities.

Therefore, as a first attempt, a physical workshop was organized to identify and analyse potential users and stakeholders who have an interest in the results of ScaleAgData (Photo 1).

Photo 1. The workshop took place during the third day of the project KO meeting in January 2023 with a participation of all RIL partners. Facilitators of the workshop were T. Coppens and P.Ilias from ILVO.

The workshop took place in two parts:

- **Part1:** Review and discussion on RILs deployment scenarios and linked project innovation areas.
- **Part 2**: Stakeholder mapping exercise.

We began our workshop with a with a short explanation providing the necessary information about the workshop's descriptions, concepts, objections and methodology to ensure a common understanding and clarity of the process.

Within the first part of the workshop the deployment scenarios of each RIL and the associated project innovation areas were reviewed and discussed for half an hour. This session provided an opportunity to discuss, how the ScaleAgData innovation areas and their methodological frameworks, prototypes and data products related to the deployment scenarios of the RIL. This also enabled participants to be prepared for the mapping exercise.

The second part of the workshop was focused on the stakeholder mapping exercise, identifying the stakeholders and their roles who will use, benefit (end users) and implement/build (tech. providers) the ScaleAgData methodological frameworks, prototypes, and data products with a special focus on the primary actors per deployment scenario using the provided material (see Annex 7.2).

After the workshop, we digitized the workshop results and shared with the project partners.

Below, you can see the overall look of the identified stakeholders and their roles within the KO meeting's Stakeholder Identification Workshop (Table 1). A detailed version of the workshop results, presenting stakeholders identified based on the deployment scenarios per RIL, is provided in Annex 7.3. It is important to note that the identified stakeholders shown in the tables as a result of the workshop series one, have evolved after the matching webinar and may undergo further changes as part of the ongoing co-design process.

Table 1. Stakeholder mapping

STAKEHOLDERS & ROLES	RIL Sustainable Dairy (Stakeholder Group / Organization & Roles)	RIL Crops (Stakeholder Group / Organization & Roles)	RIL Grassland (Stakeholder Group / Organization & Roles)	RIL Soil Health (Stakeholder Group / Organization & Roles)	RIL Water Productivity (Stakeholder Group / Organization & Roles)	RIL Yield Monitoring (Stakeholder Group / Organization & Roles)
Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors):	DMK *(Role: Dairy processor),* OHB *(Role: as a sub activity for the deployment scenarios)*	Policy Makers *(Role : Report - monitoring CAP, sustainability KPIs),* Farmers/ Agronomist Developers	IFAPA *(Role: User/Data provider, researcher),* *EURAC (Role: User/Data Provide, researcher)*Deimos *(Role: Tech. developer),* DHI *(Role: Data user)*	Farmers *(Role : End User),* *AG Cooperations, AG Cluster, AG Advisors, Researchers*	MIGAL, IES *(Role: Model user, Data provider),* *DHI, Farmer, Latvia- Faild and forest, Israil- Galilee Agri-company (Role: Consumers)*	*AVR, CNH,* Ugent *LUKE (Role: model), VITO*
Stakeholders who will implement (build) the methodological frameworks, prototypes and data products of section 1.1.3.x	OHB, ATB, 365/Claas, LUKE	NP *(Role: Tech),* Tech Providers, SME, Agronomist *(Role: Monitor field pressure),* Farmers, Agricultural advisors Developers	Deimos, EURAC, VITO, IFAPAs *(Role: Tech. developers),* DHI *(Role: Data Providers)*	Auth *(Role: Research),* ILVO, VTT, EGM *(Role: Sensor development),* ICCS, SMEs (Tech Providers)	MIGAL, IES, Kuva Space, DHI, MIGAL IES *(Role: Data provider),* VTT *(Role: Sensor provider),* Luke *(Role: Task 4.1 Digital twin concept)*	*U-Gent,* LUKE *(Role: Model),* CNH, AVR *(Role: UI), VITO (Role: UI, Implement),*
Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products of section 1.1.3.x:	DMK *(Role: Controlling)*, 365 Farm Net Software	Farmers (Role: adapt digital tech.), Tech provider, Suppliers , Insurance companies, Public bodies, Advisors	IFAPA, EURAC, Farmers, Policy makers	Farmers, Policy makers		AVR,CNH *(Role: Customers),* Farmer, VITO, Advisors
Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:	DMK farmers *(Role: User),* Payment Agencies, Regulatory authorities	Policy makers/ Governance, Food retainers/ consumers, Tech/ services Providers, Farmers Advisors,	IFAPA, EURAC, VITO *(Researchers, Data providers)*, Deimos *(Tech Developer),* AGINS *(Role: End user),* Policy makers, Researchers, SMEs,	Farmer *(Role: User),* SMEs, Policy makers, Researchers	Farmer *(user)*	AVR, CNH, VITO, Ugent, Farmer, Advisors, Argo -Industry, Public Organizations, Insurance

Stakeholders who <u>may regulate or otherwise constrain</u> part or all of a ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:	DMK Cooperative board	Technology providers Farmers/ Agro Cooperatives Policy Makers,	Italian and Spanish Ministry of Agriculture, Policy Makers, JRC, FAO, EUSO	Policy Makers, JRC, FAO, EUSO	OGC, FIWARE, Data Agri Partnership	Government, Farmers, AVR-CNH Contractors
Stakeholders who will <u>support</u> the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:	Digitization working group	Regional authorities, /Government, Agronomist/Advisors *(Role: Facilitate service providers),* SME	EURAC, Deimos, VITO *(Role: Tech. developer)*, Policy makers, AG Cooperations	National Governments, Policy makers, AG Cooperations		ICCS, Farmers *(Role: Farm Management data)*, Government associations, DHI *(Role: Data provider)*

2.2.2 Matching webinar, core technology providers and the RILs

Co-design is a collaborative design process that involves a diverse range of actors working together. It is important that technology providers and end users are involved in the design of the service, with both technology providers/service providers and users in a design position. Therefore, as a part of the stakeholder mapping process and to support and foster the identification of the RIL's technology providers, a webinar was organized by WP2 on the 3rd March 2023 with the participation of all project partners to support the matching between the core technology providers and the RILs.

.During the webinar technology providers presented WP3-WP4 technologies and informed RIL partners about their work and offerings related to the project innovation areas.

Within the first iteration of the co-design process, especially after the organized webinar and during the second workshop series, the RILs identified their stakeholders and their roles were further discussed and updated.

During the project, in line with developments in the RILs, it is possible that the stakeholders we have identified may change. Therefore, the identified stakeholders will be continuously reviewed and updated during the project, as a **governance activity of the Rolling Plan**.

2.2.3 Workshop series two – first iteration (I1S2)

The second series of co-design workshops (27-31/2023) focused on collecting specific information about user stories and use cases from an end-user perspective and relevant for the research activities of each RILs. In this series we performed six interactive online workshops, one per RIL; all murals of this co-design workshop series can be found at murals co-design workshop 2 (Figure 7).

The workshop had two parts:

- Analysis of current business problems or opportunities by focussing on the main challenges and objectives of the RILs and end users.
- Using epics, and user stories as a tool. The format of user stories, specifically structured as "As <type of user>, I want to have/be able to perform <function/task> so that I can/should perform <business reason, purpose>," serves as a concise way to encapsulate business needs and goals within the context of a user's requirements. It outlines why a user wants to perform a particular action and what result they are looking for. This part clarifies the intent behind the user's request and reveals the business value or benefit the requirement intends to achieve.

The workshop had five goals:

- Understanding targeted users and stakeholders. This aimed at revisiting the identified end users and customers for the products and services under development within the RIL. This also included technology partners of the RIL with a focus on understanding their roles.
- Analyse business challenges and objectives by examining the existing business challenges or opportunities, including the causes and reasons behind them. The focus remained on the primary challenges faced by both RILs and end-users, thus defining the overall objectives.
- Development of epics and user stories that reflect the business, stakeholder, and functional requirements in the form of epic/user stories. The development of epics and user stories took centre stage as the workshop's core objective.
- Prioritisation of the user stories. Within the framework of this goal, the workshop focused on prioritising the generated user stories. The aim was to ensure that the most impactful user requirements received the necessary attention and resources.

Prior to the workshop, preparatory actions were taken. An online workshop environment was designed in line with the envisioned outcomes and necessary information. A participant template was

created and shared with the lab leaders to determine the workshop participants and their role in the workshop (Figure 6).

Role of each participant in the workshop

End Users/ Customers (Please indicate a representative for the targeted end users/customers of products and services developed in your RI laboratory. Personas[1] will be used for identified end users who have no real representative in your lab.)
Targeted End user: Organization: Name of the participant: User Role: Organization: Name of the participant: User Role:
Targeted End user: Organization: Name of the participant: User Role: Organization: Name of the participant: User Role:

Tech. Providers/ Developers (Please indicate the participants who will represent the technology partners and their role within the RI Lab.)
Organization: Name of the participant: Role:
Organization: Name of the participant: Role:
Organization: Name of the participant: Role:
Organization: Name of the participant: Role:
Organization: Name of the participant: Role:
Organization: Name of the participant: Role:
Organization: Name of the participant: Role:

[1] A persona is an imaginary representation of a user role

Figure 6. Participant template for second series co-design workshop

The participants in each organized workshop included:

- RIL partners
- Representatives from technology partners within the RIL
- Facilitators: P. Ilias, T. Coppens, and N. Berkvens from ILVO.

The workshop agenda had two sessions:

- Session 1 (15 min)
    - Overview and Introduction of the workshop (5 min)
    - Identification of the key users/customers and user roles (5 min)
- Session 2 (70 min)
    - Identification of the user/customer goals (15 min)
    - Mapping the main user steps (10 min)
    - Developing user stories to identify user/stakeholder requirements (40 min)
    - Prioritisation of the user stories (10 min)
- Wrap up and next steps (5 min)

Session 1 : Introduction and Identification of the key users/customers

We began our workshop with a comprehensive presentation that provided essential insights into the workshop's aims, concepts, objectives, and methodology. This step was crucial to ensure a shared understanding and clarity among participants.

Step 1: The initial focus was on the stakeholders identified in Workshop 1 (as detailed in section 2.2.1). Attention was then directed towards targeted end users who stand to benefit from the forthcoming

products and services within the RIL. The development and application of personas were extended to those end users who did not have direct representation within the Lab. Guided questions were employed to facilitate this process.

Session 2: User Stories

During the second session, we began with looking at what the business needs or issues were the RILs aimed to address within the ScaleAgData project; focussing on what causes those issues and what is needed to create solutions. First we focussed on the challenges and objections of the end users and the RIL.

Step 2: Participants were guided to define specific user goals, expressed in the form of an epic[4]. These gave a clear overview of the outcomes that users would achieve by using the final product.

Step 3: Collaborators then outlined the specific tasks or steps users would take while engaging with the product. This process streamlined the creation of user stories.

Step 4: This phase involved crafting user stories, aligning each with the main steps identified earlier. A template structure was followed: "As a <type of user>, I want to have/be able to <function/perform a task>, so that I can/should perform <business reason, purpose>. "

Step 5: The workshop concluded by mapping and prioritizing the user stories using the "**MoSCoW**" technique. This technique categorizes requirements into four groups: "Must have" (critical), "Should have" (important), "Could have" (non-essential), and "Won't have" (deferred to other time) (Figure 8).

[4] Epic: When a user story is too large to be completed in a single iteration, it is considered to be an epic. Epics are decomposed further into stories (or additional epics).

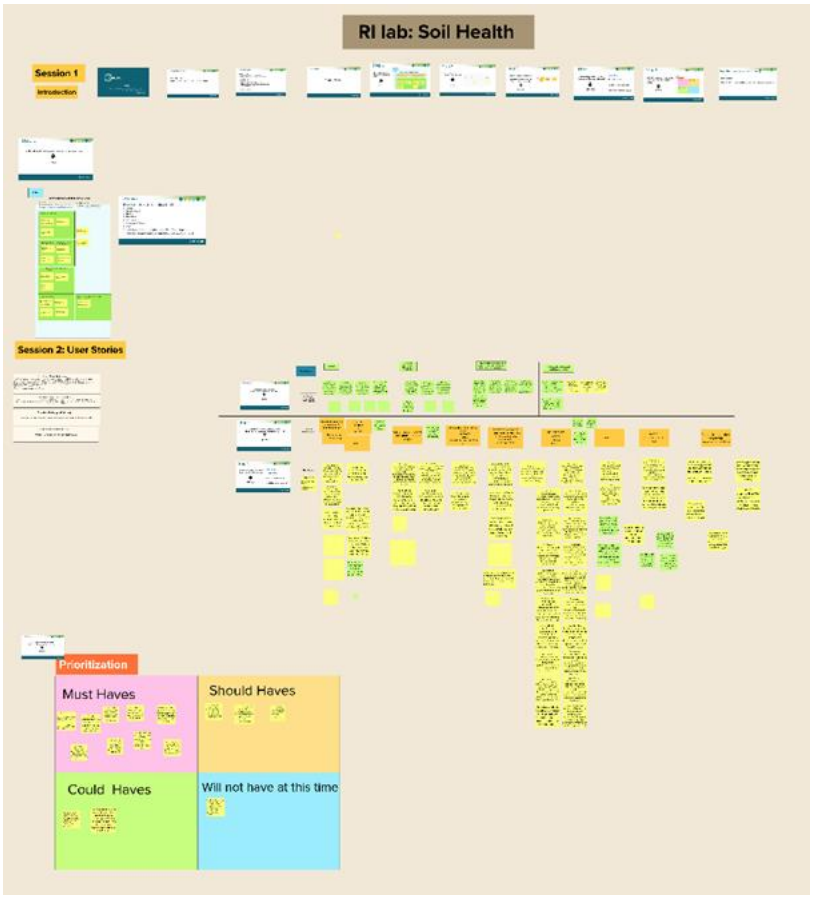

Figure 7. Example of 'mural' from co-design workshop held during the second workshop series, identifying objectives and challenges, stakeholder groups, epics and user stories and prioritization of the user stories

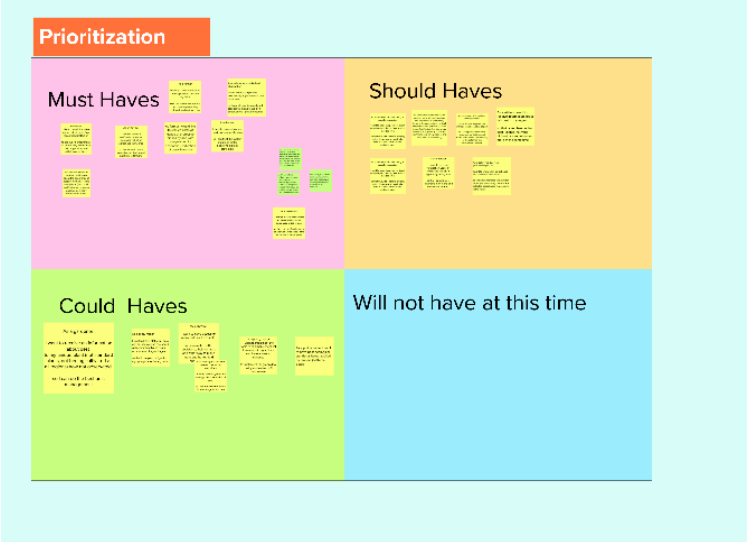

Figure 8 Example of a prioritization matrix used during the second co-design workshop.

2.2.4 Workshop series three – first iteration (I1S3)

With this workshop series, we aimed to generate non-functional requirements by:

- Generating the dataflow of each RIL as a tool
- Analysing the current state of each RIL and understand what is necessary to attain the desired future

During this third workshop series, the focus centred on defining and representing high-level dataflows and subsequently the formulation of non-functional requirements. Dataflows are a data-centric representation of the technological solution the RIL aims to develop as a data service or data stream within the project in order to meet the identified use cases and user stories. In addition, one or more of the project's innovation areas and the corresponding deployment scenario were integrated and visualized in the architecture of the dataflow.

Prior to the workshop, projected dataflows for each RIL were generated as a preparatory tool, drawing from insights obtained in previous co-design workshops. In addition, we integrated the project's innovation domains and the RIL's deployment scenario as integral parts of the data flow (see Figure 7). This composite dataflow, together with a comprehensive agenda and explanation, was distributed to the participants.

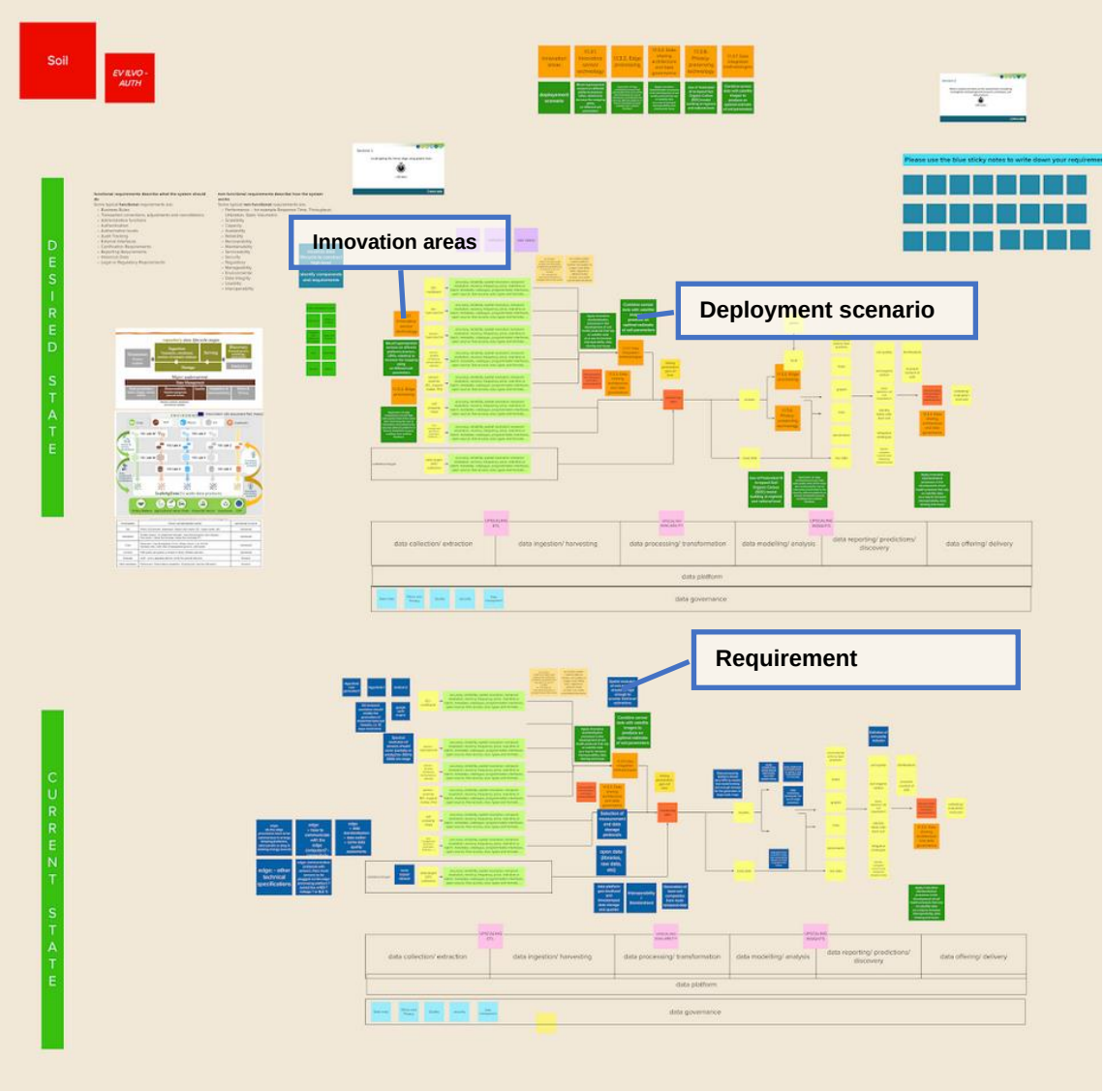

Figure 9. Example of a mural containing the dataflow generated for the Soil RIL

The goals of the workshops were:

- Identifying and visualizing the desired (To-Be) state of the RIL.By visualising the intended data flow, the workshops aimed to capture and clarify the RIL's desired (To-Be) state and understand how each RIL plans to develop data services to meet defined user stories.
- Mapping and understanding the current state. The dataflow was modified collectively to visualize and understand the current (As-Is) state of the RIL.
- Comparative analysis. By comparing the visual representations of both the future and current dataflow, crucial aspects for the transition from the current state to the desired state were identified and compiled into a set of (non-)functional and transitional requirements.

The participants of each workshop were as follows:

- RIL partners
- Representatives of the technology partners within the RIL.
- The workshop facilitators were: P. Ilias, T. Coppens, with N. Berkvens from ILVO.

The agenda for the third workshop was structured as follows and was divided into two sessions, with the participation of RIL members and collaborating technology providers:

- **Introduction to the Workshop (5 min).** This included a brief overview of the scope, concepts, goals and methodology of the workshop, in order to foster a shared understanding and clarity among all participants.
- **Session 1: Future Stage Co-Design with Graphical Tools (40 min).** In this session, we visualized the anticipated data flow and engaged in discussions to ascertain the desired state of the RIL, taking into consideration the project's innovative domains and the associated deployment scenario *(see Figure 9)*
- **Session 2: Requirements within the ScaleAgData Framework (40 min**). The first step of this session involved understanding and visualising the current status of each RIL. Participants looked at the intended future dataflow and identified components that were already in place. A comparison between the future and current dataflows was then made through discussion, highlighting the requirements for moving from the current to the desired state. These requirements were marked with blue markers, symbolising the elements essential for the transition *(see Figure 9)*
- **Wrap up and next steps (5 min).** The workshop ended with a quick summary of the main points we discussed and learned. We also talked about what we'll be doing next, so everyone knows what to expect as we move forward with the project. This helped us connect what we did in the workshop with plans for the future.

2.3 *Alignment and Cooperation with Project Stakeholder network*

In the spirit of a co-design as a collective design process involving heterogeneous actors, we focussed on a co-creation approach bringing together regional stakeholders, technology experts, policymakers and academics from different disciplines and innovative service providers to contribute jointly to the identification of specific innovation needs. To this end an interactive stakeholder network was set up (task T6.2) within the scope of WP6 Impact Maximisation and Outreach and an additional project stakeholder mapping exercise was conducted. Furthermore, the outputs of co-design workshop series one were taken into account and integrated into the project stakeholder network. This will allow the ScaleAgData project to better foster collaboration and knowledge exchange with identified stakeholders by organizing various networking activities.

In addition, we intend to collaborate with this network throughout the project in order to enhance following co-design activities.

- Generating additional requirements (if any) for the development of different data technologies.
- Enrichment with feedback on existing defined requirements.
- Rolling plan: Collect information on recent developments and innovations in sensor data to define additional project activities.
- Enrich and validate the definition of the new governance models by identifying, analyse, and map the status and level of governance models in the data ecosystem of the RI Labs' vertical domains.

To achieve this, WP2 will make use of tools like surveys, questionnaires, and interviews. Where needed these activities also will be integrated into organized WP6 capacity building and RI Lab events.

2.4 Governance frameworks planning

ScaleAgData partners deal with different types of data, including IoT data and aiming on the development of data products and service by performing transactions within loose or more organized in terms of Governance data ecosystems. For this reason ScaleAgData will address the issue of fair access to and use of data, accessing different elements of the technical and non-technical building blocks[5] of data spaces, in a way to facilitate data sharing and enable the creation of value from data within the vertical defined by the RILs.

Task 2.4, which started in July 2023 (M7), makes use of many ScaleAgData results together with other project results and EU legislations that are dealing with the issue of governance in data ecosystems. The goal is to initiate the development of innovative governance frameworks within or cross the verticals of the RILs (project expected outcomes). More specific, task t2.4 will:

- Monitor and use (when needed) the results of current Digital Europe CSA projects (2.4.1.3) related to the development of the Common European Data Spaces.
- Consider the new EU legislations (2.4.1.2), that aim to regulate the governance to allow fairness on the use of and access to data and support innovation and value generation.
- Rely on the results of tasks T2.1 & T.2.2 (D2.1) that reveal existing legal, operational and functional agreements as well as technical standards [6] widely adopted by RIL actors, stakeholders and potential users of the ScaleAgData results.
- Rely on the evaluation outcomes of WP5, task T5.3 (D5.3).
- Make use of the results of WP3, related to the data governance in WP3 task T3.4 (D3.1, D3.4).
- Make use of the results of WP6, task T6.4, because Governance typically includes business aspects. (D6.4)

After the analysis of the collected material, WP2 will identify, analyse, and map the current status and level of governance frameworks in the data ecosystem of the vertical domains of the RILs, in away and within the second iteration of WP2, T2.4 to proceed to the initiation and tailoring of a governance framework.

2.4.1 Defined approach, tools and resources

To achieve the primary goal for the initiation of the development of governance frameworks, ScaleAgData will rely mainly on the DSSC results which are the Starter Kit[7], the Glossary and the Blueprint[8]. Those tools will support the RIL partners to realise the status of different aspects of governance within their data ecosystems[9](business, legal, and organisational), allowing the adoption of rules, practices and processes needed for effective data sharing and innovation within and across the vertical domains of the RILs.

[5] Legal, Business and Governance

[6] SITRA Rulebook for a fair data economy.

[7] Starter Kit for Data Space Designers | Version 1.0 | March 2023 - Starter Kit - Data Spaces Support Centre (dssc.eu)

[8] Public Consultation - Data Spaces Blueprint v0.5 - Blueprint (external-share.com)

[9] A loosely coupled set of autonomous parties engaging in data sharing

It is important to mention that a governance framework[10] (DSSC prefers the use of framework instead of model) is set of principles, standards, policies (rules/regulations) and practices that apply to the governance, management, and operations within a particular scope (e.g., a data space, a data space initiative, or data spaces blueprint) as well as to the enforcement thereof, and the resolution of any conflicts.

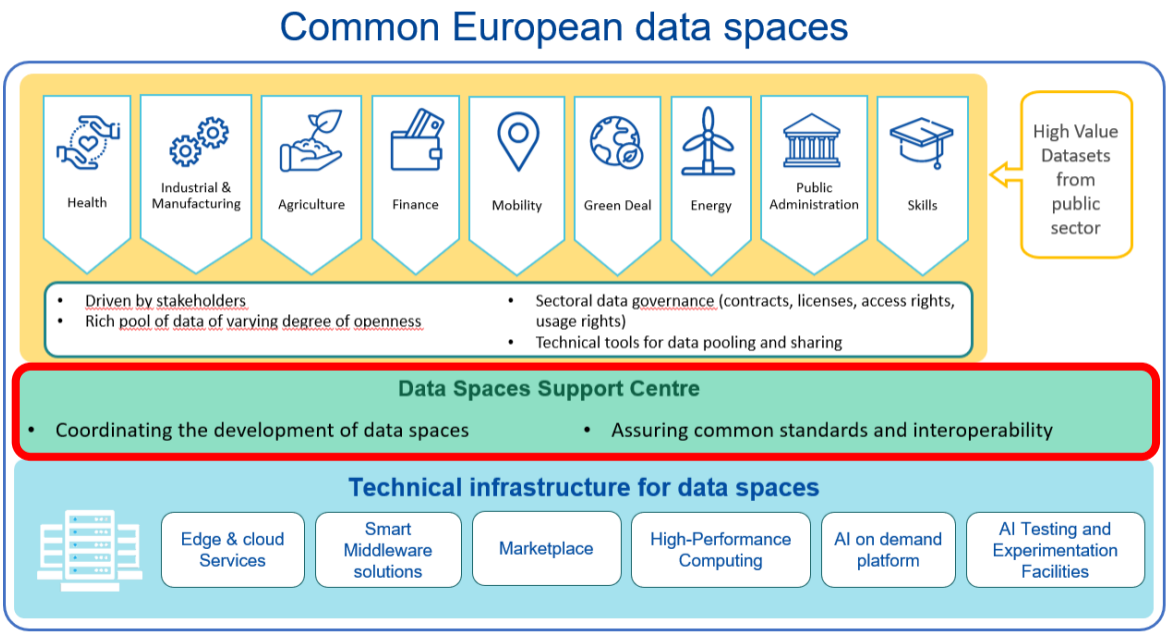

Figure 10 DSSC coordinates the development of data spaces and aim to assure common standards and interoperability. The ScaleAgData project, has links with the Agriculture and the Green Deal data space.

Another important source, we will use in this effort, are the Data sharing How-to guides, as those exist at the recently published (June 2023) European Data Spaces - Scientific Insights into Data Sharing and Utilisation at Scale.

2.4.1.1 Taxonomy of governance building blocks

ScaleAgData will follow the Building Blocks Taxonomy suggested by the Data Space Support Center[11] (DSSC) (*Figure 11*), targeting the:

- Governance building block (organizational governance within WP2 and data governance within WP3),
- Data interoperability building block (data models and formants within WP3),
- Data sovereignty and trust building blocks (access and usage policy within WP3 and WP4),
- Data value creation building blocks (data and services within WP2, WP3,WP4 and WP5)
- Business building blocks (with focus on the data products within WP6).

[10] DSSC Glossary | Version 1.0 | March 2023 - Glossary - Data Spaces Support Centre

[11] Data Spaces Support Centre (dssc.eu)

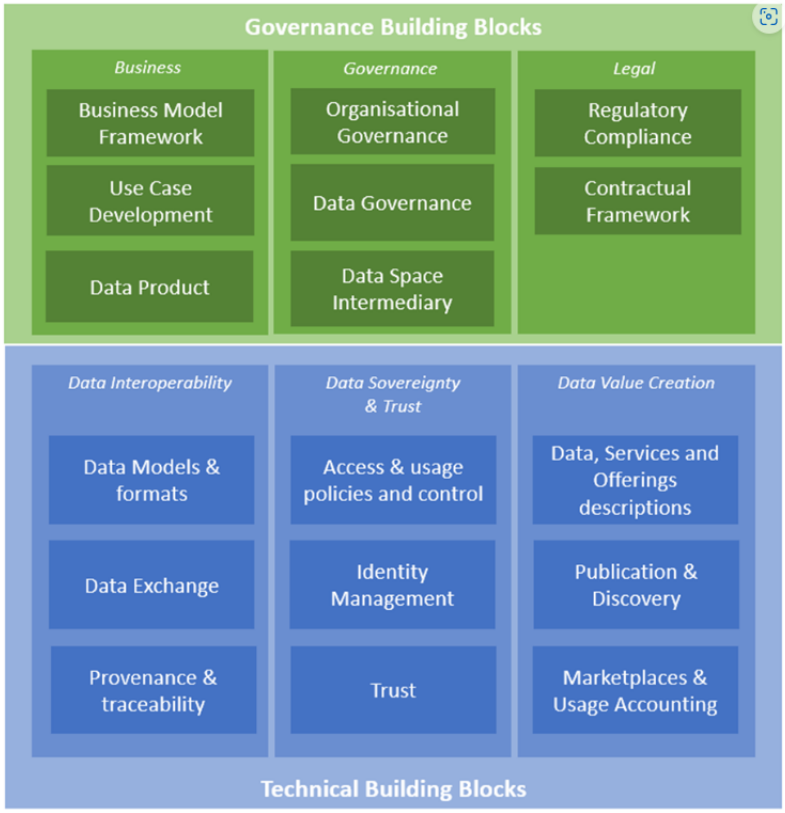

Figure 11 Taxonomy of Building Blocks v0.5 of the Data Spaces Blueprint.

2.4.1.2 Relevant Legislations related to governance

After the GDPR, the European Commission submitted several regulatory proposals, including the Digital Services Act, the Digital Markets Act, the Data Act and the Data Governance Act.

ScaleAgData emphasize on the Data Governance Act[12], the Data Act[13] since both primary objectives, have high relevance with the ScaleAgData objectives for effective data sharing and product development. The two legislations aim to :

- Ensure fairness in the allocation of value from data among actors.
- Foster access to and use of data.

and their sub-objectives are:

- To ease the switching of providers of data processing services.
- To put in place safeguards against unlawful data transfers by cloud service providers.
- The development of interoperability standards for data to be reused between sectors.

[12] The European regulation that aims to create a framework to facilitate European data spaces and increase trust between actors in the data market. The DGA entered into force in June 2022 and applies from Sept 2023. The DGA defines the European Data Innovation Board.

[13] Data Act: EU institutions finalise agreement on industrial data law – EURACTIV.com

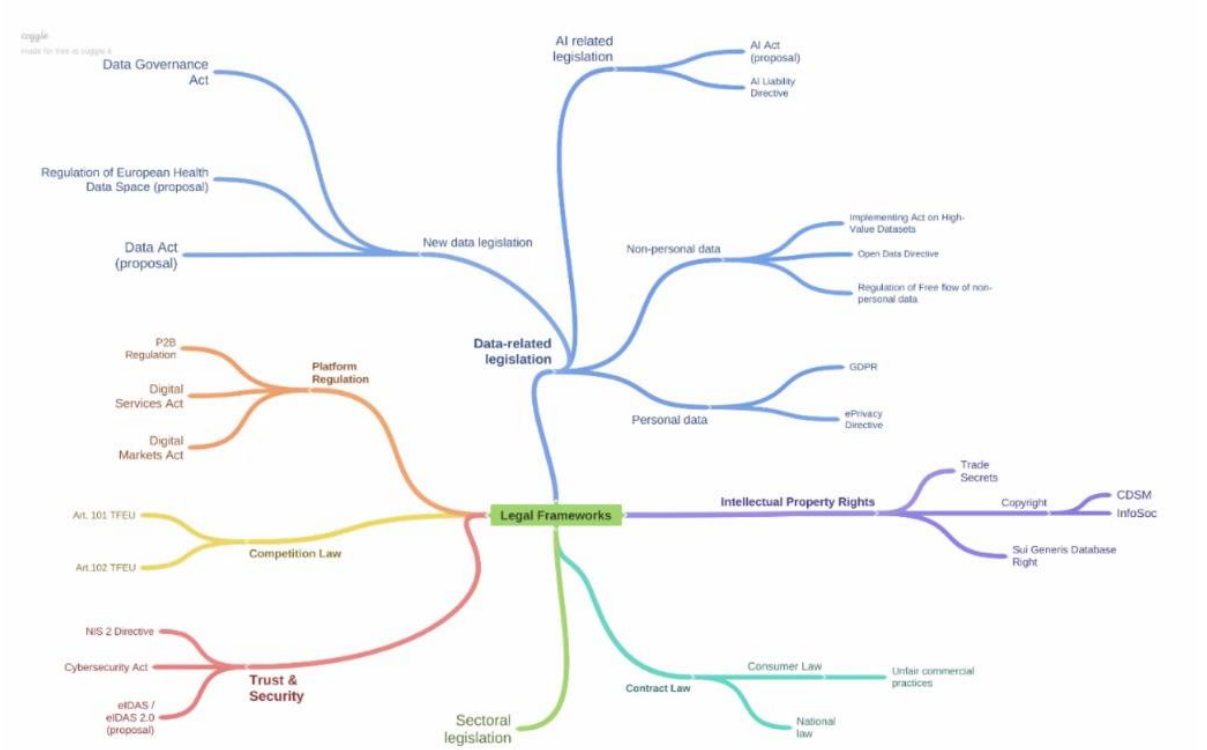

Figure 12 A mapping tree of Legal Frameworks (source DSSC)

Digital Markets Act (DMA)

Applicable on May 2, 2023 Mandatory compliance in March 2024

Even if it aims primarily to protect European citizens, it contains several measures that concern companies, their data and those of their customers. In short, the publisher of a marketplace will not be able to prevent a seller from offering its products on another marketplace or by its own means at different prices or under different conditions. A controller can no longer contractually oblige a company not to inform practices that "limit contestability or are unfair" to a local or European authority. Similarly, an undertaking can use the identification service of its choice, just as the provider can no longer impose a subscription to an ancillary service as a condition of access to its main product. A publisher of cloud applications or services should also not prevent interoperability of core functionality with competing solutions or impose software by default.

Digital Services Act (DSA)

Effective November 16, 2022 Applicable no later than 1 January 2024

The Digital Services Act targets online platforms more broadly, in order to "better protect freedom of expression and consumer rights". Clearly, the DSA intends to impose means to better fight against disinformation and to regulate targeted advertising[14].

Data governance act (DGA)

The Data governance act creates the processes and structures to facilitate data sharing by companies, individuals and the public sector.
Effective June 23, 2022 Applicable from 24 September 2023

[14] DSA, DMA, Data Act, DGA: what should we remember? | LeMagIT

The Data Governance Act (DGA) aims to create a legal framework for data sharing for the benefit of the European single market, ensuring neutral access to data and interoperability and helping to avoid lock-in effects. It has three pilars. The most relevant to the ScaleAgData project is the one related to the data intermediation services, which will play a "key role in the data economy" in promoting voluntary data sharing practices between companies and facilitating the exchange of substantial amounts of data and the use of data. The data intermediation services are intended to help small and medium-sized enterprises (SMEs) and start-ups gain access to and use of the data they need. The planned data spaces aim to support this and provide data that is needed for innovation, research and the like.

Data Act (DA)

The Data Act clarifies who can create value from data and under which conditions, and introduces new rules on who can use and access data generated in the EU across all economic sectors.

Following the data governance act adopted by the co-legislators in 2022, the data act regulation is the second main legislative initiative resulting from the Commission's February 2020 European strategy for data, which aims to make the EU a leader in our data-driven society. The Data Act is a proposed legislation regarding harmonised rules on fair access to and use of data. The goal is to give both individuals and businesses more control over their data through reinforced portability right, copying or transferring data easily from across different services, where the data are generated through smart objects, machines, and devices (emphasis on IoT).

The Data Act specifying who, other than the manufacturer or other data holder, is entitled to access the data generated by products or related services, under which conditions and on what basis.

In practice and to evaluate the relevance/applicability of the Data Act, within the ScaleAgData for the scope of the initiation of the adoption of governance frameworks, task T2.4 will use the selected material to provide answers to the following indicated questions:

- *Howe are the data generated within ScaleAgData?*
- *Do we have copying or transferring of data across different services?*
- *Do we have to deal with portability rights?*
- *Do we have connected products?*
- *Are there any plans by the RI Labs actors to establish a data market?*
- *Do they perform activities within a digital environment?*
- *Is data-driven innovation present within ScaleAgData RI Labs?*
- *Are there expressed needs or requirements for more data accessibility?*
- *Are there any discussions on the need for easy switching of providers (of data processing services)?*
- *Do we expect the use of cloud and are there any identified unlawful data transfers?*
- *Is there a need or requirements for interoperability standards for data to be reused between sectors or, in our case, between the labs?*
- *Are there any existing "connected devices" with the RI Labs? Do the users have access to the data generated by them but often harvested by manufacturers? Are there any accessibility issues?*
- *Is data sharing a practice within or across the RI Labs? If yes, do we have or expect to have contractual agreements between the actors? Do we collect any requirements related to data-sharing contractual agreements?*
- *Do we have identified any needs, upcoming needs, requirements etc related to the use of data coming from ScaleAgData private sector actors by public sector authorities (case of emergency)?*

- *What are the functionalities of the data collected by connected products?*
- *Are there any identified issues with intellectual property rights? Compensation? Need for a dispute settlement mechanism?*
- *Is there any need for switching between data processing services?*
- *Are there any identified barriers in data sharing within the labs? For example:*
    - *Lack of incentives for data holders to enter voluntarily into data sharing agreements,*
    - *Uncertainty about rights and obligations in relation to data,*
    - *Costs of contracting and implementing technical interfaces,*
    - *High level of fragmentation of information in data silos,*
    - *Poor metadata management,*
    - *Absence of standards for semantic and technical interoperability,*
    - *Bottlenecks impeding data access,*
    - *Lack of common data sharing practices and abuse of contractual imbalances with regards to data access and use.*
- *Do we have use of personal data within the RI Labs?*
- *Are the principles of minimization and data protection by design respected by the RI Labs actors? Is it a topic that concerns the RI labs? Who provides the related services?*

2.4.1.3 Relevant EU Projects related to governance

Data Space Support Center (DSSC)

The Data Spaces Support Centre will explore the needs of data space initiatives, define common requirements and establish best practices to accelerate the formation of sovereign data spaces as a crucial element of digital transformation in all areas. The Data Space Support Centre contributes to the creation of common data spaces, that were outlined in the European Data Strategy on February 2020, to collectively create a data sovereign, interoperable and trustworthy data sharing environment, to enable data reuse within and across sectors, fully respecting EU values, and supporting the European economy and society.

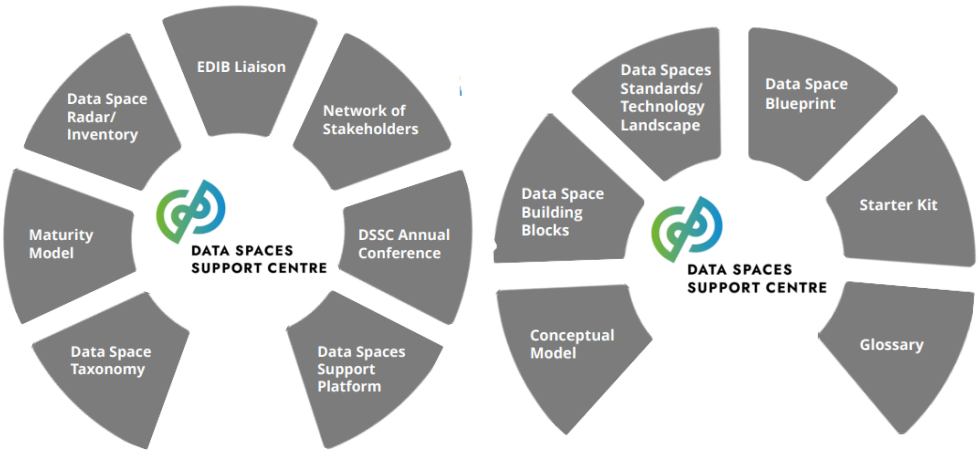

Figure 13. DSSC Assets

The DSSC has the following assets which ScaleAgData uses:

- **Data space Taxonomy:** A classification scheme used to describe, analyse and organise data space initiatives according to a defined set of characteristics.
- **Conceptual Model:** A consistent, coherent and comprehensive description of the concepts and their relationships that can be used to unambiguously explain what data spaces are about.
- **Starter Kit:** A document that helps organizations and individuals understand the requirements for creating a data space. It provides a multifaceted view of data spaces, highlighting business, legal and governance, operational, functional, and technical aspects to consider.
- **Network of stakeholders:** The group of parties relevant to the development of data spaces and with whom the Data Spaces Support Centre proactively engages in achieving its purpose and objectives.

Contact person: ILVO is an associate partner in the DSSC and Dr. Panos Ilias, represents ILVO. He participates actively on the stakeholder forum and on activities related to the taxonomy.

AgriDataSpace

The aim of the project is to build a European framework for a secure and trusted data space for agriculture. One of the objectives is to analyse and assess current governance models and develop a multi-stakeholder governance scheme for the EU data space for agriculture. AgriDataSpace is the

selected project under the CSA call for the Common European Agricultural Data Space[15]. Their deliverable D2.1 "Multi-stakeholder governance schemes and business models for agricultural data spaces" is expected at the end of 2023. It's not clear yet, if the results of the project will include a methodology and tools to support the definition of governance frameworks or the activities aim on the survey and analysis of existing governance schemes.

Contact person: ILVO is a partner in the AgriDataSpace and Eva Maes, represents ILVO. He participates actively on WP2 and leads WP1.

GREAT

Climate change and other environmental challenges are existential threats to Europe and the world. The European Green Deal will transform Europe into a modern, climate neutral continent and a competitive economy empowered to tackle these challenges. With the launch of Common European data spaces, the European data strategy aims to create a single market for data, where data can flow within the EU and across sectors, for the benefit of the citizens and planet Earth. One of the four pillars of GREAT is governance, and the project is active on themes relevant to ScaleAgData.

Contact Person: EGI and Mark Dietrich.

Figure 14. GREAT themes include Soil, Forestry and Land ecosystems.

[15] The common European data spaces is a subclass of data spaces that adheres to European rules and values. The common European data spaces were introduced in the EU data strategy and referenced in the Data Governance Act and Data Act. The Agricultural data space, it's the data space that refers to the Agricultural sector.

3 Analysis and modelling workshop outcomes

In this section we describe the activities under tasks T2.1 and T2.2. The vision scenarios, use cases and requirements identified in this section are fundamental components from which the backlogs described and generated in section 4 are based on and further built on. These backlogs, containing the validation framework, will subsequently be used for the design of the ScaleAgData architecture in task T2.3, the initiation of activities related to governance frameworks in task T2.4 and activities related to the data governance in task T3.4.

3.1 Objectives and user stories

During the second co-design workshop series (27-31/03/2023, section 2.2.3, murals co-design workshop 2) we facilitated discussions with the members of each RIL and collaborating technology providers to define:

- Main objectives and challenges for each vertical domain of the RIL and their end users
- Epics and user stories in view of the end-user stakeholder groups (3.1.2); user stories are viewed as small, lightweight requirements focussing on the end-user and desired outcome, while epics are viewed as a higher hierarchy that can be broken down to multiple user stories
- Prioritization of the user stories via categorization in a matrix with “MUST”, “SHOULD”, “COULD” and “MUST NOT” have-quadrants (Figure 8 and Table 24, Table 26, Table 28, Table 30, Table 32, Table 34, Table 36, Table 38)

By identifying the user stories, we acquire important requirements and describe the desired functionality of the service from the perspective of its end users and stakeholders. Overall, user stories help keep the focus on the user, foster collaboration and communication, enable iterative development, and provide a framework for prioritization and continuous improvement in software development projects.

3.1.1 Main objectives and challenges per RIL

Table 2. Main objectives and challenges for RIL Crop Management

The RIL Main Challenges	The IoT sensors are expensive and there is need for a way to maximise coverage with the least possible sensors
	There is no established way for aggregating data from multiple sources to support agri-environmental policy monitoring apps - there is no way to collect needed data such as the use of pesticides in an automated way
	There is lack of the needed data and AI algorithms to support services like the early detection of pest infestations in given regions
	Data are often not ready to use, as uniform data and metadata formats and standards are still not always fully adopted, hampering the interoperability of these data between different sensor networks
	Making data accessible for external users
	Uptake of sensor technology by the farmers
The Main Objective of the RIL	Unlock the potential of using weather and soil data from sensors with other data sources like EO, soil analysis and farm log data for:
	Expanding smart farming services
	Enabling monitoring of sustainability performance for policy purposes, at European-wide level
The Main Challenges End User	To have/receive recommendations, farm-specific information, insights that are detailed and specific enough for sustainable crop management at farm level
	To be able to setup the necessary technologies for digital agricultural solutions like DSS
The Main Objective of End User	Farmers: Use smart farming strategies to increase production efficiency, reduce costs and minimize risks
	Policy makers: designing and monitoring the implementation of sustainability related policies

Table 3. Main objectives and challenges for RIL Dairy

The RIL Main Challenges	Acquiring in situ data from feed production up to measuring milk quality related data.
	Reducing the amount of in-situ data required as a reasonable basis for planning and control
	Interpret KPIs to report on economic, environmental, and sustainability performance
	Combining data from dairy farmers, arable/crop, feed producers and dairy sales projections
	Data are often not ready to use, as uniform data and metadata formats and standards are still not always fully adopted, hampering the interoperability of these data between different sensor networks
	Making data accessible for external users
	Uptake of sensor technology by the farmers
	Can we understand milk quality AND quantity? challenge for now (comment)
	Getting information from farmers
The Main Objective of the RIL	Developing services for dairy farmers and their input producers to facilitate application of smart farming practices and agri-environmental monitoring
	Enable monitoring, planning and control for areas lacking in-situ data
The Main Challenges End User	Lack of scarcity of in-situ farm data to facilitate decision support, application of smart farming practices and agri-environmental monitoring
The Main Objective of End User	Maintain high milk quality and quantity

Table 4. Main objectives and challenges for RIL Grasslands

The RIL Main Challenges	Lack of spatially distributed ground sensor observations of grassland quantitative traits, which are important for the validation and/or calibration of biomass and biophysical parameters
	Implementing a ML up-scaling strategy to transfer biomass estimation model to other sites
	Data are often not ready to use, as uniform data and metadata formats and standards are still not always fully adopted, hampering the interoperability of these data between different sensor networks
	Making data accessible for external users
	Uptake of sensor technology by the farmers
The Main Objective of the RIL	Develop biomass products specifically tailored seldom available, for the validation and/or calibration of biomass and biophysical parameter (using ground sensors and state-of-the-art data fusion technologies)
	Collect spatially distributed ground sensor observations of grassland quantitative traits, which are seldom available, for the validation and/or calibration of biomass and biophysical parameters
The Main Challenges End User	Understanding how ongoing and predicted extreme events impact farmers' productivity and the adaptations needed in their management.
The Main Objective of End User	Technical recommendations to make better management decisions
	Inform index-based drought insurance, letting farmers protect their income from yield losses, avoiding land abandonment and the related consequences on landscape conservation, soil quality, and biodiversity

Table 5. Main objectives and challenges for RIL Soil

The RIL Main Challenges	Insufficient spectral and spatial resolution data from existing systems applicable for soil quality monitoring systems
	Developing models using sensitive data at farm-scale; training models while taking privacy issues into account
	Data are often not ready to use, as uniform data and metadata formats and standards are still not always fully adopted, hampering the interoperability of these data between different sensor networks
	Making data accessible for external users
	Uptake of sensor technology by the farmers
The Main Objective of the RIL	Development and demonstration of a service prototype in support of variable rate fertilisation (VRF); deliver EO-based products on soil health assessment, and edge-driven services in support of automating decision support for soil-related management applications
The Main Challenges End User	Insufficient advice/information regarding the general soil quality of the farmer's fields
The Main Objective of End User	Maintain productive and sustainable soils

Table 6. Main objectives and challenges for RIL Water

The RIL Main Challenges	The timely prediction of drought for an effective decision making on field management.
	Data are often not ready to use, as uniform data and metadata formats and standards are still not always fully adopted, hampering the interoperability of these data between different sensor networks.
	Ownership of data, privacy concerns, and data sharing infrastructure
	Making data accessible for external users
	Uptake of sensor technology by the farmers
	Difficulties in finding farmers to participate; Farmers have their own daily task/. for them time is a problem
The Main Objective of the RIL	Development and demonstration of a service prototype for the early prediction and early detection of drought stress.
The Main Challenges End User	Drought caused stress on agriculture
	Difficulty in effective decision-making in field management due to lack of timely drought prediction
	Reduction in crop quality and quantity due to drought and consequently loss of income
The Main Objective of End User	Maintain productive crops by reducing drought stress

Table 7. Main objectives and challenges for RIL Yield Monitoring

The RIL Main Challenges	Enabling the access to these often very scattered harvest sensor data
	Ownership of data, privacy concerns, and data sharing infrastructure (farmers),
	Translating these data in a yield monitoring tool at different scales throughout the EU, taking into account the different growing conditions
	Data are often not ready to use, as uniform data and metadata formats and standards are still not always fully adopted, hampering the interoperability of these data between different sensor networks
	Making data accessible for external users
	Uptake of sensor technology by the farmers
The Main Objective of the RIL	Unlock the potential of sensor data gathered via harvesters for European-wide yield monitoring
The Main Challenges End User	Lack or scarcity of parcel level yield monitoring technologies/methodologies and recommended smart farming practices that support sustainable yield production
The Main Objective of End User	Maintain or increase yield production

3.1.2 Epics and user stories in view of the end-user stakeholder groups

Table 8. Crop Management - NP SubRIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series

	Stakeholder	Content
Epics	Farmers	As a farmer I want to have a user-friendly application to register my cultivation practices (Farm book) so that I can get summaries from my records/logs and at the same time being informed about aggregated from neighbouring farmers
		Summary of the farmer's cultivation practices (e.g. Total fertilization/pesticide/water) use
		Consumption comparison with other group of farmers
User Stories	Farmers	As a farmer I want to see aggregates from neighbour farmers so that I can be informed if I am using more or less resources (water, fertilization, pesticide
		As a farmer I want to get monthly summaries based on my registered practices so that I can compare with data from previous years.
		As a farmer I want to be able to both submit/report input data but also to generate aggregations (reports)
Epics	Agronomist/Advisor	As an agronomist I want to certify farmers' crops to the use of pesticides without lots of (costly) lab analysis by only using specific number of IoT data for automatic pesticides detection so that I can issue the relevant certification
User Stories	Agronomist/Advisor	As an agronomist/advisor I want to have an application choose specific parcels so as to see aggregates for pesticide use
		As an agronomist I want to have a general idea of what agricultural practices take place at a regional level so as to better consult also the client-farmers that I supervise
Epics	Policy makers/Public authorities	As a policy maker working on a Regional Environmental Authority I want to install up to 5 five sensors for automatic pesticides detection so that with the data collected to be able to monitor the implementation of sustainability related CAP policies (Pesticide use).
User Stories	Policy makers/Public authorities	As a policy maker I want to report at monthly/yearly basis the use of pesticide so that with the data collected to be able to monitor the implementation of sustainability related CAP policies.
		As a policy maker I want to know the use of specific pesticides/ fertilization (yearly/monthly) in AoI so that to be able to report the information to the Environmental Authority
		As a policy maker I want to be able to see results (specific KPIs related to inputs usage) for a specific area of interest

Table 9. Crop Management – Horta SRL SubRIL: Epics and user stories in view of the end-user stakeholder groups identified during the 2nd co-design workshop series

	Stakeholder	Content
Epics	Farmers	As a farmer I want to have a tool supporting the management of my wheat crops, so that I can optimize the use of technical inputs and improve the crop sustainability
		Optimize seed density
		Knowing diseases infective pressure to decrease treatments when risk is low
		Monitor yield prediction one month before harvesting
		Identify pesticides with the lowest human and ecosystem impact to decrease sustainability indicators related to health KPI's
		As a farmer I want to know the crop nutrient status to plan fertilization
		Identify best herbicides according to weeds on fields and crop growing stage
		Optimize use of fertilizers to reduce GHG emissions
		Reduce production costs by optimizing the use of technical inputs
		Predict if whether trend will promote mycotoxins occurrence (with negative effects on food safety)
User Stories	Farmers	As a farmer I want monitor my fields and district around me, I want monitor models and vegetation indexes so that I can carry out treatments at a right time and in a right place
		As a farmer I want to create maps to fertilize my wheat fields in the optimal stage so that I can exploit satellite images and DSS potentiality
		As a farmer I want to optimise the use of technical inputs, so that I can improve the sustainability of my crop, saving both economic and environmental issues
		As a farmer I want to predict quality (protein, test weight, etc.) so that I can identify in advance the product class of my food product.
		As a farmer I want to create crop units, adding location, crop, previous crop, soil features, and details about irrigations and sustainability related information
		As a farmer I want to be able to record in a field book crop activities carried out on fields (by famers, technicians, agronomist or in the future automatically by machines)
		As a farmer I want to automatically get a calculation of LCA, PEF, ecosystem services, biodiversity indicators
		As a farmer I want to be able to judge the sustainability performance at farm level
		As a farmer I want to be able to connect to the crop unit of a close weather stations to collect weather parameters (main model input stream)
Epics	Agricultural Companies/ Advisor	Getting crop activities in a digital format will increase supply chain accessibility
		Getting crop activities in a digital format will increase product value thanks to traceability
		As an agronomist I want to create maps to monitoring disease and to have a prediction of yield production
		ease in the support of several client farmers
		Detect fields/areas with high diseases infective pressure
		Getting crop activities in a digital format will allow sustainability KPI's monitoring

		DSS outputs useful to plan pesticides selling
		Use of DSS allows to take decision in a more transparent way
		Use of DSS integrated with EO data will enable a full crop monitoring
User Stories	Agricultural Companies/ Advisor	As an agronomist I want to access data from a network of weather stations, so that I can monitor if rainfalls, temperature, and air relative humidity affect crop performance.
		As an agronomist I want to monitor fields of my growers so that I can support them better
		As an agronomist I want to monitor forecasting models during cropping system to optimize technical inputs
		As an agronomist I want to be able to create crop units on behalf of farmers. After that, farmers monitor scanned crop units, monitoring models and EO data.
Epics	Policy makers/ Public authorities	As a policy maker creating maps with fertilization needs to plan bulletins
		EU or national agricultural fundings related to the use of DSSs during cropping season
		As a policy maker I want to see what crops are really cultivated to perform a statistical analysis
		EU or national agricultural fundings related to the sustainability performance indicators calculated by DSS
		Public authorities can trace the use of pesticides and fertilizers, comparing them with advices coming from DSS and EO indexes in order to check the amount applied are justified and in line with the predicted risk
		Nitrogen and soil GHG emissions models useful to predict nitrogen lost and crop emissions depending by weather trend and crop operations carried out.
User Stories	Policy makers/ Public authorities	As a policy maker I want monitor insects and diseases risk to check if pest products sold in the region are aligned with requests so that I can check if chemical pressure is excessively high or in line with year requests
		As a public authority I want to know the diseases risk in the region so that I can release public improved bulletins for farmers
		As a public authority I want to monitor earth maps and connected vegetation indexes to check crop health level (on nitrogen, diseases, insects and water status) so that I can promptly activate funds/damage compensations.
		As a insurance company I want use DSS as a oracle, so that I can develop parametric insurances.
		As a policy maker I want monitor crop activities carried out on field by farmers, so that I can assess environmental impacts coming from fuel, fertilizers, chemicals, etc.
		As a policy maker I want monitor crop activities carried out on field by farmers, so that I can assess costs impacts coming from fuel, fertilizers, chemicals, etc.
		Predict if weather trend will promote mycotoxins occurrence (with negative effects on food safety)
		As a policy maker I want to be able to judge the sustainability performance (at farm and policy makers level)
		As a policy maker I want to be able to use sustainability indicators to certificate environmentally friendly food products
Epics	Seed/ Fertilizers/ Pesticides Companies	Seed or chemical companies could be considered as a new target group. They could require data on hectares cultivated with a crop in a region to predict technical inputs selling and plan a better supply chain.
		Fertilizer companies could need an assessment of the amount of nitrogen leached to predict nitrogen lost by rainfalls and organise sales, depending to crop needs.

Table 10. Crop Management – WODR & PSNCS SubRIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series

	Stakeholder	Content
Epics	Farmers	Farmer goal is to reduce number of machine usage (field trips)
		Farmer always takes care of costs, his goal is to be most cost effective
		Farmer goals is to have up to date information (even with hourly dynamic)
		Farmer needs the best strategy with highest effectiveness
		As a gardener I have specific crops usually not observed for pest recognition
		Farmer acts in proactive and reactive and easiest way
User Stories	Farmers	As a farmer I want to have notification about possible pest on my fields so I can make a optimise decision to protect my cultivations best as I can
		As a gardener I want to receive an information about pest to my unique plant (not standard plants, not being cultivated at all regions) now not observed so I can do the best pest management
		As a farmer I want to receive notification about the appearance of pests in my fields to ma smartphone (SMS, push notification) as soon as possible as an early detection of the risk
		As a farmer I want to receive highest quality of pest notification so I can trust the system and make better decisions in plant protection
		As farmer I would like to reduce costs of usage of protective means by accurate usage when its economic justification of pests level risk
		As farmer I would like to be sure that my planned spraying is performed in most effective date
		As a farmer I want to receive the most accurate information about the appearance of pests in my fields in the application in which I keep field cards (preferably in the form of notifications) so that would allow me to apply crop protection treatments in a timely manner and save time on field vetting
		As farmer I like to have information about risk of pests from recognized institution to prove the treatments in formal way to minimise risk of penalties and withdrawal of funds
		As farmer I want the services to be provided in existing platform supporting farm management
		As a farmer I want to be able to register into the advisory platform, define the fields and wait for notifications about pests risks of my fields and for my specific (interesting) plants
		As a farmer I want to receive information in my mobile application as daily note of pest occurrence risk level.
Epics	SME/ Advisor	Advisor goal is to have complementary data to assess overall situation
		Advisor needs daily reports concerning all risks located in places that is interested
		SME goal is to target its products with data driven process
		Advisor goals is to have all tools and data integrated in one place
		Advisor takes specifically care about fields and places of his clients

User Stories	SME/ Advisor	As an Advisor I want to receive a notification about an increased risk of an agrophage in my area so that I can do more extensive monitoring and notify more farmers
		As an advisor I want to receive information about risk pest in my region so that I can observe the pest / plants that have highest risk and observe more at the same time
		As a coordinator I want to receive notifications of increased risk of an agrophage in the region, so that I can notify advisors to do the work or to check if the work was done properly
		As a coordinator of monitoring of agrophages system I want to know the potential risk of agrophages at the regional level at a certain time so that I would be able to properly select the people who will take care of the observations in a particular area
		As a advisor who make field observation I want to have simple and user friendly application for data collection so I can take a minimum time to technical work and focus on a observations / pest detections
		As a manager of agriculture advisory centre, I want to have a system that manage the observation of pest so I can optimise the human resources for that task and make more and increase quality of the data from the observation network
		As a system developers and crop protection specialists we want to be notified of the results of observations that resulted from the indication of the DSS in order to perform ongoing validation
		As a coordinator of the agrophage signalling system I want to know the potential risk of agrophages at the regional level at a certain time so that I would be able to properly select the people who will take care of the observations in a particular area
		As an agricultural advisor I want to have information about potential agrophage occurrence on specific fields so that I could be able to optimize timing in terms of field vetting
		As a advisor of my farmers group I want to receive information about risks of pest in my region so I can advise my famers to start and manage plant protection
		As a advisor I want to have access to many data as it possible so I can make better decision to help farmers and other way to make more and better field observations
		As an advisor, I want at the start of agri season to receive a list of pests and diseases to be observed, then during the season I want to receive hints about the dates of observation and the possible probability of pests / diseases in my area, this is information in application like notifications, list or map
		As an advisor I want services to be provided in existing platforms supporting the advisory process
		As an advisor I want to receive information in my web application as daily note of pest occurrence risk level.
		As a SME I want to be able to adjust a process of goods/services distribution with correlation of pest's distribution in national level
Epics	Policy makers/ Public authorities	Policy maker (ministry, agency) to have a best national pest recognition system
		Agriculture scientist have access to pest recognition data
User Stories	Policy makers/	As a policy maker I want to know statistical data on DSS indications compared with confirmed by advisors' occurrences of agrophages so that I can plan budget for agrophages monitoring better

	Public authorities	As a manager in decision makers / ministry of agriculture I want to have a system that manage the observation of pest so I can optimise the public founds usage in that task
		As a policy maker / Plant protection specialist I want to know what agrophages are confirmed most often so that I can increase the number of people monitoring crops where selected agrophages may occur in the future
		As a policy maker I want to have best ecological standards being applied by farmers (better to goals)
		As a policy maker I want to implement the tools to minimize chemical treatments in agriculture and have access to statistics to implement EU green deal policy and extend KPI measurement
		As a regional coordinator I want to be able to establish rules for monitoring agrophages in voivodeship based on the indications of DSS for determining the locations where the risk of the selected agrophage is high
		As a policy maker or scientist, I want to have a dedicated interface to view the actual status of the risks and historical statistics - web and csv download

Table 11. Dairy RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series

	Stakeholder	Content
Epics	Dairy processing company	As dairy company, we want to understand expected milk quality and quantity to improve process planning and control in our dairy processing factories.
User Stories	Dairy processing company	As a dairy company, I want to have a dashboard displaying relevant data and insights
		As a dairy company, I want to be able to get predictions of milk quality and milk quantity for the next production cycle (next collection run) or in best case for a customized period of time
		As a dairy company, I want to export reports, e.g. as PDF/Excel
		As a dairy company, I want to use an API to share data with other internal systems
		As a dairy company, I want to be informed if predictions of milk quality/quantity deviate from expectations based on historical data, so that I can adjust my production planning accordingly.
		As a user, I want the service to provide good quality in terms of ease of use, information, security and interoperability
		As a dairy company, I want to analyse data to identify relevant connections between my production process and farm data
		As a dairy company, I want to use Insights provided by the application to adapt my process parameters
		As a dairy company, I want to optimize the feeding process and composition
Epics	Farmer	As a farmer, I want to optimize my process based on given data
User Stories	Farmer	As a farmer I want to receive information customized to my farm and farm practices so that I can tailor my management strategies to the unique needs of my farm and maximize the potential of my farm
		As a farmer, I want to have insights about how to optimize the feeding process
		As a dairy farmer, I want to be able to compare my productivity with industry benchmarks and other farms in my area so that I can identify areas for improvement and make data-driven decisions to stay competitive in the market.

		As a user, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data
		As a user, I want the service to provide good quality in terms of ease of use, information, security and interoperability
Epics	Service Application Provider (e.g. Software Company)	As a software provider, I want to optimize my revenue by distributing relevant services within my ecosystem
User Stories	Service Application Provider (e.g. Software Company)	As a service application provider, I want to have access to aggregated data
		As a system/application provider, we need the performance of the system to be fast, to enable quick testing
		As a service application provider, I want to use an API to connect the app to my ecosystem
		As a service application provider, I want to have a demo system to show relevant features
		As a service application provider, I want to monitor relevant data that is helpful for the user to improve my application
		As a service application provider, I want to integrate additional data to improve my application

Table 12. Grasslands RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series

	Stakeholder	Content
Epics	Farmers/ Farmer association	As a farmer I want to have an improved drought index for grassland so that my farm is better protected via necessary insurance policies
		As a farmer, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data
		As a farmer association, we would like to show insurance companies that the drought index we propose is reliable and reflects actual losses
		As a farmer association, we would like to provide our farmers a drought index that is able to accurately estimate yield losses, so that they can get proper protection against drought.
		As a farmers advisor (or farmers association) I would like to identify grasslands with low productivity so that I can make informed recommendations for fertilization schedules, crop varieties, grazing management, irrigation
		As a farmer I want to receive new or improved actionable information regarding the grassland productivity of my fields so I can understand how ongoing and predicted extreme events impact the productivity of my grasslands
		As a farmer association, we would like to provide our members updated information about the production of their grasslands and recommendation about the management to improve the benefit without damaging the resources of their farms
		As a farmer I want to receive new or improved actionable information regarding the grassland productivity of my fields so that I can sustainably use my resources and make adaptations needed in my management
		As a farmer I want to link my official farm-id to the registration flow so that everything is linked and standardized

User Stories	Farmers/ Farmer association	As a farmer association I need to receive the drought index relative to the present growing season as soon as possible in order to estimate damages and the relative insurance payments in time
		As a farmer I want to log-in with 1 click so the login goes as fast as possible
		As a user, I want the service to provide good quality in terms of ease of use, information, security and interoperability
		As a farmer I want to have to provide the minimal possible data so that I am not annoyed during the registration
		As a farmer association I need to receive the drought index relative to the present growing season at the beginning of December of this year in order to estimate damages and the relative insurance payments in time
		As a farmer I want information I have already provided in an online tool to automatically be used here so that I don't have to do double work
		As a farmer I want to have to provide information regarding my management, crops, soil type ... and other farm relevant information 1 time and that it is stored and used for the future runs
		As a farmer I want to be able to download my personal data, farm data, ... so that I can have an overview of what the tool is using
		As a user, I want the service to provide good quality in terms of ease of use, information, security and interoperability
		As a user, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data
		As a farmer I want to receive information customized to my farm and farm practices so that I can tailor my management strategies to the unique needs of my farm and maximize the potential of my crops
		As a farmer I want to receive the information in a standardized way so that I can compare with other farms or policy regulations
		historical data + metadata
		As a farmer I want to receive information clearly and understandably reported so that I can perform more targeted and accurate smart farming practices
		As a farmer I want to see the results as a map, and I want to click on a field and receive a box containing all relevant detailed information/ metadata/ values/ predictions
		As a farmer I want to see the results as a map and be able to zoom in for further details
		As a user I want the outcomes to use standard format/ metrics /parameters/ calculations so that it can be used mutually between all farmers, policy making, advisory activities and other stakeholders, and not be a source of confusion
		As a user I want the tool to provide the outcomes fast, so I have a good user experience (also when changing one of the parameters in the map)
		As a farmer I want to see the results as a map and be able to select and compare current productivity levels with historical productivity levels
		As a farmer I want to receive an alert when the drought stress goes above a certain threshold so that I can take immediate actions
		As a farmer I want to receive an alert when the productivity level goes below a certain threshold so that I can take immediate actions
		As a user I want to provide suggestions of improvements of the product/ models/... so the tool can work better to the future
		As a farmers' association I want to be provided with an index estimating yield losses per farm, parcel and municipality
		As a farmers' association I want to be able to access productivity maps on a regular basis (yearly)
		As a farmer I want to be able to define temporal and spatial resolution of remote sensing products
		As a farmer I want to be able to select graphs, views, tables, units and means
		As a farmer I want to be able to define my own alerts

		As a farmer, I want to upload and share the necessary data (document, photos, etc.) for impact-related subsidy payments so that I can provide relevant documents more efficiently and quickly.
Epics	Insurance companies	As an advisor I want to analyse the potential of grasslands productivity products so that I can provide recommendations on stocking density
		and grazing rotations
		As an advisor I want to optimise grassland biomass estimation so that I can improve the monitoring of the impact of extreme events such as drought
		As an inspector, I want to be able to collaborate with other experts in grassland productivity, remote sensing, hydrology, and climate science, so that we can work together to develop integrated solutions for mitigating drought impact on grasslands and building resilience in agricultural systems
		As an insurance company, I would like to have information on the accuracy of the index that is used to estimate yield losses so that I can understand how reliable the index is
		As an insurance company expert, I would like to have a single access point to the data provided by the Lab
		As an inspector, I want to be able to communicate effectively with farmers and other stakeholders about the impacts of ongoing and predicted extreme events on the productivity grasslands, so that we can work together to develop effective mitigation strategies
User Stories	Insurance companies	As an insurance company I would like to see a validation of the drought index that is used to estimate the damages to ensure that the index is representative of actual yield variations
		As an insurance company I will use information on grassland yield loss to establish compensation to farmers.
Epics	Policy makers/ Public authorities	As a policy maker, I want to have access to accurate grassland productivity information in my region, so that I can design policy instruments to promote good practices
		As a policy maker, I want the information to be presented in a clear and standardized format,
		So that I can quickly identify trends and patterns and compare current conditions to historical data
		As a policy maker, I want to have access to accurate grassland productivity information in my region,
		So that I can make informed decisions about management, emergency preparedness, and resource allocation
		As a policy maker, I want to be able to drill down into the data so that I can understand the specific factors that are contributing to the drought impact/risks
		As a public authority I want to inform index-based drought insurance so that we can proactively have farmers protect their income from yield losses, avoiding land abandonment and the related consequences on landscape conservation, soil quality, and biodiversity
User Stories	Policy makers/ Public authorities	As a policy maker I want to able to monitor drought stress on a larger scale (field, farm, regional or national scale)
		As a policy maker I want to rely on drought indices that accurately detect drought on grasslands. To encourage insurance companies to use the best available technology
		As a policy maker I want to rely on drought indices to encourage farmers to hire insurances
		As an administrator, I want to warn the respective farmers about possible impacts so that they can take necessary measures
		As a policy maker I want to be able to use the information on biomass loss to assess adaptation strategies and measures to be promoted and undertaken

Epics	Researchers/ Research institutes/ universities	As a researcher I want to know the methodologies developed to monitor grassland biomass
		As a researcher, I would like to access grassland productivity data to evaluate products and use them as inputs for further analysis
User Stories	Researchers/ Research institutes/ universities	As a research institute/university, I want to use the grassland productivity maps for integration into other modelling activities that use this layer as input.
		As an organisation (Pa), we need the performance of the system to be fast, to enable quick testing
		As an organisation (COVAP), we need to be able to integrate services in our own applications.
		As a researcher I will provide feedback and on the robustness of data and recommendations to improve its accuracy through new validation data

Table 13. Soil RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series

	Stakeholder	Content
Epics	Farmers	As a farmer I want to receive new or improved actionable information regarding soil fertilization rates for my fields so that I can perform more efficient smart farming practices
		As a farmer I want to receive new or improved actionable information regarding soil quality for my fields so that I can perform more efficient smart farming practices
		As a farmer I want to receive accurate early detection of soil degradation of my fields so that I can perform more efficient farm management
		As a farmer I want to be provided by services that are real-time so I can act immediately in adopting my farming practices
User Stories	Farmers	As a farmer I want to link my official farm-id to the registration flow so that everything is linked and standardized
		As a farmer I want to log-in with 1 click so the login goes as fast as possible
		As a farmer I want to have to provide the minimal necessary data/ information, so I am not annoyed/demotivated during the registration
		As a farmer I want my personal data to be protected and not open
		As a user, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data
		As a user, I want to be able to choose which data I share with others and want my data to remain private.
		As a Farmer I want to have detailed information at parcel level...
		As a farmer I want information I have already provided to automatically be used during future applications so that I don't have to do keep on providing the same information for each new run
		As a farmer I want to be able to download my personal data, farm data, ... so that I can have an overview of what the tool is using
		As a user, I want the service to be of a high standard in terms of ease of use, information, security and interoperability
		As a farmer I want to receive information customized to my farm and farm practices so that I can tailor my fertilization management strategies to the unique needs of my farm and maximize the potential of my crops
		As a farmer I want to be able to get variable rate fertilization predictions for the next 3, 6, 9 or 12 months so I can plan for interventions/actions at multiple times to the future

		As a farmer I want to be informed on new tech and services available to upgrade my farming system
		As a farmer I want to be able to view the Information /details of soil quality along with the GIS map so that I can make better fertilization planning
		As a farmer I want to receive information clearly and understandably reported so that I can perform more targeted and accurate smart farming practices
		As a farmer I want to receive the information in a standardized way so that I can compare with other farms or policy regulations
		As a farmer I want to be informed on the state of important soil health indicators for my fields so that I can gain trust in the tool and decisions it makes
		As a farmer I want to receive guiding regarding the best sustainable practices I can take to mitigate loss of soil quality so that the actions have a maximum benefit for my crops
		As a farmer, I want to get information regarding the right type and amount of fertilizer for each field so that I can optimize the yield of my crops
		As a farmer, I want to use sustainable and organic fertilizers whenever possible so that I can minimize the environmental impact of my fertilizer
		As a farmer, I want to know the nutritional requirements of my crops so that I can choose the appropriate fertilizer to use on my fields.
		As a farmer I want to receive the information visualized on a map/in a GIS tool so that I can easily target the necessary regions in my field or link this information to my other GIS-compatible machines
		As a farmer I want to receive the information in a convenient form so that it fits in the soil quality management strategies applicable at my farm: fertilization schedules (organic, foliar, controlled release, ...), adjust planting dates, crop selection
		As a farmer I want to see the results as a map and be able to zoom in for further details so that I can better estimate the current situation
		As a farmer I want to see the results as a map, and I want to click on a field and receive a box containing all relevant detailed information/ metadata/ values/ predictions
		As a farmer I want to see the results as a map and be able to select and compare current soil quality levels with historical levels so that I can better estimate the current situation
		As a user I want the outcomes to use standard format/ metrics /parameters/ calculations so that it can be used mutually between all farmers, policy making, advisory activities and other stakeholders, and not be a source of confusion
		As a user I want the tool to provide the outcomes fast, so I have a good user experience (also when changing one of the parameters in the map)
		As a farmer, I want to analyse the nutrient content of the soil in each field so that I can determine the optimal type and amount of fertilizer to use.
		As a farmer, I want to know the best time to apply fertilizer to my fields so that I can maximize the uptake of nutrients by my crops and minimize losses to the environment.
		As a farmer, I want to track the fertilizer application history for each of my fields so that I can monitor the nutrient levels over time and make adjustments as needed.
		As a farmer I want to receive an alert when the soil quality goes under a certain threshold so that I can take immediate actions
		As a farmer, I want to be alerted when it is time to apply fertilizer to my fields based on soil nutrient levels, weather conditions, and other factors, so that I can efficiently manage my resources and avoid over-fertilization.

		As a farmer, I want to upload and share the necessary data (document, photos, etc.) for impact-related subsidy payments so that I can provide relevant documents more efficiently and quickly.
		As a farmer, I want to be able to upload of farm calendar: farming practices, pesticides, fertilizers, etc
		As a user I want to provide suggestions of improvements of the product/ models/... so the tool can work better to the future
Epics	SME/ SME Agricultural Companies/ Advisors	As an inspector, I would like to identify fields with low soil quality so that I can make informed recommendations for adjusting fertilization schedules and crop varieties
		As an inspector, I want to be able to communicate effectively with farmers and other stakeholders about the risks and impacts of soil degradation on crops, so that we can work together to develop effective mitigation strategies
		As an inspector, I want to be able to collaborate with other experts in soil science, hydrology, and climate science, so that we can work together to develop integrated solutions for mitigating soil degradation and building resilience in agricultural systems As an agricultural advisor I want to have user friendly tools
User Stories	SME/ SME Agricultural Companies/ Advisors	As an organisation (Pa), we need the performance of the system to be fast, to enable quick testing
		As an organisation (Pa), we need to be able to integrate services in our own applications.
		As a company selling fertilizers, I would like to get overall indication of the soil nutrient levels etc, to better target my marketing
Epics	Policy makers/ Public authorities	As a policy maker, I want to have access to accurate soil quality information in my region, so that I can make informed decisions about soil management, emergency preparedness, and resource allocation
		As a decision-maker, I want to receive early warning for soil degradation so that I can reduce its consequences and develop effective strategies for soil resource management on a monthly or seasonal timeline
		As a policy maker, I want the information to be presented in a clear and standardized format, so that I can quickly identify trends and patterns and compare current conditions to historical data
		As a policy maker, I want to be able to drill down into the data so that I can understand the specific factors that are contributing to the soil degradation conditions
		As a policy maker I want to have validated and harmonised results
User Stories	Policy makers/ Public authorities	As a policy maker I want to able to monitor soil quality on a larger scale (field, farm, regional or national scale) so that I can make coordinated decisions
		As an inspector I want to see information regarding the plants phenological observation for field
		As a controller, I would like to see information on soil characteristics and past agricultural practices
		As a policy maker I want to have timeseries of results and annual changes
		As a paying agency, I want to be alerted which fields remain bare in the most sensitive period, so that I can see compliance of GAEC 6
		As an administrator, I want to warn the farmers in a certain area about possible loss of soil quality so that they can take necessary measures
Epics	Researchers / Research	As a researcher, I would like to access the soil data & metadata to evaluate new analytical models and benchmark them against the current state of the art
		As a researcher I would like to have the ability to evaluate or even build soil properties models without barriers coming from IPRs

	institutes/ universities	As a researcher, I would like to have access to meaningful data sources
		As a researcher, I would like access to available or upcoming EO products, which can be used as input sources.
		As a researcher, I would like to integrate maps of soil properties that depict information in the parcel level into my modelling pipelines so that I can generate higher-level products.
User Stories	Researchers / Research institutes/ universities	As a research lab I want to generate NRT soil quality mapping based on edge-driven data
		As a research lab I want to utilize regional top Soil Organic Carbon maps so that I can integrate them into my other modelling activities that use this layer as input
		As a researcher I want to have the ability to harvest automatically available relevant resources
		As a researcher I would like to have open and free access to new data of hyperspectral satellite images
		As a researcher I want to have access on national data for validation
		As a researcher I would like to have the ability to process new advance satellite products in an easy way,
		As a researcher I want to have the ability to build models without the need to share data
		As a data scientist, I want to have access to available knowledge, such as methodologies or data
		As a researcher I want the ability to use (work) the data products using programmable interfaces within my digital environment

Table 14. Water RIL: Epics and user stories in view of the end-user stakeholder groups identified during the 2nd co-design workshop series

	Stakeholder	Content
Epics	Farmers/ Agricultural Companies	As a farmer I want to receive new or improved actionable information regarding drought prediction for my fields so that I can perform more efficient smart farming practices
		As a farmer I want to receive new or improved actionable information regarding crop stress (drought detection) for my fields so that I can perform more efficient smart farming practices
		As a farmer I want to receive accurate information regarding early detection of drought stress for plants in my fields so that I can perform more efficient farm management
		As a farmer I want to get actionable information so I can implement better irrigation water resource planning and management
		As a farmer, I would like information on what is the optimum use of water to achieve optimum yields, so that I can increase my income
		As a farmer I want to receive an updated information on the crop status/health.
		As a farmer I want to receive suggestion on irrigation schedule
		As an agricultural company which is a regional entity, I want to be informed on all prospects of Quinoa growth in the Galilee to be able to make informed recommendations for growth conditions, including irrigation and soil moisture management and the overall feasibility and profitability of this crop un our region
		As an agricultural company, which is a regional entity I want to be able to communicate with farmers and other stakeholders about the current and future risks and impacts of drought stress on crops in a region, so that we can recommend on develop effective mitigation strategies

User Stories	Farmers/ Agricultural Companies	As a farmer I want to have updated information daily basis so that I can adapt I can plan my activities for tomorrow and adapt the situation
		As a farmer I would like to have the information on a parcel level
		As a farmer/ agri company I want service that can support me on early prediction with a good accuracy
		As a farmer I want to be able to use and understand this service easily and without help.
		As a farmer I want to have information on different plants also.
		As a farmer, I want clear instructions on what data I need to provide and in what format and how often. so that process will be more clear and less complicated
		As a farmer, I would like to understand and see the current status not only for one field, but also for my other fields so that I can make more effective planning
		As a farmer I don't want to use lots of sensors to get information for larger area so that I don't have to spend lots of time effort and money on sensors
		As a farmer I want to have affordable early prediction services
		As a farmer, I want information, suggestion on the optimal irrigation regime for each season and plant.
		As a farmer I want information on optimal irrigation regime for have optimal yield
		As a farmer I want information I have already provided to automatically be used during future applications so that I don't have to do keep on providing the same information for each new run
		As a farmer I want to be able to download my personal data, farm data, ... so that I can have an overview of what the tool is using
		As a user, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data
		As a farmer I want to receive the information in a convenient form
		So that it fits in the water management strategies applicable at my farm: irrigation schedules, adjust planting dates, select drought-resistant crops, applying mulch or reducing tillage
		As a farmer, I want to be able to select and see the data from a specific sensor for a specific plot so that I can make better planning
		As a farmer I want to receive information customized to my farm and farm practices so that I can tailor my drought management strategies to the unique needs of my farm and maximize the potential of my crops
		As a user, I want the service to be of a high standard in terms of ease of use, information, security and interoperability
		As a farmer I want to see updated information regarding water resources and levels applicable to my farm/fields so I can make better decisions regarding irrigation and other management activities
		As a farmer I want to be able to select drought predictions for the next 3, 6, 9 or 12 months so I can plan for interventions/actions at multiple times to the future
		As a farmer I want to receive information clearly and understandably reported so that I can perform more targeted and accurate smart farming practices
		As a farmer I want to receive the information in a standardized way so that I can compare with other farms or policy regulations
		As a farmer/ advisor I want the accuracy of the models to be as high as possible so that I can minimize drought problems as much as possible

		As a farmer I want to be able to view the ground water information includes the ground water level, ground water quality so that I can make better irrigation planning.
		As a farmer I want to receive guidance regarding the best practices I can take to mitigate the drought stress so that the actions have a maximum benefit for my crops
		As a farmer, I want to see the current reservoir water level so that I can make a better irrigation plan.
		As a farmer I want to be able to view the Information /details of water source along with the GIS map so that I can make better irrigation plans
		As a farmer I want to see the results as a map and be able to zoom in for further details so that I can better estimate the current situation
		As a farmer I want to see the results as a map and I want to click on a field and receive a box containing all relevant detailed information/ metadata/ values/ predictions
		As a farmer I want to see the results as a map and be able to select and compare current drought levels with historical drought levels so that I can better estimate the current situation
		As a user I want the tool to provide the outcomes fast so I have a good user experience (also when changing one of the parameters in the map)
		As a farmer I want to receive an alert when the drought stress goes above a certain threshold for my fields so that I can take immediate actions
		As a user I want to provide suggestions in improving the product/ models/... so the tool can work better to the future
Epics	Advisor	As an inspector I would like to identify fields with drought damage so that I can make informed recommendations for adjusting planting schedules and crop varieties
		As an inspector, I want to be able to communicate with farmers and other stakeholders about the current and future risks and impacts of drought stress on crops in a region, so that we can work together to develop effective mitigation strategies
		As an inspector, I want to be able to collaborate with other experts in soil science, hydrology, and climate science, so that we can work together to develop integrated solutions for mitigating drought stress and building resilience in agricultural systems
User Stories	Advisor	As an inspector, I want to see information regarding the plants phenological observation for field
		As a controller, I would like to see information on soil characteristics and past agricultural practices

Table 15. Yield Monitoring RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series

topics	Stakeholder	Content
Epics	Farmers/farming associations	Insights in field overview & yield potential
		Advice for farmers (e.g., VRA maps)
		Compare with other fields close by (benchmarking)
		As a farmer I would like to get yield prediction during the growing season.
		As a farmer I would like to get up-to-date info about growing conditions in my fields in a concise and easily accessible form
		As a farmer I would like to get improved yield maps (e.g., gap filled)
		As a farmer, I would like to know what I am expected to do in order to get the services available (amount of work needed etc.)

User Stories	Farmers/farming associations	As a farmer I want to have a tool to insert my fields for a certain season so that I can have an overview during the growing season of the yield potential (on regular moments)
		As an advisor I want to be able to "download" the raw field data (all possible sensor points) in my own tool to do further deep analysis. Download can be via excel or most sophisticated API.
		As a farmer I would like to get the information of my crops in standardized format, so that I can compare with earlier years, or against policy regulations
		As a user I want the service to be versatile so that I can easily tailor the user I/F for my specific needs (e.g. the data that I want to share, or the info that I want to receive)
		As a farmer, I want to retrieve field-based data from my own FMIS, so that I can save time and don't need to do error-prone manual entry.
		As a farmer, I want to be able to define my fields per growing season if I do not have a FMIS
		As a farmer, I want to have a VRA (variable rate application) map generation for fertilisation on my fields
		As a farmer, if I have a FMIS or other tool, I want to be able to digitally "link" my current FMIS & the ScaleAgData solution envisioned, avoiding double entry and errors
		As a farmer, I want to have a "place" to input manual data to be combined with other data algorithms (using existing available digital data on his fields)
Epics	Advisor	Raw Data to base advice upon
		Easy Access to data
		Evaluation of impact of advice
User Stories	Advisor	As an advisor I would like to have an information sharing layer, where I can send targeted messages to individual farmers
		As a potato processing company, I want to have a daily view on the potato yield which will become available after harvesting
		As a machine construction company, I want to have "extra" data to finetune my machine measurements (e.g. adapt yield monitoring system with an improved terra estimation parameter per field)
		As the European Commission I want to have an overview of all potato fields in Europe with a clear indication of the growing state and yield potential
Epics	Policy makers/Public authorities	Yield estimates at regional level for decision-making
		Monitoring EU food production for food security (Cfr. MARS-OP)
		Impact assessment of new policies
User Stories	Policy makers/Public authorities	As a public authority I want to receive yield estimates for my region of interest (local, country, European level) so that I can take action if needed (e.g. to react on drought related yield losses - import/export related actions can be taken)
		As a public authority I want to have access to data in a "controlled" way (meaning owner of the data should give his consent)
Epics	Agricultural value chain actors: input suppliers, processing industry	Data sharing with processing companies to optimise processes end-to-end
		Insight in yield potential increase to deal with higher product demand

Epics	Service providers/ Farm management system providers	Data sharing with FMIS in both directions to avoid double and manual entries
Epics	Insurance sector	(Field level) yield estimates for damage assessment
		Regional Risk analysis (historical)
User Stories	Insurance sector	As an insurance company (loss adjuster) I want to get access to yield maps for the field for which I received a damage claim from a farmer so that I can check if damage occurred, to quantify the damage, request additional info from the farmer, and then decide about the pay-out to the farmer
		As an insurance company I want to use yield estimates of previous years to assess the (historical) risk of insuring certain fields / areas so that I can adapt premiums accordingly for those customers/regions
		As an insurance company I want to get yield maps for fields with damage claims to check if or where damage occurs

3.2 Dataflows

During the third workshop-series (15-17/05/2023, section 2.2.4, Figure 15) together with the RIL members and collaborating technology providers, we focused on defining and visualizing the dataflows. These dataflows are a data-centric representation of the solution each RIL intends to develop as a data service in order to meet the specific user stories identified in section 3.1.2. These dataflows can be seen as a visual representation of the vision scenario each RIL envisions, while the user stories enlisted in the previous section (3.1.2) formulate the benefits and outcomes comprised by each vision scenario.

Much attention was given to depicting the tackled project innovation area's (orange post-it notes in Figure 15) and the linked deployment scenario by the RIL (green post-it notes in Figure 15) as clear components in the dataflow. By focusing on a dataflow, we are able to identify the series of operations or transformations the data undergoes throughout the entire data service/product and emphasize the dependencies between the different components of the service. In addition, by visualizing the anticipated dataflow we were able to identify the desired (To-Be) state of the RIL. Afterwards, this dataflow was collectively modified to visualize the current (As-Is) state of the RIL. As a last step, by comparing both dataflows we could hold discussions to determine which aspects were needed to evolve from the current state to the desired state. These aspects were collected as the (non-) functional and transitional requirements (blue post-it notes in Figure 15) needed further in the project (tasks T2.3, T2.4 and T3.4).

The dataflows of each RIL can be found at murals co-design workshop 3, while the requirements are listed for each RIL in Table 16 to Table 23.

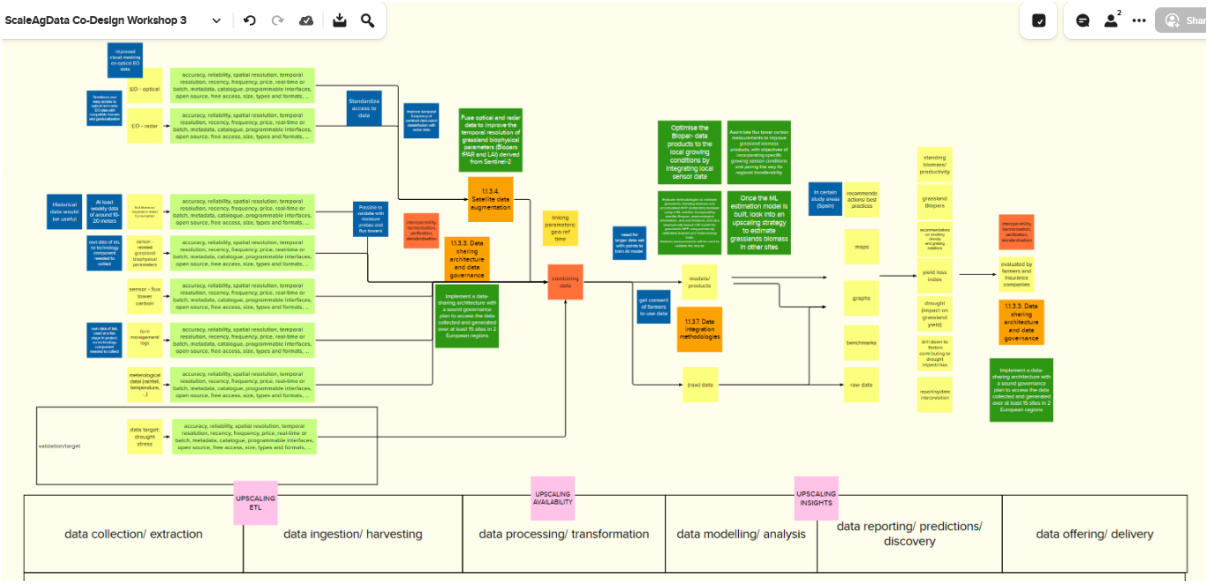

Figure 15. Example of 'mural' from co-design workshop held during the 3nd workshop series identifying dataflows of current and desired state

Table 16. Crop Management - NP SubRIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	Sensor - pesticide detection	1.1.3.1. Innovative sensor technology	Non -functional	Detect active components
	Data sources sensors	1.1.3.5. From data assimilation to service development / 1.1.3.7. Data integration methodologies	Non -functional	DHI : providing soil moisture, Actual evapotranspiration – ETa, irrigation schedule, soil properties, based on Neuropublic's in-situ gaiatron station
	Data sources EO	1.1.3.5. From data assimilation to service development / 1.1.3.7. Data integration methodologies	Non -functional	EGM & OHB: Super-resolution EO-based data
	Farm management data	1.1.3.3. Data sharing architecture and data governance / 1.1.3.6. Privacy-preserving technology	Non -functional	Use of existing NP's technology storing Farm Book data
Data modelling	Digital twin	1.1.3.5. From data assimilation to service development / 1.1.3.7. Data integration methodologies	Non -functional	LUKE: Usage and integration of Digital Twin

Table 17. Crop Management – Horta SRL SubRIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	EO - Sentinel	1.1.3.7. Data integration methodologies	Non-functional	Improved EO data (spatial resolution; temporal resolution; frequency; price; types and format)
	In situ - soil characteristics	1.1.3.7. Data integration methodologies	Non -functional	Soil characteristics (soil texture, organic carbon content)
	Agronomic characteristics	1.1.3.7. Data integration methodologies	Non -functional	Crop type, phenological stage, evapotranspiration and soil moisture
		1.1.3.7. Data integration methodologies	Non -functional	Users must connect to the crop unit a close weather stations to collect weather parameters (main model input stream)
Data reporting		1.1.3.7. Data integration methodologies	Non -functional	Improvement of calculation in the 3 pillars is needed
		1.1.3.7. Data integration methodologies	Non -functional	Improve fertilisation advice

		1.1.3.7. Data integration methodologies	Non -functional	Improvement of crop yield prediction
		1.1.3.7. Data integration methodologies	Non -functional	Add other crop quality parameters
		1.1.3.7. Data integration methodologies	Non -functional	Improvement of water soil content and plant stress

Table 18. Crop Management – WODR & PSNC SubRIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation areas

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	Meteorological datal (rainfall, temperature, ...)	1.1.3.7. Data integration methodologies	Non-functional	Precipitation data with high resolution (case will be described)
	EO data	1.1.3.7. Data integration methodologies	Non -functional	EO data (e.g. NDVI) from the fields where observations are made in order to be able to correlate pest mathematical model data and EO data in order to be able to indicate risk more quicky and efficiently
Data ingestion	Target variable	1.1.3.3. Data sharing architecture and data governance / 1.1.3.5. From data assimilation to service development	Non -functional	Feedback to validate final data
	Historical pest observation data	1.1.3.3. Data sharing architecture and data governance / 1.1.3.5. From data assimilation to service development	Non -functional	Management of common time slots
	In general	1.1.3.3. Data sharing architecture and data governance / 1.1.3.5. From data assimilation to service development	Non -functional	Datahub
Data processing		1.1.3.3. Data sharing architecture and data governance	Non -functional	Combining tools
Data modelling		1.1.3.2. Edge processing	Non -functional	Algorithms for inference and DSS
Data reporting		1.1.3.5. From data assimilation to service development / 1.1.3.6. Privacy-preserving technology	Non -functional	Advance processed data visualization

	Pest recognition	1.1.3.5. From data assimilation to service development / 1.1.3.6. Privacy-preserving technology	Non - functional/acceptance requirement	Not automated pest recognition
	Historical pest densities	1.1.3.5. From data assimilation to service development / 1.1.3.6. Privacy-preserving technology	Non -functional	Spot-on only regarding historical pest densities
Data offering		1.1.3.5. From data assimilation to service development / 1.1.3.6. Privacy-preserving technology	Non -functional	Interfaces

Table 19. Dairy RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	EO data	1.1.3.1. Innovative sensor technology	Non-functional	Daily EO data
	Data sources in general	1.1.3.4. Satellite data augmentation	Non -functional	Timestamp and geolocation
	Data sources in general	1.1.3.3. Data sharing architecture and data governance	Non -functional	Recognizable/common format for each data source
Data ingestion	In general	1.1.3.3. Data sharing architecture and data governance	Non -functional	Standardized interface (API) for automatic data ingestion
	In general	1.1.3.3. Data sharing architecture and data governance	Non -functional	Metadata
Data processing	Platform	1.1.3.5. From data assimilation to service development	Non -functional	Data processing optimization (e.g. chunking/tiling, parallel-computing)
Data modelling	In general	1.1.3.6. Privacy-preserving technology	Non -functional	Data access
	In general	1.1.3.5. From data assimilation to service development	Non -functional	Harmonized data
Data reporting	In general	1.1.3.7. Data integration methodologies	Non -functional	Quality indicators
Data offering	In general	1.1.3.3. Data sharing architecture and data governance	Non -functional	Metadata
	In general	1.1.3.5. From data assimilation to service development	Non -functional	Licensing

Table 20. Grasslands RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation areas

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	EO-optical	1.1.3.4. Satellite data augmentation	Non -functional	Improved cloud masking on optical EO data
	EO-optical + radar	1.1.3.4. Satellite data augmentation	Non -functional	Timeliness and easy access to optical and radar EO data with compatible formats and geo-localization
	Soil moisture/vegetation water consumption	1.1.3.4. Satellite data augmentation	Non -functional	Historical data would be useful
		1.1.3.4. Satellite data augmentation	Non -functional	At least weekly data of around 10-20 meters
	Sensor - related grassland biophysical parameters	1.1.3.3. Data sharing architecture and data governance	Non -functional	Own data of lab, no technology component needed to collect
	Farm management/ logs	1.1.3.3. Data sharing architecture and data governance	Non -functional	Own data of lab, used at a later stage in project, no technology component needed to collect
	In general	1.1.3.7. Data integration methodologies	Non -functional	Farmers association will mediate with some farmers to give us access to their fields to perform ground measurements
Data ingestion	EO-optical + radar	1.1.3.3. Data sharing architecture and data governance	Non -functional	Standardize access to data
	EO-optical + radar	1.1.3.4. Satellite data augmentation	Non -functional	Improve temporal frequency of sentinel data using data fusion with radar data
	EO + soil moisture sensor	1.1.3.3. Data sharing architecture and data governance	Non -functional	Possible to validate EO data with moisture probes and flux towers
Data modelling		1.1.3.7. Data integration methodologies	Non -functional	Need for larger data set with points to train AI model
		1.1.3.7. Data integration methodologies	Non -functional	Get consent of farmers to use data
		1.1.3.3. Data sharing architecture and data governance	Non -functional	Farmers association will contribute to the definition of some details of the procedure to calculate drought index
Data reporting	Recommended actions/ best practices	1.1.3.7. Data integration methodologies	Non -functional	In certain study areas (Spain)
		1.1.3.7. Data integration methodologies	Non-functional	Integrated products/services with tools currently used by farmers in their daily activities
			Transition requirement	Capacity building

Table 21. Soil RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	EO-multiband data	1.1.3.1. Innovative sensor technology	Non-functional	Hyperfield next generation?
		1.1.3.1. Innovative sensor technology	Non -functional	Hyperfield-1
		1.1.3.1. Innovative sensor technology	Non -functional	Sentinel 2
		1.1.3.1. Innovative sensor technology	Non -functional	EO temporal resolution should enable the generation of cloud-free bare soil mosaics, i.e. 15 days revisit time
		1.1.3.1. Innovative sensor technology	Non -functional	Using sentinel 2 data from google earth engine as data source
	Sensor - hyperspectral	1.1.3.1. Innovative sensor technology	Non -functional	Spectral resolution of sensors should cover (partially or wholly) the 350 to 2500 nm range
Data collection	Edge processing	1.1.3.2. Edge processing	Non -functional	Do the edge processors have to be autonomous in energy keeping (batteries, solar panels or plug in existing energy source)
		1.1.3.2. Edge processing	Non -functional	How to communicate with the edge computers? - connectivity
		1.1.3.2. Edge processing	Non -functional	Data standardisation
		1.1.3.2. Edge processing	Non -functional	Data outlier
		1.1.3.2. Edge processing	Non -functional	Some data quality assessments
		1.1.3.2. Edge processing	Non -functional	Other technical specifications
		1.1.3.2. Edge processing	Non -functional	Communication protocols with sensors. How much sensors to be plugged on the edge processing platform? (wired like rs485? voltage? or BLE?)
Data collection	Target data source	1.1.3.3. Data sharing architecture and data governance	Non -functional	Lucas topsoil dataset
Data collection	In general	1.1.3.3. Data sharing architecture and data governance	Non -functional	Access to catalogue services allowing the evaluation of product characteristics
Data processing	Data integration methodologies	1.1.3.7. Data integration methodologies	Non -functional	Spatial resolution of end-products should be high enough to provide field-level estimations
	Data sharing architecture and data governance	1.1.3.3. Data sharing architecture and data governance	Non -functional	Selection of measurement and data storage protocols

		1.1.3.3. Data sharing architecture and data governance	Non -functional	Open data (libraries, raw data, etc)
		1.1.3.3. Data sharing architecture and data governance	Non -functional	Data platform geo-localised and timestamped data storage and queries
		1.1.3.3. Data sharing architecture and data governance	Non -functional	Interoperability/Standardised
		1.1.3.3. Data sharing architecture and data governance	Non -functional	Generation of bare soil composites from multi-temporal data
Data modelling	Platform	1.1.3.6. Privacy-preserving technology	Non -functional	Data processing platform should have GPU to enable fast model training and enough storage for the generation of large-scale maps
	Edge processing	1.1.3.2. Edge processing	Transition requirement	Edge computing some minor use cases, but not operational
		1.1.3.2. Edge processing	Non -functional	Edge computing platform exists at EGM but has to be adapted to the case
		1.1.3.2. Edge processing	Non -functional	Edge computing, existing ML will run on edge processor
	Privacy-preserving technology	1.1.3.6. Privacy-preserving technology	Non -functional	Federated AI with tensorflow model also using satellite datasets available on google earth engine
Data reporting		1.1.3.3. Data sharing architecture and data governance	Non -functional	Definition of soil quality indicator
		1.1.3.3. Data sharing architecture and data governance	(Non -) functional	Integrate results within other existing decision-making processes
			Transition requirement	Training of the user to understand the results

Table 22. Water RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	General for all data sources	1.1.3.3. Data sharing architecture and data governance	Non-functional	Farmers need to give consent to use their data
		1.1.3.3. Data sharing architecture and data governance	Non-functional	What is the data availability of the data components

		1.1.3.3. Data sharing architecture and data governance	Non-functional	Water usage as farm management
		1.1.3.3. Data sharing architecture and data governance	Non-functional	Data types for acquisition
		1.1.3.5. From data assimilation to service development	Non-functional	Real-time data needed for digital twin, daily data
		1.1.3.5. From data assimilation to service development	Non-functional	Size of fields
		1.1.3.5. From data assimilation to service development	Non-functional	Iterations in experiments
Data processing	Data sharing architecture	1.1.3.3. Data sharing architecture and data governance	Functional	Comparability of data and models from two regions
Data modelling	Platform	1.1.3.5. From data assimilation to service development	Non-functional	Processing environment to run models
	Digital twin	1.1.3.5. From data assimilation to service development	Transition requirement	Help with demonstrating digital twin + using a interface/ platform
		1.1.3.5. From data assimilation to service development	Non-functional	For digital twin important to work with near real time data
		1.1.3.5. From data assimilation to service development	Non-functional	Input of required data through API with agreed data model
		1.1.3.5. From data assimilation to service development	Non-functional	Management data when there are changes
		1.1.3.5. From data assimilation to service development	Non-functional	Weather and EO data (phenology, biomass etc.) daily if possible.
		1.1.3.5. From data assimilation to service development	Non-functional	Description of the data models and processing environment used
		1.1.3.5. From data assimilation to service development	Transition requirement	Getting from data products to digital twin
Data reporting		1.1.3.5. From data assimilation to service development	Non-functional	Understanding user interface needs from discussions with farmers
		1.1.3.5. From data assimilation to service development	Non-functional	Daily update of the crop status (e.g. health, potential yield)

Table 23. Yield Monitoring RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's

Phase in data flow	Component	Innovation area	Type of requirement	Requirements
Data collection	Sensors on harvester	1.1.3.3. Data sharing architecture and data governance	Non-functional/functional	Permission from farmers to use the data
Data ingestion	Sensors on harvester	1.1.3.3. Data sharing architecture and data governance	Non-functional	Harvester data accessible via APIs, in standardized format
Data modelling	Digital twin	1.1.3.5. From data assimilation to service development	Non-functional	Based on data integration to APSIM crop model, https://twinyields.github.io/
		1.1.3.5. From data assimilation to service development	Non-functional	Requirements for setting up Digital Twin: Cultivar, sowing date, fertilizer amount, soil map / sample data. Historical yield data needed to calibrate models
		1.1.3.5. From data assimilation to service development	Non-functional	Input of required data trough API with agreed data model (e.g. NGSI-LD) or FMIS specific APIs.
		1.1.3.5. From data assimilation to service development	Non-functional	Management data when there are changes.
		1.1.3.5. From data assimilation to service development	Non-functional	Weather and EO data (phenology, biomass etc.) daily if possible
	Data integration methodologies	1.1.3.7. Data integration methodologies	Non-functional	Historical yield data from harvesters
		1.1.3.6. Privacy-preserving technology	Non-functional	Methods for transfer learning, continuous learning...
		1.1.3.7. Data integration methodologies	Non-functional	Yield upscaling methods
Data offering		1.1.3.3. Data sharing architecture and data governance	Non-functional	API to make resulting yield products accessible

3.3 RIL use cases

A use case describes interactions between an actor (a user or system) and a system. It outlines the steps or actions that a user or system takes to achieve a specific goal and helps defining the behaviour of the system;. The following use cases were composed by compiling all information provided during the co-design workshops. The project partners then modified and verified the uses case related to their RIL.

3.3.1 RIL Yield monitoring:

Use Case: Yield monitoring and cultivation practices service

Objective:

The objective of this use case is to unlock the potential of sensor data gathered via harvesters for local and European-wide yield monitoring, while optimizing crop production. The use case focuses in a first phase on providing farmers with a user-friendly service to register their cultivation practices, access summaries of their records, access satellite derived information on crop growth and development, receive aggregated data from neighboring farmers that can be used as a benchmark and receive practical advice (e.g., task maps for VRA fertilization) to optimize resource usage. With the farmer's permission the information that is collected for the field can also be shared with farm advisors or researchers that assist the farmer, or with insurance companies, in case damage occurred on an insured field. In a second phase, local yield information will be scaled up to regional yield statistics which might be useful for policy makers.

User Stories:

Table 15. Yield Monitoring RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series.

Requirements:

Table 23. Yield Monitoring RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 yield monitoring

Benefits:

- Farmers:
  - Monitor and optimize resource usage.
  - Get access to satellite, weather and soil data.
  - Get access to yield maps / historical variability maps, based on sensor and/or satellite data.
  - Identify if they are using more or less resources compared to others and adjust the practices on the farm accordingly.
  - Analyse variability within the field, make informed decisions / adjust field practices accordingly.
  - Receive expert recommendations for improving their crop production while ensuring responsible resource usage.
  - Analyse the effectiveness of applied practices.
- Policy makers:

  - Gain insights into the resource usage of farmers and develop policies to promote sustainable agriculture.
- Researchers:
  - Gain insights into yield variations and related resource usage by farmers at regional level and develop policies to promote sustainable agriculture.

Operational Flow:

- Farmers register their fields and cultivation practices in the connected platforms if the farmer has a FMIS (farm management information system) or other tools, the farmer should be able to digitally "link" his current FMIS & the ScaleAgData solution envisioned, avoiding double entry and errors.
- The service uses sensor data gathered via harvesters and combines this with farm management data, EO data, meteorological data and various field data (e.g. soil and crop data) to map/estimate yield and link it with resource usage.
- A VRA (variable rate application) map will be generated for fertilization on the farmer's fields.

As a result,

- A farmer has a "place" to input manual data to be combined with other data algorithms (using existing available digital data on his fields).
- The service provides farmers with summaries of their records.
- The service provides farmers with improved crop yield maps/estimates for their fields.
- The service provides farmers with aggregated data from neighbouring farmers.
- The service provides farmers with reports that highlight the key metrics and changes over time.

Additionally, if the owner of the data gives his consent:

- Researchers or farm advisors can get access to the farmer's data to gain better insights on the impact of cultivation practices on yield, to provide advice on how to optimize resource usage. Insurance companies can get yield maps for fields with damage claims to check if or where damage occurs, this should be done in a "controlled" way. Policy makers and other stakeholders (like other chain actors) have access to data in a "controlled" way.

Conclusion of future scenarios:

By connection ScaleAgData services with existing platforms for crop monitoring such as WatchITgrow, AVR Connect and APDT (or others), farmers will have the possibility to register their cultivation practices, access summaries of their records (including yield maps), access satellite, weather and soil data, compare their resource consumption with neighboring farmers, and receive expert recommendations for improving their yield production while ensuring responsible resource usage.

3.3.2 RIL Water:

Use Case: Smart farming service for early prediction and detection of drought stress

Objective:

The objective of this use case is to develop and demonstrate a service prototype that provides early prediction and detection of drought stress, enabling farmers to maintain productive crops by reducing the impact of drought.

User Stories:

Table 14. Water RIL: Epics and user stories in view of the end-user stakeholder groups identified during the 2nd co-design workshop series

Requirements:

Table 22. Water RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's.

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 water

Benefits:

- Farmers:
  - Receive early warnings of drought stress, allowing them to take timely action to mitigate the impact.
  - Make more efficient use of water resources by optimizing their irrigation schedules.
  - Increase their income by maintaining productive crops.
- Policy makers:
  - Gain insights into the impact of drought on agriculture and develop policies to support farmers.
- Researchers:
  - Gain insights into the mechanisms of drought stress and develop new technologies to mitigate its impact.

Operational Flow:

- Sensors are deployed in the fields to collect relevant parameters such as local meteorological and soil moisture data.
- The collected data is sent to the service, which uses advanced algorithms and machine learning models to predict the occurrence of drought and detect drought stress early.
- Airborne data from spectral and thermal sensors is used to upscale point measurements to a parameter distribution maps
- Satellite data is used to upscale the model to a larger area where precise local sensor data is not available
- Based on the prediction and detection results, the service provides farmers with actionable information on irrigation practices, including water usage optimization.
- The service also offers useful comments and suggestions about the irrigation scheme, considering the specific needs of the crops and the prevailing weather conditions, to help farmers make informed decisions.

Conclusion for future scenarios:

The smart farming service for early prediction and detection of drought stress will help farmers make more efficient use of water resources, plan their irrigation schedules effectively, and take timely measures to reduce the negative effects of drought stress. Ultimately, this service will empower farmers to maintain productive crops, increase their income, and achieve sustainable agricultural practices.

3.3.3 RIL Soil:

Use Case: Soil organic carbon service for smart farming

Objectives:

Develop and demonstrate a service prototype to provide soil organic carbon levels in the topsoil as part of a soil health assessment based on Earth Observation (EO) data. Deliver actionable information and edge-driven services for automating decision support in soil-related management services as to be able to maintain productive and sustainable soils.

User Stories:

Table 13. Soil RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series.

Requirements:

Table 21. Soil RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's.

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 soil

Benefits:

- Farmers:
  - Receive actionable information about soil quality for their fields.
  - Customize the recommendations based on their specific practices and crops.
  - Improve crop yield.
- Inspectors:
  - Monitor soil health across a region.
- Advisors:
  - Provide farmers with personalized recommendations.
- Researchers:
  - Gain insights into soil health.

Implementation:

The use case will be implemented by developing a service that provides farmers with actionable information about soil quality. The service will use EO data to assess the topsoil organic content and will be integrated with existing decision-making processes on the farm. The service will also include training materials and resources to help users understand the results and utilize the data effectively.

Operational Flow:

- Farmers register and onboard the service, providing necessary information about their farms and crops.
- The service provides a user-friendly visualization interface where farmers can view actionable information about soil quality for their fields.
- The results from the service are integrated into existing decision-making processes on the farm, allowing farmers to customize the recommendations based on their specific practices and crops.

- The service includes training materials and resources to help users understand the results and utilize the data effectively.

Conclusion for future scenarios:

The service will provide farmers, inspectors, advisors, and researchers with timely and accurate information about soil health. This information will support smart farming practices, improve crop yield, and help maintain productive and sustainable soils.

3.3.4 RIL Grassland:

Use Case: Development of a Grassland Drought Index for Improved Farm Management and Insurance Protection

Objective:

The objective of this use case is to develop a biomass product specifically tailored for the validation and calibration of biomass and biophysical parameters, utilizing ground sensors and state-of-the-art data fusion technologies. The use case aims to collect spatially distributed ground sensor observations of grassland quantitative traits, which are seldom available, to validate and calibrate biomass and biophysical parameters. Furthermore, the use case intends to provide technical recommendations for better management decisions and inform index-based drought insurance, allowing farmers to protect their income from yield losses, avoid land abandonment, and mitigate the impact on landscape conservation, soil quality, and biodiversity.

User Stories:

Table 12. Grasslands RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series.

Requirements:

Table 20. Grasslands RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation areas.

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 grasslands

Benefits:

- Farmers:
  - Make informed decisions about grassland management.
  - Protect their income through proper insurance coverage.
  - Receive actionable information to enhance their grassland productivity.
- Insurance companies:
  - Establish compensation policies for farmers based on accurate estimates of yield losses.
- Farmers associations:
  - Receive updates on grassland productivity on a yearly basis.
- Policy makers:
  - Assess and promote adaptation strategies and measures to mitigate the impact of drought.

Operational Flow:

- The developed service will be integrated in tools currently used by farmers in their daily activities.
- The user will be able to define temporal and spatial resolution of remote sensing products.
- The user will be able to select graphs, views, tables, units and means for data transfer.
- The service will provide a drought index estimating yield losses per farm, parcel and municipality.
- Farmers associations will access productivity maps on a regular basis (yearly).
- Insurance companies will use information on grassland yield loss to establish compensation to farmers.
- Policy makers will use the information on biomass loss to assess adaptation strategies and measures to be promoted and undertaken.
- Researchers will be able to provide feedback relating to the robustness of data and recommendations to improve the model's accuracy through new validation data.

Conclusion for future scenarios:

The development of a grassland drought index will help farmers make informed decisions about grassland management, protect their income through proper insurance coverage, and receive actionable information to enhance their grassland productivity. The index will also be useful for insurance companies and policy makers to assess and promote adaptation strategies and measures to mitigate the impact of drought.

3.3.5 RIL Dairy:

Use Case: Smart Services for Dairy Processors and Dairy Farmers

Objective:

The objective of this use case is to develop services that facilitate the application of smart farming practices and agri-environmental monitoring for dairy farmers and their input producers. The aim is to enable monitoring, planning, and control for areas lacking in-situ data while maintaining high milk quality and quantity.

User Stories:

Table 11. Dairy RIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series.

Requirements:

Table 19. Dairy RIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's.

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 dairy

Benefits:

- Dairy farmers and input producers:

    - Make data-driven decisions.
    - Optimize their processes.
    - Improve milk quality and quantity.
- Dairy companies:
    - Milk quality forecasting
- Software provider:
    - Increased revenue and customer satisfaction.

Operational Flow:

- Using Insights provided by the application to adapt my production parameters.
- Analyse data to identify relevant connections between my production process and farm data.
- Using Insights provided by the application to adapt my process parameters.
- Optimize the feeding process and composition.
- Monitoring relevant data that is helpful for the user to improve my application.
- Integrate additional data to improve my application.

Conclusion for future scenarios:

The smart farming services provided will enable dairy farmers and input producers to make data-driven decisions, optimize their processes, and contribute to the maintenance of high milk quality and quantity. Additionally, the software provider will benefit by offering valuable services within their ecosystem, leading to increased revenue and customer satisfaction.

3.3.6 RIL (sublab NP) Crop Management:

Use Case: Integration of Weather, Soil, and Farm Data for Smart Farming and Sustainability Monitoring

Objective:

The objective of this use case is to unlock the potential of integrating weather and soil data from sensors with other data sources such as Earth Observation (EO), soil analysis, and farm log data. By combining these data sources, the aim is to expand smart farming services, enable monitoring of sustainability performance for policy purposes at a European-wide level, and provide farmers with the tools to increase production efficiency, reduce costs, and minimize risks.

User Stories:

Table 8. Crop Management - NP SubRIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series.

Requirements:

Table 16. Crop Management - NP SubRIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's.

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 crop management

Benefits:

- Farmers:
    - Increase production efficiency.

  - Reduce costs.
  - Minimize risks.
  - Compare their resource usage with others in their region.
  - Receive personalized recommendations from agronomists and advisors.
- Policy makers:
  - Monitor sustainability performance of European agriculture.
  - Design and monitor policies that promote sustainable agriculture.

Operational Flow:

- Farmers register their cultivation practices and resource usage in the smart farming service.
- The service uses the existing NP's technology storing Farm Book data.
- The service collects weather and soil data from sensors, as well as EO, soil analysis, and farm log data.
- The service analyses the collected data and provides farmers with summaries and insights.
- Farmers can access aggregated data from their own parcels and from neighbouring farmers.
- Agronomists and advisors use the service to analyse aggregated data enabling them to see results (specific KPIs related to inputs usage) for a specific area of interest.

Conclusion for future scenarios:

The integration of weather, soil, and farm data will enable the development of smart farming services that can help farmers increase production efficiency, reduce costs, and minimize risks. The use case will also help policy makers monitor sustainability performance of European agriculture and design and monitor policies that promote sustainable agriculture.

3.3.7 RIL (sublab Horta) Crop Management:

Use Case: Integrated Smart Farming System for Crop Management and Sustainability Monitoring

Objective:

The objective of this use case is to unlock the potential of using weather and soil data from sensors, along with other data sources such as Earth Observation (EO), soil analysis, and farm log data. The system aims to expand smart farming services, enable monitoring of sustainability performance at a field level, and provide farmers with tools to increase production efficiency, reduce costs, and minimize risks. The user of the system is the crop manager, so the main application is at farm level, with the farmer being able to optimize the technical inputs for the management of his fields and monitor his sustainability performances.

User Stories:

Table 9. Crop Management – Horta SRL SubRIL: Epics and user stories in view of the end-user stakeholder groups identified during the 2nd co-design workshop series.

Requirements:

Table 17. Crop Management – Horta SRL SubRIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation area's.

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 crop management

Benefits:

- Farmers:
    - Make data-driven decisions about crop management.
    - Optimize resource utilization.
    - Improve sustainability practices.
    - Ease data collecting for certification for environmentally friendly food products application.

Operational Flow:

- Users create crop units by providing details such as location, crop type, previous crop, soil features, and information about irrigation and sustainability practices.
- Users must connect a nearby weather station to the crop unit, as weather parameters are a primary input stream for the models.
- Advisors can create crop units on behalf of farmers, and farmers can monitor scanned crop units, monitoring models, and EO data.
- The system utilizes monitoring and forecasting models throughout the cropping system to optimize the service of technical inputs.
- Crop activities carried out on fields, whether by farmers, technicians, agronomists, or machines, are recorded in a field book.
- The system automatically calculates Life Cycle Assessment (LCA), Product Environmental Footprint (PEF), ecosystem services, and biodiversity indicators.
- Sustainability performance is evaluated at farm level, enabling judgment of sustainability performance.
- Sustainability indicators can also be used to apply for certification of environmentally friendly food products.
- Aggregation of many on farm-level sustainability assessment in principle can help policy makers to monitor farms environmental impact trends in different regions/cropping systems/years.

Conclusion for future scenarios:

This integrated smart farming system combines weather and soil data with other relevant information, empowering farmers to make data-driven decisions, optimize resource utilization, and improve sustainability practices.

3.3.8 RIL (sublab WODR-PSNC) Crop Management:

Use Case: Integration of Weather and Soil Data for Smart Farming and Policy Monitoring

Objective:

The objective of this use case is to unlock the potential of weather and soil data from sensors by integrating them with other data sources such as Earth Observation (EO), soil analysis, and farm log data. The aim is to expand smart farming services, enable monitoring of sustainability performance at a European-wide level for policy purposes, and provide farmers with the tools to increase production efficiency, reduce costs, and minimize risks. Additionally, the use case caters to policy makers by facilitating the design and monitoring of sustainability-related policies.

User Stories:

Table 10. Crop Management – WODR & PSNCS SubRIL: Epics and user stories in view of the end-user stakeholder groups identified during the second co-design workshop series.

Requirements:

Table 18. Crop Management – WODR & PSNC SubRIL: Requirements identified during the third co-design workshop series at different stages in the dataflow and related to one or more innovation areas.

Dataflow design:

ScaleAgData Co-Design Workshop 3_2023-06-08 crop management

Benefits:

- Farmers:
  - Access to comprehensive data and utilize various smart farming services.
  - Receive daily notifications regarding the risk level of pest occurrence specific to their fields.
  - Take proactive measures to minimize the impact of pests.
- Advisors:
  - Provide recommendations and guidance based on real-time and historical information.
  - Stay updated on the risk level of pest occurrence.
- Policy makers:
  - View the current status of pest risks, along with historical statistics.
  - Design and monitor sustainability-related policies.

Operational Flow:

- The service is provided in an existing platform supporting farm management.
- Farmers register on the advisory platform and define their fields.
- Advisors receive a list of pests and diseases to be observed at the beginning of the agricultural season.
- Throughout the season, advisors receive hints, such as notifications, lists, or maps, about the dates of observation and the probability of pests/diseases in their area.
- Farmers and advisors receive daily notifications regarding observations and the risk level of pest occurrence, for farmers this is specific to their fields and their crops.
- Regional coordinators utilize Decision Support Systems (DSS) to determine the locations where the risk of selected agrophages (crop pests) is high, they provide the rules for monitoring the agrophages.
- Small and Medium Enterprises (SMEs) involved in goods/services distribution adjust their processes based on the correlation between pests' distribution at the national level.
- Policy makers and scientists have a dedicated interface that allows them to view the current status of pest risks, along with historical statistics; this information can also be downloaded as e.g. a csv file.

Conclusion for future scenarios:

By integrating weather and soil data with other relevant sources, this use case empowers farmers with valuable insights, supports advisors in providing timely recommendations, and aids policy makers in designing and monitoring sustainability-related policies at a European-wide level.

4 Requirements documentation and validation framework

In this section all the outcomes of the analysis and modelling (Section 3) are brought together and combined to generate a (high-level) backlog for each RIL.

Figure 16 visualizes the steps and combination of information used to generate the backlog.

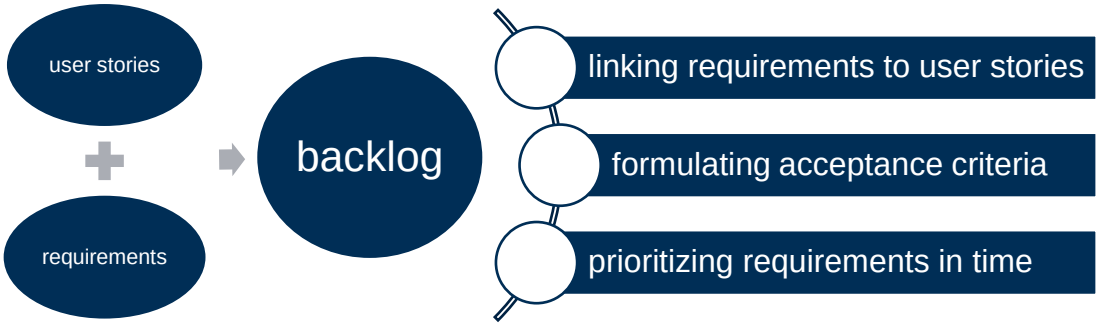

Figure 16. Steps performed to generate a backlog for each RIL

The backlog is centralized in function of the user stories (section 3.1.2). The user stories are tangible, delineated and prioritized components with their own requirements that define the end-user related objectives and advantages of the vision scenario. The user stories were prioritized ('MUST', 'SHOULD' and 'COULD') during the co-design workshops (section 3.1.2) and affect a certain stakeholder. A second important source used for the backlog are the requirements defined using the dataflow (section 3.2). The following actions were performed by each RIL:

- Linking the (non-) functional requirements (section 3.2) needed to tackle each specific user story. As each requirement is also mapped to a specific innovation area (section 3.2), the rolling plan (described and reported in the following section 5) can be used to determine which technology provider(s) will collaborate with the research partners for a specific requirement and subsequently a specific user story.
- Formulating specific acceptance criteria determining when the corresponding user story can be assumed to be fulfilled by the developed solution. These acceptance criteria comprise the validation framework for each vision scenario of the RIL.
- Prioritizing the enlisted requirements using a time-related categorization ('WITHIN 6 MONTHS', 'WITHIN 1 YEAR', 'WITHIN 2 YEARS' or 'WITHIN 3 YEARS'), this was done in the non-functional requirements tab of the backlog document.

All backlog documents can be found at the following link prioritization and summary co-design documents. A summarized backlog together with the related requirements can be found in Table 24 to Table 39 for each RIL.

4.1 Crop Management RIL backlog

4.1.1 Horta SubRIL

Table 24. Backlog for Crop Management - Horta SubRIL containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of non-functional requirements (nrs.)	Acceptance criteria	User story
Crop Management - Horta SRL	MUST	Policy maker	3; 4	Sufficient number of weather points in representative areas to cover the regional situation; well performing prediction models	As a public authority I want to know the diseases risk in the region so that I can release public improved bulletins for farmers
	MUST	Farmer	1; 3; 4	Well performing models, tested and validated	As a farmer I want monitor my fields and district around me, I want monitor models and vegetation indexes so that I can carry out treatments at a right time and in a right place.
	MUST	Agronomist	4	Available weather station data in the relevant area, easy to understand information	As an agronomist I want to access data from a network of weather stations, so that I can monitor if rainfalls, temperature, and air relative humidity affect crop performance.
	MUST	Farmer	5; 6; 7	Well performing system, with proved advantages with respect to the common practice	As a farmer I want to optimise the use of technical inputs, so that I can improve the sustainability of my crop, saving both economic and environmental issues
	MUST	Agronomist	1; 4; 3	Well performing system, with proved advantages with respect to the common practice	As an agronomist I want to monitor fields of my growers so that I can support them better.
	SHOULD	Policy maker	3; 4; 1	Sufficient number of weather points in representative areas to cover the regional situation; well performing prediction models	As a policy maker I want monitor insects and diseases risk to check if pest products sold in the region are aligned with requests so that I can check if chemical pressure is excessively high or in line with year requests
	SHOULD	Policy maker	1; 3; 4	Sufficient number of weather points in representative areas to cover the regional situation; well performing prediction models	As a public authority I want to monitor earth maps and connected vegetation indexes to check crop health level (on nitrogen, diseases, insects and water status) so that I can promptly activate funds/damage compensations.

	SHOULD	farmer	1; 6; 3	Well performing models, tested and validated	As a farmer I want to create maps to fertilize my wheat fields in the optimal stage so that I can exploit satellite images and DSS potentiality
	SHOULD	farmer	8; 7	Well performing models, tested and validated	As a farmer I want to predict quality (protein, test weight, etc.) so the I can identify in advance the product class of my food product.
	COULD	insurance company	7; 8; 9	Well performing models, tested and validated; scalability of the model in wide geographical areas	As a insurance company I want use DSS as a oracle, so that I can develop parametric insurances.
	COULD	policy maker	5	Reliable register of crop operation; calculation of sustainability indicators	As a policy maker I want monitor crop activities carried out on field by farmers, so that I can assess environmental impacts coming from fuel, fertilizers, chemicals, etc.

Table 25 List of requirements and their time-related prioritization for Crop Management - Horta SubRIL

Nr	Requirements	priority in time
1	Improved EO data (spatial resolution; temporal resolution; frequency; price; types and format)	WITHIN 1 YEAR
2	Soil characteristics (soil texture, organic carbon content)	WITHIN 2 YEARS
3	Crop type, phenological stage, evapotranspiration and soil moisture	WITHIN 6 MONTHS
4	Users must connect to the crop unit a close weather stations to collect weather parameters (main model input stream)	WITHIN 6 MONTHS
5	Improvement of calculation in the 3 pillars is needed	WITHIN 1 YEAR
6	Improve fertilisation advice	WITHIN 1 YEAR
7	Improvement of crop yield prediction	WITHIN 2 YEARS
8	Add other crop quality parameters	WITHIN 3 YEARS
9	Improvement of water soil content and plant stress	WITHIN 1 YEAR

4.1.2 NP SubRIL

Table 26. Backlog for Crop Management - NP SubRIL containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of non-functional requirements (corresponding numbers described in Table 27)	Acceptance criteria	User story
Crop Management - NP	MUST	farmer	4; 2	The farmer can easily add in the API (Comp.4) information about the cultivation practices of these parcels and produce summaries. Information about irrigation schedule and soil properties can be easily available (Comp.2).	As a farmer I want to have a user-friendly application to register my cultivation practices (Farm book) so that I can get summaries from my records/logs.
	MUST	farmer	2; 3; 1	Through estimates of the available soil moisture, soil properties (Comp.2), detection of pesticides (Comp.1) and vegetation health (Comp.3) aggregates about resource usage can be produced.	As a farmer I want to see aggregates from neighbour farmers so that I can be informed if I am using more or less resources (water, fertilization, pesticide).
	MUST	policy maker	4; 1; 5	Based on data collected through farmers calendar's (Comp.4), detection of pesticide usage (Comp.1) and assimilations (Comp.5), reports can be produced.	As a policy maker I want to report at monthly/yearly basis the use of pesticide so that with the data collected to be able to monitor the implementation of sustainability related CAP policies.
	SHOULD	policy maker	4; 1	Based on data collected through farmers calendars (Comp.4) and detection of specific pesticides use (Comp.1) reports are produced.	As a policy maker I want to know the use of specific pesticides/ fertilization (yearly/monthly) in AoI so that to be able to report the information to the Environmental Authority.
	SHOULD	agronomist	4; 2; 1; 5	Based on data collected through farmers calendars (Comp.4), soil moisture estimates (Comp.2),	As an agronomist I want to have a general idea of what agricultural practices take place at a regional level so as to better consult also the client-farmers that i supervise.

				detection of pesticides use (Comp.1) and aggregation methods (Comp.5) , reports can be produced.	
	COULD	farmer	4; 2	The farmer can easily produce monthly comparative summaries from the information added in the API about cultivation practices (Comp.4) and information about irrigation and soil moisture of parcels from Gaiatron stations (Comp.2).	As a farmer I want to get monthly summaries based on my registered practices so that I can compare with data from previous years.
	COULD	agronomist	4; 1	Through farmers' calendar information (Comp.4) and pesticide detection data (Comp.1), aggregates can be produced regarding pesticide use.	As an agronomist/advisor I want to have an application to be able to choose specific parcels so as to see aggregates for pesticide use.

Table 27. List of requirements and their time-related prioritization for Crop Management - NP SubRIL

Nr	Requirements	priority in time
1	Detect active components	WITHIN 2 YEARS
2	DHI: providing soil moisture, Actual evapotranspiration – ETa, irrigation schedule, soil properties, based on Neuropublic's in-situ Gaiatron station	WITHIN 1 YEAR
3	EGM & OHB: Super-resolution EO-based data	WITHIN 3 YEAR
4	Use of existing NP's technology storing Farm Book data	WITHIN 1 YEAR
5	LUKE: Usage and integration of Digital Twin	WITHIN 3 YEARS

4.1.3 WODR-PSNC SubRIL

Table 28. Backlog for Crop Management – WODR-PSNC SubR Lab containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of necessary non-functional requirements (corresponding numbers described in Table 29)	Acceptance criteria	User story
Crop Management - WODR + PSNC	MUST	farmer	11	working interface / application	As farmer I like to have information about risk of pests from recognized institution to prove the treatments in formal way to minimise risk of penalties and withdrawal of funds
	MUST	farmer	6	working notification channel	As a farmer I want to receive notification about the appearance of pests in my fields to my smartphone (SMS, push notification) as soon as possible as a early detection of th risk
	MUST	advisor	1,2,3,6	working notification channel	As an Advisor I want to receive a notification about an increased risk of an agrophage in my area so that I can do more extensive monitoring and notify more farmers
	MUST	farmer	6	working notification channel	As a farmer I want to have notification about possible pest on my fields so I can make a optimise decision to protect my cultivations best as I can
	MUST	farmer		clarify information	As farmer I would like to reduce costs of usage of protective means by accurate usage when its economic justification of pests level risk
	MUST	advisor	1,2,6	beta-test application	As a advisor who make field observation I want to have simple and user friendly application for data collection so I can take a minimum time to technical work and focus on a observations / pest detections
	MUST	farmer	6	working notification channel	As a farmer I want to receive highest quality of pest notification so I can trust the system and make better decisions in plant protection
	MUST	advisor	6	working notification channel	As a system developers and crop protection specialists we want to be notified of the results of observations that resulted from the indication of the DSS in order to perform ongoing validation

	MUST	advisor	1,2,6	beta-test application	As an agricultural advisor I want to have information about potential agrophage occurrence on specific fields so that I could be able to optimize timing in terms of field vetting
	MUST	advisor	2,6	working notification channel	As a advisor of my farmers group I want to receive information about risks of pest in my region so I can advise my famers to start and manage plant protection
	MUST	advisor	1,2,6	working notification channel	As a coordinator I want to receive notifications of increased risk of an agrophage in the region, so that I can notify advisors to do the work or to check if the work was done properly
	SHOULD	advisor	1,2,6	beta-test application with regional data - tables or maps	As a coordinator of monitoring of agrophages system I want to know the potential risk of agrophages at the regional level at a certain time so that I would be able to properly select the people who will take care of the observations in a particular area
	SHOULD	farmer	2,6	beta-test application with regional data - tables or maps	As a farmer I want to receive the most accurate information about the appearance of pests in my fields in the application in which I keep field cards (preferably in the form of notifications) so that would allow me to apply crop protection treatments in a timely manner and save time on field vetting
	SHOULD	advisor	6	working notification channel	As an Advisor I want to receive a notification about an increased risk of an agrophage in my area so that I can do more extensive monitoring and notify more farmers
	SHOULD	advisor	1,2,6	beta-test application-dedicated functionality	As a manager of agriculture advisory centre I want to have a system that manage the observation of pest so I can optimise the human resources for that task and make more and increase quality of the data from the observation network
	SHOULD	policy maker	6	beta-test application with regional data - tables or maps	As a policy maker / Plant protection specialist I want to know what agrophages are confirmed most often so that I can increase the number of people monitoring crops where selected agrophages may occur in the future
	SHOULD	advisor	1,2,6	working notification channel and application functionality	As a advisor I want to receive information about risk pest in my region so that I can observe the pest / plants that have highest risk and observe more at the same time

	COULD	farmer	1,2,6	working interface / application	As a gardener I want to receive an information about pest to my unique plant (not standard plants, not being cultivated at all regions) now not observed so I can do the best pest management
	COULD	policy maker	6	beta-test application with dedicated functionality	As a policy maker I want to know statistical data on DSS indications compared with confirmed by advisors occurrences of agrophages so that I can plan budget for agrophages monitoring better
	COULD	advisor	1,2,6	number of data, minimum 3 sources	As a advisor I want to have access to many data as it possible so I can make better decision to help farmers and other way to make more and better field observations
	COULD	policy maker	6	beta-test application with dedicated functionality	As a manager in decision makers / ministry of agriculture I want to have a system that manage the observation of pest so I can optimise the public founds usage in that task
	COULD	policy maker	11	beta-test application with dedicated functionality	As a policy maker I want to implement the tools to minimize chemical treatments in agriculture and have access to statistics to implement EU green deal policy and extend KPI measurement
	COULD	policy maker	11	beta-test application with dedicated functionality	As a policy maker I want to have best ecological standards being applied by farmers (better to goals)

Table 29. List of requirements and their time-related prioritization for Crop Management - WODR-PSNC SubRIL

Nr	Requirements	Priority in time
1	precipitation data with high resolution (case will be derscribed)	WITHIN 1 YEAR
2	EO data (e.g. ndvi) from the fields where observations are made in order to be able to correlate pest mathematical model data and EO data in order to be able to indicate risk more quicky and efficiently	WITHIN 6 MONTHS
3	feedback to validate final data	WITHIN 1 YEAR
4	management of common time slots	WITHIN 6 MONTHS
5	datahub	WITHIN 1 YEAR
6	combining tools (all data source captured with values?)	WITHIN 2 YEAR
7	Algorithms for inference and DSS	WITHIN 1 YEAR
8	Advance processed data visualization	WITHIN 1 YEAR

9	not automated pest recognition	WITHIN 1 YEAR
10	spot-on only regarding historical pest densities	WITHIN 1 YEARS

4.2 Dairy RIL backlog

Table 30. Backlog for Dairy RIL containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of non-functional requirements (corresponding nrs. described in Table 31)	Acceptance criteria	User story
Dairy	MUST	dairy processing company	4, 5, 7, 9, 10, 11	Prediction is available in real time	As a dairy company, I want to be able to get predictions of milk quality and milk quantity for the next production cycle (next collection run) or in best case for a customized period of time
	MUST	service Application Provider	7, 8	Service availability and access can be customised	As a service application provider, I want to have access to aggregated data
	SHOULD	dairy processing company	1, 2, 3, 4, 5, 9	The forecasted milk quality & quantity correlates to the actual measurements from deliveries	As dairy company, we want to understand expected milk quality and quantity to improve process planning and control in our dairy processing factories.
	SHOULD	dairy processing company	5, 7, 8, 9, 11	Dashboard provides overview of the requested KPIs with regular updates	As a dairy company, I want to have a dashboard displaying relevant data and insights
	SHOULD	dairy processing company	4, 5, 7, 8, 10, 11	At least successful white box test of API	As a dairy company, I want to use an API to share data with other internal systems
	SHOULD	dairy processing company	4, 5, 6, 7, 8, 9, 10, 11	The forecasted milk quality & quantity correlates to the actual measurements from deliveries	As a dairy company, I want to be informed if predictions of milk quality/quantity deviate from expectations based on historical data, so that I can adjust my production planning accordingly.
	SHOULD	dairy processing company	7, 8	Guaranteed service availability checked, user-acceptance test successful	As a user, I want the service to provide good quality in terms of ease of use, information, security and interoperability
	SHOULD	dairy processing company	4, 5, 6, 7, 8, 9, 10, 11	Positive correlation can be identified	As a dairy company, I want to analyse data to identify relevant connections between my production process and farm data

	SHOULD	farmer	7, 8	The access rights can be defined	As a user, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data
	SHOULD	farmer	7, 8, 10	Guaranteed service availability checked, user-acceptance test successful	As a user, I want the service to provide good quality in terms of ease of use, information, security and interoperability
	SHOULD	service Application Provider	10, 11	Service availability and access can be customised	As a software provider, I want to optimize my revenue by distributing relevant services within my ecosystem
	SHOULD	service Application Provider	4, 5, 6	Response time corresponds to defined thresholds	As a system/application provider, we need the performance of the system to be fast, to enable quick testing
	SHOULD	service Application Provider	4, 5	API integrated	As a service application provider, I want to use an API to connect the app to my ecosystem
	SHOULD	service Application Provider	4, 5	Demo system available, having no impact on operational data	As a service application provider, I want to have a demo system to show relevant features
	COULD	dairy processing company	7, 8, 9	Available pdf	As a dairy company, I want to export reports, e.g. as PDF/Excel
	COULD	dairy processing company	7, 8, 9	The forecasted milk quality & quantity correlates to the actual measurements from deliveries	As a dairy company, I want to use Insights provided by the application to adapt my process parameters
	COULD	dairy processing company	9, 10, 11	Potential correlation identified	As a dairy company, I want to support associated farmers in optimizing their feeding process and composition
	COULD	farmer	10, 11	Data granularity can be broken down to farm level	As a farmer, I want to optimize my process based on given data
	COULD	farmer	10, 11	Data granularity can be broken down to farm level	As a farmer I want to receive information customized to my farm and farm practices so that I can tailor my management strategies to the unique needs of my farm and maximize the potential of my farm
	COULD	farmer	10, 11	Data granularity can be broken down to farm level	As a farmer, I want to have insights about how to optimize the feeding process

	COULD	farmer	7, 8, 9, 10, 11	Data granularity can be broken down to farm level	As a dairy farmer, I want to be able to compare my productivity with industry benchmarks and other farms in my area so that I can identify areas for improvement and make data-driven decisions to stay competitive in the market.
	COULD	service Application Provider	7, 8, 9, 10	Relevant KPIs are identified, required data is collected and KPIs are being reported	As a service application provider, I want to monitor relevant data that is helpful for the user to improve my application
	COULD	service Application Provider	9, 10, 11	Application can be extended with additional parameters	As a service application provider, I want to integrate additional data to improve my application

Table 31. List of requirements and their time-related prioritization for Dairy RIL

Nr	Requirements	Priority in time after start of task T5.2
1	Regular EO data, either daily or at least weekly	WITHIN 1 YEAR
2	Timestamp and geolocation	WITHIN 6 MONTHS
3	Recognizable/common format for each data source	WITHIN 1 YEAR
4	Standardized interface (API) for automatic data ingestion	WITHIN 1 YEAR
5	Metadata	WITHIN 6 MONTHS
6	Data processing optimization (e.g. chunking/tiling, parallel-computing)	WITHIN 2 YEARS
7	Data access	WITHIN 6 MONTHS
8	Harmonized data	WITHIN 1 YEAR
9	Quality indicators	WITHIN 1 YEAR
10	Metadata	WITHIN 1 YEAR
11	Licensing	WITHIN 2 YEARS

4.3 Grasslands RIL backlog

Table 32. Backlog for Grasslands RIL containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of necessary non-functional requirements (corresponding nrs. described in Table 33)	Acceptance criteria	User story
Grasslands	MUST	farmer	1, 2, 3, 4, 8, 9, 13	Drought index available not later than the first week of December of the insurance year	As a farmers' association I need to receive the drought index relative to the present growing season as soon as possible in order to estimate damages and the relative insurance payments in time
	MUST	farmer			As a farmers' association I need to regularly access grasslands production maps to provide management advisory services to farmers
	SHOULD	insurance company	1, 3, 4, 7, 9, 13	In situ yield data must be collected. The correlation between yield and the biophysical parameter used for the calculation of the drought index must be high (r > 0.7 at parcel level)	As an insurance company I would like to see a validation of the drought index that is used to estimate the damages to ensure that the index is representative of yield (Alps)
	SHOULD	farmer	8	The final product has to be integrated in existing platforms/web GIS/other system which can be accesses by the interested used upon registration	As a farmer I want to see the results as a map and be able to select and compare current productivity levels with historical productivity levels
	SHOULD	farmer	13	A continuous dialogue has to be held with farmer association to include their	As a user I want to provide suggestions of improvements of the product/ models/... so the tool can work better to the future

				suggestions and knowledge in the design of the lab output	
	COULD	farmer	8	The final product has to be integrated in existing platforms/web GIS/other system which can be accesses by the interested used upon registration	As a farmer I want to see the results as a map and I want to click on a field and receive a box containing all relevant detailed information/ metadata/ values/ predictions
	COULD	farmer	13, 15	The farmer associations have to contribute to the definition of the expected format of the lab output	As a farmer, I want to receive the information in a standardized way, so that I can compare with other farms or policy regulations
	COULD	policy maker	13, 15	The lab aims to generate a satellite-based biophysical parameters and biomass/biomass variation product at the parcel scale. Comparable large-scale products have to be identified to put the results of the lab in a wider context and compare the results at different scales. Policy makers have to be informed of the available products at the different spatial scales of interest.	As a policy maker I want to able to monitor drought stress on a larger scale (field, farm, regional or national scale)
	COULD	farmer	13	The farmer associations have to provide standardized identifiers of the farms and parcels	As a farmer, I want to link my official farm-id to the registration flow, so that everything is linked and standardized

Table 33. List of requirements and their time-related prioritization for Grasslands RIL

Nr	Requirements	Priority in time
1	Improved cloud masking on optical EO data	WITHIN 1 YEAR
2	Timeliness and easy access to optical and radar EO data with compatible formats and geolocalization	WITHIN 1 YEAR
3	Historical data would be useful	WITHIN 1 YEAR
4	At least weekly data of around 10-20 meters	WITHIN 2 YEARS
5	Own data of lab, no technology component needed to collect	WITHIN 2 YEARS
6	Own data of lab, used at alter stage in project, no technology component needed to collect	
7	Farmers association will mediate with some farmers to give us access to their fields to perform ground measurements	WITHIN 1 YEAR
8	Standardize access to data	WITHIN 2 YEARS
9	Improve temporal frequency of sentinel data using data fusion with radar data	WITHIN 2 YEARS
10	Possible to validate EO data with moisture probes and flux towers	WITHIN 2 YEARS
11	Need for larger data set with points to train AI model	WITHIN 2 YEARS
12	Get consent of farmers to use data	WITHIN 2 YEARS
13	Farmers association will contribute to the definition of some details of the procedure to calculate drought index	WITHIN 2 YEARS
15	Integrated products/services with tools currently used by farmers in their daily activities	

4.4 Soil RIL backlog

Table 34 Backlog for Soil RIL containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of necessary non-functional requirements (corresponding nrs. described in Table 35)	Acceptance criteria	User story
Soil Health	MUST	farmer	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16 21, 22, 26, 27	The R2 should be above 0.7 and RPD above 2	As a farmer, I want the accuracy of the models to be as high as possible, so that I can minimize drought problems as much as possible
	MUST	farmer	17, 19, 20	Provide information once in interface and run service 10 times afterwards without having to provide information again	As a farmer, I want to provide my management, crops, soil type ... farm relevant information 1 time and that it is stored and used for the future runs
	MUST	SME Agricultural Company/policy maker	16, 20, 27, 28	The product is integrated in different applications, in the project we will use DjustConnect (Belgium) and Open Geoserver (Greece)	As an organization (Pa), we need to be able to integrate services in our own applications.
	MUST	farmer	20	In Belgium I am able to log into the application with ITSME and see my SOC predictions, only for my fields and not the fields of another farmer	As a farmer, I want to link my official farm-id to the registration flow, so that everything is linked and standardized
	MUST	farmer	20	With 1 click I can log in to the application and see the SOC prediction of a first field within 10sec	As a farmer, I want to log-in with 1 click so the login goes as fast as possible
	MUST	farmer	20, 26	Data products and services are compliant and ensure transparency and security in the context of intellectual property and GDPR (one-demand request)	As a user, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data

	MUST	SME Agricultural Company/policy maker	20	With 1 click I can log in to the application and see the SOC prediction of a first field within 10sec	As an organization (Pa), we need the performance of the system to be fast, to enable quick testing
	MUST	farmer	20, 28, 29	Without any extra help I can find the SOC prediction for my field and not that of another farmer	As a user, I want the service to be highly qualitative in terms of ease of use, security and interoperability
	SHOULD	farmer	20	I can perform the whole registration flow using my official farm-id, in Belgium being ITSME	As a farmer, I want to have to provide the minimal possible data, so that I am not annoyed during the registration
	SHOULD	policy maker	1, 2, 3, 4, 5, 6, 16, 19, 20, 22	I can find a SOC prediction map of both Flanders (Belgium) and Central Macedonia (Greece) and zoom in to parcel level SOC predictions	As a policy maker I want to able to monitor SOC predictions on a larger scale (field, farm, regional or national scale)
	COULD	farmer	16, 17, 19, 20, 27, 29	The SOC predictions of my fields are visualized in an understandable map and when I click on a field, I see the exact SOC prediction and the field geolocation information	As a farmer, I want to see the results as a map and I want to click on a field and receive a box containing all relevant detailed information/ metadata/ values/ predictions
	COULD	researcher	20	While developing the service, when I click on a pixel of a parcel, I can see the uncertainty of the prediction as a value or we have a separate regional SOC map where the pixel colours represent the uncertainty of the predictions	As a researcher, I want to also visualize the uncertainty of the models' prediction in the maps, so that I can be sure where a model is not certain in its estimations

Table 35 List of requirements and their time-related prioritization for Soil RI Lab

Nr	Requirements	Priority in time
1	Kuva's Hyperfield next generation?	WITHIN 2 YEARS
2	Kuva's Hyperfield-1	WITHIN 2 YEARS
3	Copernicus Sentinel-2	WITHIN 6 MONTHS
4	EO temporal resolution should enable the generation of cloud-free bare soil mosaics	WITHIN 6 MONTHS

5	We use sentinel 2 data from google earth engine as data source	WITHIN 6 MONTHS
6	Spectral resolution of sensors should cover (partially or wholly) the 350 to 2500 nm range	WITHIN 6 MONTHS
7	Do the edge processors have to be autonomous in energy keeping (batteries, solar panels or plug in existing energy source)	WITHIN 1 YEAR
8	Communication between sensing devices and edge processors. How much sensors to be plugged on the edge processing platform?	WITHIN 1 YEAR
9	Data standardisation	WITHIN 1 YEAR
10	Data outlier detection	WITHIN 1 YEAR
11	Data quality assessments (e.g., reflectance with 0-100%)	WITHIN 1 YEAR
12	Other technical specifications	WITHIN 1 YEAR
14	Use of LUCAS topsoil dataset	WITHIN 6 MONTHS
15	Access to catalogue services allowing the evaluation of product characteristics	WITHIN 2 YEARS
16	Spatial resolution of end-products should be high enough to provide field-scale estimations	WITHIN 6 MONTHS
17	Selection of measurement and data storage protocols	WITHIN 1 YEAR
18	Open data (libraries, raw data, etc)	WITHIN 1 YEAR
19	Data platform geo-localised and timestamped data storage and queries	WITHIN 6 MONTHS
20	Interoperability/Standardised	WITHIN 1 YEAR
21	Generation of bare soil composites from multi-temporal data	WITHIN 1 YEAR
22	Data processing platform should have GPU to enable fast model training and enough storage for the generation of large scale maps	WITHIN 1 YEAR
23	Edge computing some minor use cases, but not operational	WITHIN 1 YEAR
25	Edge computing, existing ML will run on edge processor	WITHIN 2 YEARS
26	Federated AI with TensorFlow model also using satellite datasets available on google earth engine	WITHIN 6 MONTHS

27	Definition of soil quality indicator	WITHIN 6 MONTHS
28	Integrate results within other existing decision-making processes	WITHIN 3 YEARS
29	Training of the user to understand the results	WITHIN 3 YEARS

4.5 Water RIL backlog

Table 36. Backlog for Water RIL containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of non-functional requirements (corresponding nrs. described in Table 37)	Acceptance criteria	User story
Water	MUST	farmers	1	Login or data request/approval is required	As a user, I don't want my data to be shared with others or uploaded to a central platform for processing as it is private and sensitive data
	MUST	farmers	5, 11, 14, 18	Status and prediction update at least once a day	As a farmer, I want to receive information clearly and understandably reported, so that I can perform more targeted and accurate smart farming practices
	MUST	farmers	5, 11, 14, 17, 18	Prediction update at least once per day; acceptable service cost should be discussed	As a farmer I want to have affordable early prediction services
	MUST	farmers	5, 11, 14, 17, 18	Status and prediction update at least once a day on a field level	As a farmer, I want to receive information customized to my farm and farm practices, so that I can tailor my drought management strategies to the unique needs of my farm and maximize the potential of my crops
	MUST	farmers	1, 2, 3, 4, 5, 6, 12, 13, 14	TBD with the farmer	As a farmer, I want clear instructions on what data I need to provide and in what format and how often. So that process will be more clear and less complicated
	MUST	farmers	10, 16, 17, 18	Status and prediction update at least once a day on a field level; zoom in option to view parameter distribution within the field	As a farmer, I want to see the results as a map and be able to zoom in for further details, so that I can better estimate the current situation
	MUST	farmers	5, 11, 14, 18	Status and prediction update at least once a day	As a farmer, I want to have updated information daily basis, so that I can adapt I can plan my activities for tomorrow and adapt the situation

	MUST	farmers	17	TBD with the farmer; agile development with several iterations; on-demand service-assistance	As a farmer I want to be able to use and understand this service easily and without help.
	MUST	farmers/advisor	12, 13, 14, 15, 18	TBD with the farmer; on-demand service-assistance	As a farmer/ advisor, I want the accuracy of the models to be as high as possible, so that I can minimize drought problems as much as possible
	MUST	farmers	17, 18	Status and prediction update at least once a day	As a farmer I want information on optimal irrigation regime to have optimal yield
	MUST	farmers	17, 18	Status and prediction update at least once a day, possibility to inspect different fields	As a farmer, I would like to understand and see the current status not only for one field, but also for my other fields so that I can make more effective planning
	MUST	farmers	17, 18	TBD with the user; on-demand service-assistance	As a user, I want the service to be of a high standard in terms of ease of use, information, security and interoperability
	MUST	farmers	17, 18	Status and prediction update at least once a day on a field level	As a farmer I would like to have the information on a parcel level
	MUST	farmers	17, 18	TBD with the farmer; on-demand service-assistance	As a farmer/ agri company I want a service that can support me on early prediction with a good accuracy
	MUST	farmers	5, 11, 14, 17, 18	Prediction update at least once per day; acceptable service cost should be discussed	As a farmer I don't want to use lots of sensors to get information for larger area so that I don't have to spend lots of time effort and money on sensors
	MUST	farmers	17, 18	TBD with the farmer; on-demand service-assistance	As a farmer, I want to receive the information in a standardized way, so that I can compare with other farms or policy regulations
	SHOULD	farmers	17, 18	The result is displayed on the map	As a user, I want the tool to provide the outcomes fast, so I have a good user experience (also when changing one of the parameters in the map)
	SHOULD	farmers	17, 18	Possibility to view data on the platform	As a farmer, I want to see the results as a map and I want to click on a field and receive a box containing all relevant detailed information/ metadata/ values/ predictions
	SHOULD	farmers	17, 18	Possibility to view data on the platform	As a farmer, I want to be able to select and see the data from a specific sensor for a specific plot so that I can make better planning
	SHOULD	farmers	17, 18	Possibility to view data on the platform	As a farmer, I want to receive the information in a convenient form, so that it fits in the water management strategies applicable

					at my farm: irrigation schedules, adjust planting dates, select drought-resistant crops, applying mulch or reducing tillage
	SHOULD	farmers	1, 17, 18	Possibility to download data from the platform	As a farmer, I want to be able to download my personal data, farm data, … so that I can have an overview of what the tool is using
	SHOULD	farmers	1, 17, 18	Previously uploaded data is stored and is accessible	As a farmer, I want information I have already provided to automatically be used during future applications, so that I don't have to do keep on providing the same information for each new run
	SHOULD	farmers	17, 18	Status and prediction update at least once a day	As a farmer, I want to receive guidance regarding the best practices I can take to mitigate the drought stress so that the actions have a maximum benefit for my crops
	SHOULD	farmers	17, 18	Status and prediction update at least once a day, suggestions on irrigation regime	As a farmer, I want information, suggestion on the optimal irrigation regime for each season and plant.
	SHOULD	farmers	17, 18	Possibility to view data on the platform	As a farmer, I want to see the results as a map and be able to select and compare current drought levels with historical drought levels, so that I can better estimate the current situation
	COULD	advisor	1, 17, 18	Previously uploaded data is stored and is accessible	As a controller, I would like to see information on soil characteristics and past agricultural practices
	COULD	farmers	17, 18	Status and prediction update at least once a day, suggestions on irrigation regime	As a farmer, I want to see updated information regarding water resources and levels applicable to my farm/fields, so I can make better decisions regarding irrigation and other management activities
	COULD	farmers	17, 18	Status and prediction update at least once a day, suggestions on irrigation regime	As a farmer, I want to receive an alert when the drought stress goes above a certain threshold for my fields, so that I can take immediate actions
	COULD	farmers	17, 18	Status and prediction update at least once a day, suggestions on irrigation regime	As a user, I want to provide suggestions in improving the product/ models/…, so the tool can work better to the future

Table 37. List of requirements and their time-related prioritization for Water RIL

Nr	Requirements	Priority in time
1	Farmers need to give consent to use their data	WITHIN 6 MONTHS
2	What is the data availability of the data components	WITHIN 6 MONTHS
3	Water usage as farm management	WITHIN 3 YEARS
4	Data types for acquisition	WITHIN 6 MONTHS
5	Real-time data needed for digital twin, daily data	WITHIN 2 YEARS
6	Size of fields	WITHIN 6 MONTHS
7	Iterations in experiments	WITHIN 3 YEARS
8	Comparability of data and models from two regions	WITHIN 3 YEARS
9	Processing environment to run models	WITHIN 1 YEAR
10	Help with demonstrating digital twin + using a interface/ platform	WITHIN 2 YEARS
11	For digital twin important to work with near real-time data	WITHIN 3 YEARS
12	Input of required data through API with agreed data model	WITHIN 2 YEARS
13	Management data when there are changes	WITHIN 3 YEARS
14	Weather and EO data (phenology, biomass etc.) daily if possible.	WITHIN 1 YEAR
15	Description of the data models and processing environment used	WITHIN 1 YEAR
16	Getting from data products to digital twin	WITHIN 2 YEARS
17	Understanding user interface needs from discussions with farmers	WITHIN 1 YEAR
18	Daily update of the crop status (e.g. health, potential yield)	WITHIN 2 YEARS

4.6 Yield Monitoring RIL backlog

Table 38. Backlog for Yield Monitoring RIL containing prioritization acceptance criteria of user stories and (non-) functional requirements linked to the user story

RIL	Priority	Stakeholder	List of non-functional requirements (corresponding nrs. described in Table 39)	Acceptance criteria	User story
Yield Monitoring	MUST	farmer	1,2,3,5,6,7,8,9,10,14,15	Products available in FMIS/other tool	Insights in field overview & yield potential
	MUST	farmer	1,2,3,5,6,7,8,9,10,14,15	Products available in FMIS/other tool	Advice for farmers (e.g., VRA maps)
	MUST	farmer	1,3,5,6,7,8,9,14,15	Products available in FMIS/other tool	As a farmer I would like to get up-to-date info about growing conditions in my fields in a concise and easily accessible form
	MUST	farmer	1,2,4,5,	Products available via API	improved yield maps (e.g., gap filled, corrected for soil)
	MUST	farmer	1,2,3,5,6,7,8,9,10,14,15	Products available in FMIS/other tool	As a farmer, I want to have a VRA (variable rate application) map generation for fertilization on my fields
	MUST	advisor	1,2,3,4,5,15	Products available via API	Raw Data to base advice upon
	MUST	advisor	14,15	Products available via API	Easy Access to data
	MUST	advisor	1,2,3,4,5,14,15	Products available via API	As a machine construction company I want to have "extra" data to finetune my machine measurements (e.g. adapt yield monitoring system with an improved terra estimation parameter per field)
	MUST	policy maker	1,10,11,13,14	Products available via API	yield estimates at regional level for decision-making
	MUST	policy maker	1,10,11,13,14	Products available via API	As a public authority I want to receive yield estimates for my region of interest (local, country, European level) so that I can take action if needed (e.g. to react on drought related yield losses - import/export related actions can be taken)

	MUST	policy maker	1	Data agreement in place	As a public authority I want to have access to data in a "controlled" way (meaning owner of the data should give his consent)
	SHOULD	farmer	1,2,3,5,6,7,8,9,10,14,15	Products available in FMIS/other tool	As a farmer I would like to get yield prediction during the growing season. Is this possible?
	SHOULD	farmer	15	Products available in FMIS/other tool	As a farmer I want to have a tool to insert my fields for a certain season so that I can have an overview during the growing season of the yield potential (on regular moments)
	SHOULD	farmer	15	Products available in FMIS/other tool	As a farmer I want to have a tool to insert my fields for a certain season so that I can have an overview during the growing season of the yield potential (on regular moments)
	SHOULD	farmer	14	Products available via API	As an advisor I want to be able to "download" the raw field data (all possible sensor points) in my own tool to do further deep analysis. Download can be via excel or most sophisticated API.
	SHOULD	farmer	15	Products available in FMIS/other tool	As a farmer I would like to get the information of my crops in standardized format, so that I can compare with earlier years, or against policy regulations
	SHOULD	farmer	15	Products available in FMIS/other tool	As a farmer, if I have a FMIS (farm management information system) or other tool, I want to be able to digitally "link" my current FMIS & the ScaleAgData solution envisioned, avoiding double entry and errors
	SHOULD	farmer	15	Products available in FMIS/other tool	As a farmer, I want to have a "place" to input manual data to be combined with other data algorithms (using existing available digital data on his fields)
	SHOULD	advisor	1,10,11,13,14	Products available via API	As an European Commission I want to have an overview of all potato fields in Europe with a clear indication of the growing state and yield potential
	SHOULD	service providers	15	Products available in FMIS/other tool	Data sharing with FMIS in both directions to avoid double and manual entries
	SHOULD	insurance sector	10,11,12	Products available via API	(field level) yield estimates for damage assessment
	SHOULD	insurance sector	10,11	Products available via API	Regional Risk analysis (historical)

	SHOULD	insurance sector	1,2,14	Products available via API	As an insurance company (loss adjuster) I want to get access to yield maps for the field for which I received a damage claim from a farmer so that I can check if damage occurred, to quantify the damage, request additional info from the farmer, and then decide about the pay-out to the farmer
	SHOULD	insurance sector	1,10,14	Products available via API	As an insurance company I want to use yield estimates of previous years to assess the (historical) risk of insuring certain fields / areas so that I can adapt premiums accordingly for those customers/regions
	SHOULD	insurance sector	1,2	Products available via API	As an insurance company I want to get yield maps for fields with damage claims to check if or where damage occurs
	COULD	farmer	1	Products available in FMIS/other tool	Compare with other fields close by (benchmarking)
	COULD	farmer		Products manual available	As a farmer, I would like to know what I am expected to do in order to get the services available (amount of work needed etc.)
	COULD	farmer	15	Products available in FMIS/other tool	As a user I want the service to be versatile so that I can easily tailor the user I/F for my specific needs (e.g. the data that I want to share, or the info that I want to receive)
	COULD	farmer	15	Products available in FMIS/other tool	As a farmer, I want to retrieve field-based data from my own FMIS, so that I can save time and don't need to do error-prone manual entry.
	COULD	advisor	15	Products available in FMIS/other tool	As an advisor I would like to have an information sharing layer, where I can send targeted messages to individual farmers
	COULD	advisor	1,2,3,5,6,7,8,9,10,14,15	Products available in FMIS/other tool	As a potato processing company, I want to have a daily view on the potato yield which will become available after harvesting
	COULD	policy maker	1,10,11,13,14	Products available via API	Monitoring EU food production for food security (cfr. MARSOP)
	COULD	agricultural value chain actors	1,14	Products available via API	Data sharing with processing companies to optimise processes end-to-end
	COULD	agricultural value chain actors	9,10	Products available via API	Insight in yield potential increase to deal with higher product demand

Table 39. List of requirements and their time-related prioritization for Yield Monitoring RIL

Nr	Requirements	Priority in time
1	Permission from farmers to use the data	WITHIN 6 MONTHS
2	Yield data from harvesters accessible via APIs, in standardized format	WITHIN 1 YEAR
3	Weather data - daily if possible	WITHIN 1 YEAR
4	Cameras on harvester for terra estimation (incl. hyperspectral camera)	WITHIN 2 YEARS
5	Satellite data (vegetation indices, biomass, soil moisture, ET) daily if possible	WITHIN 1 YEAR
6	Requirements for setting up Digital Twin: Cultivar, sowing date, fertilizer amount, soil map / sample data. Historical yield data needed to calibrate models	WITHIN 1 YEAR
7	Input of required data trough API with agreed data model (e.g. NGSI-LD) or FMIS specific APIs.	WITHIN 1 YEAR
8	Management data when there are changes.	WITHIN 1 YEAR
9	APSIM crop model, https://twinyields.github.io/	WITHIN 2 YEARS
10	ML-based yield models	WITHIN 2 YEARS
11	Methods for transfer learning	WITHIN 3 YEARS
12	Methods for continuous learning	WITHIN 3 YEARS
13	Yield upscaling methods (to regional level)	WITHIN 2 YEARS
14	API to make resulting products accessible	WITHIN 2 YEARS
15	Products can be accessed by and exchanged with existing tools / FMIS	WITHIN 2 YEARS

5 Rolling plan

5.1 Approach

The rolling plan is a tool integrated in the ScaleAgdata project with the purpose of "adapting the work to the most recent developments and innovations in the field of sensors and sensor data in the public and private domain".

The rolling plan will also be used to identify partners, research topics and technologies impacted by changes to the intended research activities, e.g. partner X would like to use a certain sensor in their research. In such cases the rolling plan will be used to identify all impacted parties. Taking the global project goals and available resources into account the requested change can be discussed and evaluated with all relevant/involved parties.

The rolling plan is a “living” document visualising and reporting the research activities (cfr. deployment scenarios and innovation areas) for the different research partners and technical providers. The work package leaders and project coordinator have, as a good practice, opted to review and evaluate the rolling plan regularly, 3-4 times per year, during the monthly scheduled ExBo-meetings.

5.2 Matrix

The rolling plan has been developed as a "contribution matrix", i.e. mapping the research partners of each RIL to the seven innovation topics of the project via their intended deployment scenario. In addition, we have added the technology providers that will collaborate with the research partners for these activities; using technology-provider-specific-colours, we have mapped the technology providers to the deployment scenario/innovation area they are involved in for the RIL.

This contribution matrix has been setup as an Excel sheet (Table 40 to Table 47, rolling_plan) that can easily be shared and used by all partners. By visualizing the individual and specific contributions/dependencies in a matrix, setting this up in an Excel sheet and subsequently adding filters in the excel sheet, we can easily filter to a certain research partner, technology provider, stakeholder, RIL or innovation area and identify the impacted partners, research topics, and technologies, facilitating consideration and assessment of requested changes with all relevant partners.

Table 40. Rolling plan for the Water RIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DHI	LUKE	VITO	RIL	1.1.3.3. Data sharing architecture and data governance	1.1.3.4. Satellite data augmentation	1.1.3.5. From data assimilation to service development
DHI	LUKE	VITO	Water - VRIES	Data sharing and model transferability between two distant regions (Latvia and Israel)	Combination of high spatial resolution data from airborne spectral/thermal imagers with available satellite data (e.g. Sentinel-2) to improve temporal resolution	Service prototype through the digital twin concept, combined with data fusion models from different data sources for early prediction and detection of drought caused stress in target crops
DHI	LUKE	VITO	Water - VRIES	/	Combination of high spatial resolution data from airborne spectral/thermal imagers with available satellite data (e.g. Sentinel-2) to improve temporal resolution	/
DHI	LUKE	VITO	Water - MIGAL	Data sharing and model transferability between two distant regions (Latvia and Israel)	Combination of high spatial resolution data from airborne spectral/thermal imagers with available satellite data (e.g. Sentinel-2) to improve temporal resolution	Service prototype through the digital twin concept, combined with data fusion models from different data sources for early prediction and detection of drought caused stress in target crops
DHI	LUKE	VITO	Water - MIGAL	/	Combination of high spatial resolution data from airborne spectral/thermal imagers with available satellite data (e.g. Sentinel-2) to improve temporal resolution	/

Table 41. Rolling plan for the Crop Management – NP SubRIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DHI	EGM	LUKE	RIL	1.1.3.1. Innovative sensor technology	1.1.3.3. Data sharing architecture and data governance	1.1.3.5. From data assimilation to service development	1.1.3.6. Privacy-preserving technology	1.1.3.7. Data integration methodologies
DHI	EGM	LUKE	Crop manage	A new sensor for automatic pesticides detection will	Create a mechanism and a governance plan for collecting the IoT and farm log data at the farm	Data assimilation and data fusion will be used to maximise the reach of its IoT network while	Create a mechanism and a governance plan for collecting the IoT and farm log data at the farm level	Data assimilation and data fusion will be used to maximise the reach of its IoT network while minimising the number of

			ment - NP	be used to collect data needed by Policy Makers to monitor CAP sustainability KPIs.	level and aggregating them at a regional level to support policy makers in making decisions.	minimising the number of sensors needed to support proper advice to farmers.	and aggregating them at a regional level to support policy makers in making decisions.	sensors needed to support proper advice to farmers.
DHI	EGM	LUKE	Crop management - NP	/	Create a mechanism and a governance plan for collecting the IoT and farm log data at the farm level and aggregating them at a regional level to support policy makers in making decisions.	/	Create a mechanism and a governance plan for collecting the IoT and farm log data at the farm level and aggregating them at a regional level to support policy makers in making decisions.	Data assimilation and data fusion will be used to maximise the reach of its IoT network while minimising the number of sensors needed to support proper advice to farmers.

Table 42. Rolling plan for the Crop Management – Horta SubRIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DHI	VITO	RIL	1.1.3.7. Data integration methodologies	
DHI	VITO	Crop management - Horta SRL	Combine weather and soil data from in situ sensors with Sentinel2 data for better crop monitoring and more precise input for the DSS .	Using advanced modelling techniques and based on the farm log, the DSS will calculate the sustainability KPIs of the farms for the selected operations, offering guidance and proof
DHI	VITO	Crop management - Horta SRL	Combine weather and soil data from in situ sensors with Sentinel2 data for better crop monitoring and more precise input for the DSS .	Using advanced modelling techniques and based on the farm log, the DSS will calculate the sustainability KPIs of the farms for the selected operations, offering guidance and proof

Table 43. Rolling plan for the Crop Management – WODR-PSNC SubRIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DHI	LUKE	VITO	OHB	RIL	1.1.3.2. Edge processing	1.1.3.3. Data sharing architecture and data governance	1.1.3.5. From data assimilation to service development	1.1.3.6. Privacy-preserving technology	1.1.3.7. Data integration methodologies
DHI	LUKE	VITO	OHB	Crop management	to a) estimate the probability of occurrence and	to enable early detection of pest infestation in given regions by	to enable early detection of pest infestation in given regions by	to enable early detection of pest infestation in given regions by	Combine data coming from phenological observation stations, weather stations, soil

				- WODR_PSNC	b) identify pests on the fields	integrating to a national Pest Signalling System	integrating to a national Pest Signalling System	integrating to a national Pest Signalling System	sensors and machinery, and implement the respective AI algorithms and data fusion/integration
DHI	LUKE	VITO	OHB	Crop management - WODR_PSNC	to a) estimate the probability of occurrence and b) identify pests on the fields	to enable early detection of pest infestation in given regions by integrating to a national Pest Signalling System	to enable early detection of pest infestation in given regions by integrating to a national Pest Signalling System	to enable early detection of pest infestation in given regions by integrating to a national Pest Signalling System	Combine data coming from phenological observation stations, weather stations, soil sensors and machinery, and implement the respective AI algorithms and data fusion/integration
DHI	LUKE	VITO	OHB	Crop management - WODR_PSNC	to a) estimate the probability of occurrence and b) identify pests on the fields	to enable early detection of pest infestation in given regions by integrating to a national Pest Signalling System	to enable early detection of pest infestation in given regions by integrating to a national Pest Signalling System	to enable early detection of pest infestation in given regions by integrating to a national Pest Signalling System	Combine data coming from phenological observation stations, weather stations, soil sensors and machinery, and implement the respective AI algorithms and data fusion/integration

Table 44. Rolling plan for the Yield Monitoring RIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DHI	EGM	LUKE	VTT	RIL	1.1.3.1. Innovative sensor technology	1.1.3.3. Data sharing architecture and data governance	1.1.3.5. From data assimilation to service development	1.1.3.6. Privacy-preserving technology	1.1.3.7. Data integration methodologies
DHI	EGM	LUKE	VTT	Yield monitoring - CNH	/	Enable the accessibility to harvester data through a data sharing architecture with a sound data governance plan	Turning yield variability data into essential information on where growth conditions were suboptimal, to the benefit of the farmers, using the Digital Twin concept from section	Privacy preserving AI-technologies will be used as the base model (Section 1.1.3.6), depending on the architecture that will be technically feasible	Setting up a flexible ML-based yield estimation model, capable of incorporating new yield information from the current growing season in order to (I) capture the specific growing conditions and impacts on the yield, and (ii) enable to account for regional differences in growth conditions
DHI	EGM	LUKE	VTT	Yield monitoring - AVR BVBA	Using hyperspectral camera to improve the terra estimate of potato harvest	Enable the accessibility to harvester data through a data sharing architecture with a sound data governance plan	Turning yield variability data into essential information on where growth conditions were suboptimal, to the benefit of the farmers, using the Digital Twin concept from section	Privacy preserving AI-technologies will be used as the base model (Section 1.1.3.6), depending on the architecture that will be technically feasible	Setting up a flexible ML-based yield estimation model, capable of incorporating new yield information from the current growing season in order to (I) capture the specific growing conditions and impacts on the yield, and (ii) enable to account for regional differences in growth conditions
DHI	EGM	LUKE	VTT	Yield monitoring - Ugent	Using hyperspectral camera to improve the terra estimate of potato harvest	Enable the accessibility to harvester data through a data sharing architecture with a sound data governance plan	Turning yield variability data into essential information on where growth conditions were suboptimal, to the benefit of the farmers, using the Digital Twin concept from section	Privacy preserving AI-technologies will be used as the base model (Section 1.1.3.6), depending on the architecture that will be technically feasible	Setting up a flexible ML-based yield estimation model, capable of incorporating new yield information from the current growing season in order to (I) capture the specific growing conditions and impacts on the yield, and (ii) enable to account for

									regional differences in growth conditions
DHI	EGM	LUKE	VTT	Yield monitoring - Ugent	/	/	Turning yield variability data into essential information on where growth conditions were suboptimal, to the benefit of the farmers, using the Digital Twin concept from section	/	/
DHI	EGM	LUKE	VTT	Yield monitoring - VITO	/	Enable the accessibility to harvester data through a data sharing architecture with a sound data governance plan	Turning yield variability data into essential information on where growth conditions were suboptimal, to the benefit of the farmers, using the Digital Twin concept from section	Privacy preserving AI-technologies will be used as the base model (Section 1.1.3.6), depending on the architecture that will be technically feasible	Setting up a flexible ML-based yield estimation model, capable of incorporating new yield information from the current growing season in order to (I) capture the specific growing conditions and impacts on the yield, and (ii) enable to account for regional differences in growth conditions
DHI	EGM	LUKE	VTT	Yield monitoring - VITO	/	/	/	/	Setting up a flexible ML-based yield estimation model, capable of incorporating new yield information from the current growing season in order to (I) capture the specific growing conditions and impacts on the yield, and (ii) enable to account for regional differences in growth conditions

Table 45. Rolling plan for the Soil RIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DEIMOS	EGM	KUVA	VTT	ICCS	RIL	1.1.3.1. Innovative sensor technology	1.1.3.2. Edge processing	1.1.3.3. Data sharing architecture and data governance	1.1.3.6. Privacy-preserving technology	1.1.3.7. Data integration methodologies
DEIMOS	EGM	KUVA	VTT	ICCS	Soil - AUTH	Mount hyperspectral sensors on different platforms (tractors, UAVs, robotics) to increase the mapping ability on different soil parameters	Application of edge computing to ensure high data quality while at the same time minimising the size of information transmitted to the cloud by different platforms or farmers (handheld sensors), enabling more real-time feedback	Apply innovative standardization processes in the development of soil health products that rely on satellite data as a way to increase interoperability, data sharing and reuse	Use of Federated AI to topsoil Soil Organic Carbon (SOC) model building at regional and national level	Combine sensor data with satellite images to produce an optimal estimate of soil parameters
DEIMOS	EGM	KUVA	VTT	ICCS	Soil - EV ILVO	Mount hyperspectral sensors on different platforms (tractors, UAVs, robotics) to increase the mapping ability on different soil parameters	Application of edge computing to ensure high data quality while at the same time minimising the size of information transmitted to the cloud by different platforms or farmers (handheld sensors), enabling more real time feedback	Apply innovative standardization processes in the development of soil health products that rely on satellite data as a way to increase interoperability, data sharing and reuse	Use of Federated AI to topsoil Soil Organic Carbon (SOC) model building at regional and national level	Combine sensor data with satellite images to produce an optimal estimate of soil parameters

Table 46. Rolling plan for the Grasslands RIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DEIMOS	DHI	VITO	RIL	1.1.3.3. Data sharing architecture and data governance	1.1.3.4. Satellite data augmentation	1.1.3.7. Data integration methodologies			
DEIMOS	DHI	VITO	Grasslands - EURAC	Implement a data-sharing architecture	Fuse optical and radar data to	Optimise the Biopar- data	Evaluate methodologies to estimate grasslands standing	Implement a ML upscaling	Assimilate flux tower carbon

				with a sound governance plan to access the data collected and generated over at least 15 sites in 2 European regions	improve the temporal resolution of grassland biophysical parameters (Biopars fPAR and LAI) derived from Sentinel-2	products to the local growing conditions by integrating local sensor data	biomass and accumulated NPP: (I) standing biomass using a ML solution incorporating satellite Biopars, meteorological information, and soil moisture, and (ii) a biophysically based LUE model for grasslands NPP using previously calibrated Biopars and meteorology. In situ biomass measurements will be used to validate the results	strategy to transfer biomass estimation model to other sites	measurements to improve grassland biomass products, with objectives of incorporating specific growing season conditions and paving the way for regional transferability
DEIMOS	DHI	VITO	Grasslands -IFAPA	/	Fuse optical and radar data to improve the temporal resolution of grassland biophysical parameters (Biopars fPAR and LAI) derived from Sentinel-2	/	Evaluate methodologies to estimate grasslands standing biomass and accumulated NPP: (I) standing biomass using a ML solution incorporating satellite Biopars, meteorological information, and soil moisture, and (ii) a biophysically based LUE model for grasslands NPP using previously calibrated Biopars and meteorology. In situ biomass measurements will be used to validate the results	/	/

Table 47. Rolling plan for the Dairy RIL (colours map technology providers to the deployment scenario/innovation area they are involved in for the RIL)

DEIMOS	VITO	OHB	RIL	1.1.3.1. Innovative sensor technology	1.1.3.2. Edge processing	1.1.3.3. Data sharing architecture and data governance	1.1.3.4. Satellite data augmentation	1.1.3.5. From data assimilation to service development	1.1.3.6. Privacy-preserving technology	1.1.3.7. Data integration methodologies
DEIMOS	VITO	OHB	Dairy - ATB, DMK, OHB	Data sets at hand (i.e. specifically milk quality and quantity data) shall be analysed & correlated with indicators relevant for an environmental performance of dairy farms (e.g. usage of pesticides, water, land). Measuring performance using EOD based on regional in-situ data correlation.	Data sets at hand (i.e. specifically milk quality and quantity data) shall be analysed & correlated with indicators relevant for an environmental performance of dairy farms (e.g. usage of pesticides, water, land). Measuring performance using EOD based on regional in-situ data correlation.	Upcoming EnMAP data shall be tailored and processed, facilitating access and adaption to related data models, investigating potentials of synergies with services from the OHB data platform	Adopting models facilitating forecasting and simulation, making use of ML, facilitating model adaptation for different optimality criteria and for scaling towards extended usage of EOD in other regions. The RIL aims at combining data from dairy farmers, arable/crop, feed producers and dairy sales projections	Adopting models facilitating forecasting and simulation, making use of ML, facilitating model adaptation for different optimality criteria and for scaling towards extended usage of EOD in other regions. The RIL aims at combining data from dairy farmers, arable/crop, feed producers and dairy sales projections	Upcoming EnMAP data shall be tailored and processed, facilitating access and adaption to related data models, investigating potentials of synergies with services from the OHB data platform	Data sets at hand (i.e. specifically milk quality and quantity data) shall be analysed & correlated with indicators relevant for an environmental performance of dairy farms (e.g. usage of pesticides, water, land). Measuring performance using EOD based on regional in-situ data correlation.

6 Conclusions and next steps

6.1 Conclusion

In the course of the activities described in this deliverable we have used a co-design approach, whereby we have been able to gather information for each RIL and the vertical domain they represent. The project partners will be able to build further on the information we have collected by using this input in several upcoming project tasks as e.g. tasks T2.3 (ScaleAgData Architectural Design), T3.4 (Data Governance, Sharing Meta architecture and Integration), T4.4 (Technology Validation in the RI environment), etc. in view of the development and technology validation of the methodological tools and data products aspired in the ScaleAgData project.

We have equally made a first important contribution to the initiation of development of innovative governance frameworks, by first aligning with the recent developments in data spaces and governance but also by defining the approach and identifying the tools.

Finally, we have been able to develop a rolling plan that will be used to manage necessary and requested “adaptations” to the project activities.

Two general remarks in view of the activities performed in this deliverable are related to the validation framework and the difference in data/technological maturity of the different RILs:

- Acceptance criteria outline the conditions a product or feature must meet to satisfy stakeholders, bridging requirements and validation. Using the SMART approach (Specific, Measurable, Achievable, Relevant, Time-bound), we ensure the criteria are clear, actionable, and practical. Our validation framework integrates both quantitative criteria, such as metrics and KPIs for measurable aspects like accuracy and speed, and qualitative criteria, addressing usability, user satisfaction, and business alignment. This comprehensive approach ensures the product meets technical and user/business requirements effectively.
  The acceptance criteria for a specific prioritized user story, forming the basis of the validation framework, currently lean more on qualitative aspects than quantitative ones due to the system's limited maturity and clarity, which made it difficult to define criteria with precise metrics and KPIs. **To address this, we planned to refine and enhance these criteria during the second iteration,** once we had gained more clarity and benefited from anticipated external stakeholder contributions, ensuring they better reflect the system’s evolved maturity

- A second remark and linked to the previous one is the large difference in data and technology maturity between the research partners and RILs. While some of the partners have vast experience with technological development of data products or automating data pipelines and data streams, other research partners have less experience with this and are more focussed on examining if and how certain innovative technologies can aid in improved monitoring capabilities as part of competitive and sustainable agriculture. This difference in maturity has been challenging at times when facilitating the co-design workshops and collecting the gathered input reported in this deliverable

6.2 Next Steps

Next steps to be performed in respect to WP2 are:

- **Progress monitoring:** We will closely monitor all relevant project activities, with a specific focus on tracking progress within the RI Labs.

- **Active Participation:** Our commitment extends to active participation and close collaboration with following project activities
    - Task T5.3 " Coordination, Monitoring, Evaluation & Impact Analysis ": We will actively participate to gather feedback on the progress of RI Labs.
    - Task T6.2 " Fostering Network of Relevant Projects, Initiatives and Institutions": We will use the established stakeholder network to engage with external stakeholders.
    - When deemed necessary, we will also take part in WP5 meetings and WP6 organized events, conduct interviews, and administer surveys to gather information that will support our co-design activities."
- **Tools Adaptation**: As we gather information during the progression of the labs, we will remain flexible in adapting our tools for eliciting lab-specific requirements, ensuring alignment with each lab's evolving needs.
- **Fine-tuning and updating requirements:** Additionally, we will dedicate efforts to fine-tuning and updating the collected requirements, ensuring that they stay relevant and reflective of the RIL's and project's evolving objectives.
- **Make it SMART**: As mentioned higher, working to the second iteration of the co-design activities performed in WP2, we plan to prepare and discuss with the RILs the value of redefining/translating the current more qualitative acceptance criteria (i.e. the validation framework) into SMART criteria that include more quantitative elements such as metrics and KPIs. These updates will be documented in D2.2, scheduled for submission in June 2025.
- **Support the Governance of ScaleAgData innovation:** As described in section 5.1, we will continue to follow up the rolling plan in view of necessary adaptations to the planned research activities.
- **Stakeholder participation:** In addition, we plan to add project partners solely having a stakeholder participation in the project (e.g. AGINS) to the rolling plan in order to also be able to take their interests into account in the ScaleAgData project
- **Governance frameworks:** After the analysis of the collected material, WP2 will identify, analyse, and map the current status and level of governance frameworks in the data ecosystem of the vertical domains of the RILs, in away and within the second iteration WP2, T2.4 to proceed to the initiation and tailoring of a governance framework.

7 ANNEXES

7.1 A glossary of the co-design framework

Business analysis is the set of activities performed to identify business needs and recommend relevant solutions; and to elicit, document, and manage requirements.

The **requirement** is defined as "a condition or capability that is required to be present in a product, service, or result to satisfy a contract or other formally imposed specification."

Requirement types:

- **Business Requirements**. Describe the higher-level needs of the organization as a whole, such as business issues or opportunities, and reasons why a project has been undertaken.
- **Stakeholder Requirements**. Describe the needs of a stakeholder or stakeholder group, where the term stakeholder is used broadly to reflect the role of anyone with a material interest in the outcome of an initiative, and could include customers, suppliers, and partners, as well as internal business roles.
- **Solution Requirements**. Describe the features, functions, and characteristics of a product, service, or result that will meet the business and stakeholder requirements. Solution requirements are further grouped into functional and non-functional requirements.
    - Functional Requirements. Describe the behaviors of the product.
    - Non-functional Requirements. Describe the environmental conditions or qualities required for the product to be effective.
- **Transition Requirements**. Describe temporary capabilities, such as data conversion and training requirements, and operational changes needed to transition from the current state to the future state.

Needs assessment consists of the business analysis work that is conducted in order to analyze a current business problem or opportunity.

Persona analysis is a technique that is conducted to analyze a class of users or process workers. It is a powerful tool for understanding stakeholder needs and for targeting product design and behavior for each class of user. A persona is a fictional character created to represent a user group or group of stakeholders who have similar needs.

A **project life cycle** is the series of phases that a project passes through from its initiation to its closure. Project life cycle models range from predictive (fully plan-driven) to adaptive (change-driven), and hybrid approaches fall anywhere between the two. **Predictive**: scope is entirely defined up-front. Requirements are completed before product development begins. Also referred as Waterfall methods. **Iterative**: project is split into phases and project phases are intentionally repeated. High-level scope is defined up-front and the detailed scope is elaborated upon for each iteration. Business analysis is performed up-front and then in small amounts throughout the project. **Adaptive**: Iterations are conducted quickly. Changes are expected; when new requirements are presented, these are captured in a product backlog, and then the backlog is reprioritized. Business analysis is constant. Also refereed as change driven or agile methods. In adaptive life cycle projects, retrospectives are meetings that are scheduled on a regular basis or conducted when a body of work is completed.)

Prioritizing requirements is an important step in managing product scope. Requirements are prioritized based on a number of factors such as:

- Value. Addressing high-value requirements first to reap the financial or goodwill benefits up-front.
- Cost. Evaluating requirements based on financial costs or opportunity costs.
- Difficulty. Considering how difficult the requirement is to fulfill.
- Regulatory. Addressing regulatory or legislative requirements that have imminent compliance deadlines first.
- Risk. Implementing high-risk requirements first to uncover issues early.

Requirement traceability allows the project team to trace backwards to identify the origin of a requirement, trace forward to identify how the requirement was tested and implemented, or trace in-between requirements to provide insight into the value a group of related requirements can deliver.

Requirements verification is the process of reviewing requirements and models to ensure they meet quality standards.

Requirements validation is the process of ensuring that all requirements accurately reflect the intent of the stakeholder and that each requirement aligns to one or more business requirements.

Requirements change process in adaptive approaches expect that requirements will evolve over time and, as a result, often take a flexible approach to requirements change control.

Requirements elicitation is the activity of drawing out information from stakeholders and other sources. In business analysis, it involves eliciting information about the causes of the business problem or the reasons for addressing a current opportunity, as well as the information that will eventually be used to derive a sufficient level of requirements to enable solution development and implementation.

Elicitation techniques are brainstorming, document analysis, facilitated workshops, focus groups, interviews, observations, prototyping (low fidelity, high fidelity), questionnaires and surveys. In agile projects the work is not a prototype but an actual slice of the product it self.

Requirement Analysis is the process of examining, breaking down, and synthesizing information to further understand it, complete it, and improve it. Analysis is used to provide structure to the requirements and related information.

Requirements are modeled and refined to achieve further clarity, correctness, correctness, and to elicit additional information to define the details necessary for the product to be built.

Model refers to a visual representation of information, both abstract and specific, that operates under a set of guidelines in order to efficiently arrange and convey a lot of information in a concise manner. Models are diagrams, tables, or structured text. Use case diagrams, process flow, **use case, user story**, wireframes are models.

- **Process models** describe business processes and ways in which stakeholders interact with those processes. Use case and user story are process models. User story are
- **Scope models** structure and organize the features, functions, and boundaries of the business domain being analyzed. Use case diagram are scope models.

Models need to be prioritized according to applicability. Choosing parameters are: the methodology, the characteristics of a project, the timing within the project life cycle, categories of models and level of abstraction. Models complement one another and enable analysis of the project from different

perspectives (cross-checking models). We use models to determine what is important and valuable so that the right requirements are created. There are many common modeling languages:

- Business process modeling notation (BPMN). Used to model complex business processes for the purpose of making changes to these processes.
- Requirements modeling language (RML). Used to visually model requirements for easy consumption by all stakeholders, particularly business stakeholders.
- System modeling language (SysML). Used to analyze complex systems and includes a subset of UML.

However whether a specific modeling standard is used during analysis or not is unimportant; what is important is to use consistent syntax each time a similar model is used so as not confuse stakeholders.

Use Case diagram shows all of the in-scope use cases for a system. In a use case diagram, a use case is represented by an oval with the name of the use case within it. An actor is shown as a stick figure. Straight lines in the diagram associate the use cases that the actor interacts with.. The association merely establishes a connection that shows this actor is in some way associated with the use case. These diagrams also show the stakeholders who directly interact with the solution (actors), and the interfaces that need to be created between the system features (use cases) and the actors. Use case diagrams do not show requirements, but help to organize requirements for business analysis efforts or layout in a requirements document.

Use case describes a set of scenarios. A scenario is any single pass through a system to achieve a goal for the primary actor. A use case is a series of activities, actions, and reactions that take the primary actor from initiation to successful completion of the goal. Textual use cases are represented in a standardized document template or in tabular form with standardized columns. Use cases are used when there are complex back and forth interactions between users and systems. Use cases offer a context for a scenario and specifically show how stakeholders envision the solution (**vision scenarios**). Use cases typically are not standalone requirements but help to identify functional and nonfunctional requirements (separately because the latest apply to the whole system). During analysis, each step is analyzed to look for requirements to support the step. In particular, system steps will likely have requirements traced to them.

Use case common fields	Descriptions
Name.	A verb phrase that indicates the goal of the use case.
Description.	A simple explanation of the use case.
Actors	Roles that are active participants in the use case.
Organizational benefit	Describes why the use case is important to the project or organization; used for prioritization.
Trigger	The event that causes the use case to start.
Preconditions	Describes everything that should be in place prior to the use case starting in order for the use case to succeed.
Normal flow.	The normal course of steps to move from the preconditions to the post conditions.
Post conditions.	Everything that has changed in the environment at the end of a use case.
Alternate flows	Alternative sets of steps an actor can take to achieve the goal other than what is described in the main flow. These flows are often branch points from steps in the main flow.
Exception flows	Errors or disruptions in the normal flow that require an actor or system to perform a different action to respond to the exception. These are often

	branch points from steps in the main flow and will usually terminate a use case. Exception flows result in failure or nonachievement of the goal.

User story is a statement, written from the point of view of the user, and describes the functionality needed in a solution. A user story often takes the format of:

As an <actor>,
I want to have/be able to <function>,
so that I can/don't have to <business reason>.

Use story should have quality (INVEST) means:

- *Independent.* Each story should stand alone, avoiding the creation of dependencies between stories, as much as possible.
- *Negotiable*. The story is subject to negotiation at all times regarding the content, priority, form, and function of the story, and becomes more concrete just before implementation.
- *Valuable.* The story only defines features or functions that are valuable to the business and that help solve the business problem.
- *Estimable.* The story should be clear enough to generate a valid estimate or lead to a discussion that will generate an estimate.
- *Small.* Stories should be small enough to be implemented, adding an increment of real value, within a single iteration.
- *Testable*. Each story should be independently verifiable.

When using user stories, acceptance criteria are provided that are used to confirm that the story is completed and working as expected. In agile methodologies, user stories populate a backlog and are used as a basis for prioritizing future development. A user story contains many requirements; therefore, it serves as a functional grouping of requirements.

Epic: When a user story is too large to be completed in a single iteration, it is considered to be an epic. Epics are decomposed further into stories (or additional epics). Stories are used by the development team to build the product.

Document the solution requirements: Requirements specification is a generic term that includes all documents that contain requirements. These requirements may be high-level, business-oriented wants and needs, or very detailed specifications required to build the new product or service. After analyzing all of the information that has been elicited, the business analyst documents the resulting requirements in one of many forms, depending on the organization, the project needs, and the project life cycle being used. Requirements documentation is only one of several techniques to ensure consensus among all of the stakeholders as to the behavior of the solution. Documentation should not replace communication and collaboration. Requirements are written at different levels of detail and are associated with different requirement types, for example, business, stakeholder, solution, and transition requirements, where solution requirements are further categorized as functional and nonfunctional.
Requirements should be unambiguous (clarity), precise (right words), consistent (one time, no contradiction and redundancy), correct, and complete (but not too much information).
Additionally,validation it needs to be measurable, feasible (operational and technological, cost-effectiveness, time), traceable and testable.

Requirement prioritization is been done by using one or more prioritization techniques in order to facilitate priority decisions from the key stakeholders. Some techniques are the MoSCoW (Must, Should, Could, Wont have), Multi-voting, Time-boxing and Weighted ranking

Requirement documentation with use cases (instead of text-based requirements). Use cases may be used by an organization in addition to a functional requirements specification or used instead of producing a separate functional requirements specification. Use cases may be used when there are multiple paths and scenarios that the system needs to accommodate.

Requirement documentation with use cases (instead of text-based requirements). When packaged together, user stories represent a high-level version of solution requirements. Usually we maintain the stories in a requirement management tool.

A **backlog** is a prioritized listing of product requirements and deliverables to be completed, often written stories, and prioritized by the business to manage and organize the project's work. Where backlogs are commonly leveraged to contain only user stories, the term can be used more broadly as backlogs may contain use cases, requirements, and defects to be fixed, in addition to the user stories.

Traceability provides the ability to track product requirements from their origin to the deliverables that satisfy them. Traceability is sometimes qualified as bidirectional or forward and backward, because requirements are traced in more than one direction. Not all projects require the same amount of traceability.

Solution evaluation determines how well a solution meets the business needs expressed by stakeholders, including delivering value to the customer. Some evaluation activities result in a qualitative or coarsely quantitative assessment of a solution. There are many ways to evaluate:

- Consider the business goals and objectives
- Consider Key Performance Indicators
- Project, customer, sales and marketing, operational metrics

7.2 Innovation areas and deployment scenarios matrixes

TableA 1. ScaleAgData Innovation Areas

ScaleAgData Innovation Areas/Approaches[16]			
Code	Description	Relative Tasks	Task Leaders and other tech providers
IA1	Innovative sensor technology (from TRL 3-5 to TRL 5-6)	Task 3.1	VTT,Kuva, ICCS,EGM,AUTH,NP,EV ILVO
IA2	Edge processing (from TRL 4 to TRL 6)	Task 3.2	EGM,ICCS,VTT, AUTH
IA3	Data sharing architecture and data governance (from TRL4 to TRL 5)	Task 3.4	ICCS, DME, DES, NP, EGM, EV ILVO
IA4	Satellite data augmentation (from TRL3 to TRL 6)	Task 3.3	VITO, DES, ICCS, Kuva, OHB DS
IA5	From data assimilation to service development (from TRL 3 to TRL 5)	Task 4.1	Luke, VRI IES, NP, UGent
IA6	Privacy-preserving technology (from TRL 4 to TRL 6)	Task 3.2	EGM,ICCS,VTT, AUTH
IA7	Data integration methodologies (from TRL 4 to TRL 6)	Task 4.2	VITO, OHB DS, ATB, DME, DES, NP, EURAC, IFAPA, DHI, Kuva, AUTH, EV ILVO

TableA 2. Deployment Scenarios for the RIL: Water productivity

Deployment Scenarios for the RIL: Water productivity		
Code	Description	*Related Innovation area (s)*
DSW1	Data sharing and model transferability between two distant regions (Latvia and Israel)	IA3
DSW2	Combination of high spatial resolution data from airborne spectral/thermal imagers with available satellite data (e.g. Sentinel-2) to improve temporal resolution	IA4
DSW3	Service prototype through the digital twin concept, combined with data fusion models from different data sources for early prediction and detection of drought caused stress in target crops	IA5

[16] Or the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x

TableA 3. Deployment Scenarios for the RIL: Crop management

Deployment Scenarios for the RIL: Crop management		
Code	Description	*Related Innovation area (s)*
DSC1	NP will create a mechanism and a governance plan for collecting the IoT and farm log data at the farm level and aggregating them at a regional level to support policy makers in making decisions	IA3, IA6
DSC2	A new sensor for automatic pesticides detection will be used to collect data needed by Policy Makers to monitor CAP sustainability KPIs	IA1
DSC3	Data assimilation and data fusion will be used to maximise the reach of its IoT network while minimising the number of sensors needed to support proper advice to farmers	IA5,IA7
DSC4	HORTA SRL will combine weather and soil data from in situ sensors with Sentinel2 data for better crop monitoring and more precise input for the DSS. Using advanced modelling techniques and based on the farm log, the DSS will calculate the sustainability KPIs of the farms for the selected operations, offering guidance and proof.	IA7
DSC4	WODR & PSNC will combine of data coming from phenological observation stations, weather stations, soil sensors and machinery, and implement the respective AI algorithms and data fusion/integration	IA7
DSC5	Estimate the probability of occurrence and identify pests on the fields	IA2
DSC6	Enabling early detection of pest infestation in given regions by integrating to a national Pest Signalling System	IA3, IA5, IA6

TableA 4. Deployment Scenarios for the RIL: Yield monitoring

Deployment Scenarios for the RIL: Yield monitoring		
Code	Description	*Related Innovation area (s)*
DSY1	Enable the accessibility to harvester data through a data sharing architecture with a sound data governance plan	IA3
DSY2	Turning yield variability data into essential information on where growth conditions were suboptimal, to the benefit of the farmers, using the Digital Twin concept from section	IA5
DSY3	Setting up a flexible ML-based yield estimation model, capable of incorporating new yield information from the current growing season in order to (i) capture the specific growing conditions and impacts on the yield, and (ii) enable to account for regional differences in growth conditions	IA7
DSY4	Privacy preserving AI-technologies will be used as the base model depending on the architecture that will be technically feasible.	IA6

TableA 5. Deployment Scenarios for the RIL: Soil Health

Deployment Scenarios for the RIL: Soil health		
Code	Description	*Related Innovation area (s)*
DSS1	Mount hyperspectral sensors on different platforms (tractors, UAVs, robotics) to increase the mapping ability on different soil parameters	IA1
DSS2	Application of edge computing to ensure high data quality while at the same time minimising the size of information transmitted to the cloud by different platforms or farmers (handheld sensors), enabling more real-time feedback	IA2
DSS3	Use of Federated AI to topsoil Soil Organic Carbon (SOC) model building at regional and national level	IA6
DSS4	Combine sensor data with satellite images to produce an optimal estimate of soil parameters	IA7
DSS5	Apply innovative standardization processes in the development of soil health products that rely on satellite data as a way to increase interoperability, data sharing and reuse	IA3

TableA 6. Deployment Scenarios for the RIL: Grasslands

Deployment Scenarios for the RIL: Grasslands		
Code	Description	*Related Innovation area (s)*
DSG1	Implement a data-sharing architecture with a sound governance plan to access the data collected and generated over at least 15 sites in 2 European regions	IA3
DSG2	Fuse optical and radar data to improve the temporal resolution of grassland biophysical parameters (Biopars fPAR and LAI) derived from Sentinel-2	IA4
DSG3	Optimise the Biopar- data products to the local growing conditions by integrating local sensor data	IA7
DSG4	Evaluate methodologies to estimate grasslands standing biomass and accumulated NPP: (i) standing biomass using a ML solution incorporating satellite Biopars, meteorological information, and soil moisture, and (ii) a biophysically based LUE model for grasslands NPP using previously calibrated Biopars and meteorology. In-situ biomass measurements will be used to validate the results	IA7
DSG5	Implement a ML upscaling strategy to transfer biomass estimation model to other sites	IA7
DSG6	Assimilate flux tower carbon measurements to improve grassland biomass products, with objectives of incorporating specific growing season conditions and paving the way for regional transferability	IA7

TableA 7. Deployment Scenarios for the RIL: Sustain Dairy

Deployment Scenarios for the RIL: Sustain Dairy		
Code	Description	*Related Innovation area (s)*
DSD1	Data sets at hand (i.e. specifically milk quality and quantity data) shall be analysed & correlated with indicators relevant for an environmental performance of dairy farms (e.g. usage of pesticides, water, land). Measuring performance using EOD based on regional in-situ data correlation	IA1,IA2,IA7
DSD2	Adopting models facilitating forecasting and simulation, making use of ML, facilitating model adaptation for different optimality criteria and for scaling towards extended usage of EOD in other regions. The RIL aims at combining data from dairy farmers, arable/crop, feed producers and dairy sales projections	IA4,IA5
DSD3	Upcoming EnMAP data shall be tailored and processed, facilitating access and adaption to related data models, investigating potentials of synergies with services from the OHB data platform	IA3,IA6

7.3 Stakeholders Mapping

7.3.1 RIL Dairy

TableA 8. RIL Dairy Stakeholder Mapping

STAKEHOLDERS & ROLES **RIL SUSTAIN DAIRY DEPLOYMENT SCENARIOS**	**Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors):** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will implement (build) the methodological frameworks, prototypes and data products of section 1.1.3.x** **(Stakeholder Group /Organization & Roles)**	**Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who may regulate or otherwise constrain part or all of a ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will support the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**
DSD1- Data sets at hand (i.e. specifically milk quality and quantity data) shall be analysed & correlated with indicators relevant for an environmental performance of dairy farms (e.g. usage of pesticides, water, land). Measuring performance using EOD based on regional in-situ data correlation.	DMK *(Role: Dairy processor)*	OHB, ATB, 365/Claas		DMK farmers *(Role: User)*	DMK Cooperative board	Digitization working group
DSD2- Adopting models facilitating forecasting and simulation, making use of ML, facilitating model adaptation for different optimality criteria and for scaling towards extended usage of EOD in other regions. The RIL aims at combining data from dairy farmers, arable/crop, feed producers and dairy sales projections.	DMK *(Role: Dairy processor)*	ATB, OHB, 365/Claas, LUKE	DMK *(Role: Controlling)*, 365 Farm Net Software	DMK farmers *(Role: User)*		
DSD3- Upcoming EnMAP data shall be tailored and processed, facilitating access and adaption to related data models, investigating potentials of synergies with services from the OHB data platform .	OHB *(Role: as a sub activity for the deployment scenarios)*	OHB		Payment Agencies, Regulatory authorities		

7.3.2 RIL Crop Management

TableA 9. RIL Crop Managment Stakeholder Mapping

STAKEHOLDERS & ROLES RIL CROP MANAGEMENT DEPLOYMENT SCENARIOS	Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors): (Stakeholder Group /Organization & Roles)	Stakeholders who will implement (build) the methodological frameworks, prototypes and data products of section 1.1.3.x (Stakeholder Group /Organization & Roles)	Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)	Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)	Stakeholders who may regulate or otherwise constrain part or all of a ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)	Stakeholders who will support the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)
DSC1- NP will create a mechanism and a governance plan for collecting the IoT and farm log data at the farm level and aggregating them at a regional level to support policy makers in making decisions.	Policy Makers *(Role : Report - monitoring CAP, sustainability KPIs)*	NP *(Role: Tech provider: Collecting IOI +Farm log data, Aggregate-- provide metrics (indicators to policy makers)*	Farmers (Role: need to adapt digital tech. in order to minimize the administrative burden- report frequently farm log)	Policy makers+ Ministry+ Governance*(Role: Analyse aggregates from IOI and farm log adjust policies),* Reinsurance company	Technology providers *(results on data assimilation may not be accurate enough)*, Data provider *(Role: in-situ or IOI data may not be enough)*	Regional authorities, Ministries, Government
DSC2- A new sensor for automatic pesticides detection will be used to collect data needed by Policy Makers to monitor	Policy Makers *(Role : Report - monitoring CAP, sustainability KPIs))*	Tech. providers task T3.1 *(Role: Tech provider: Collecting data from IOI (pesticide sensors) +Farm log+ EO, develop a service for detection of pesticide use at parcel level)*, KUVA Space	Farmers (Role: need to adapt digital tech. in order to minimize the administrative burden- report frequently farm log)	Re/ insurance, Food retainers/ consumers *(Role: Be aware about used of pesticide),* Policy makers *(Role: Needs to report indicators),* Government/Ministry *(Role: Monitor the implementation of national strategy Plan)*	Farmers/ Agro Cooperatives *(Role: Issues with funding + lower price of their product + penalties from government)*	Regional authorities, Ministries, Government

DSC3- Data assimilation and data fusion will be used to maximise the reach of its IoT network while minimising the number of sensors needed to support proper advice to farmers	Policy Makers *(Role: Assisting in reporting/ Calculating indicators to cover a wider area of interest),* Farmers/ Agronomist *(Role: Providing info about the use of pesticides in their monitored area)*	Tech Providers *(Role: Aggregate local data in supporting strategies in a wider area)*	Tech provider *(Role: Less sensors will be needed to be installed),* Suppliers	Farmer *(Role: more farmers will take advantage from advise, minimize the initial investment),* Tech Providers/ Companies /Service providers *(Role: increase the market, lower the price for make it more affordable for farmers)*	Tech provider +assistant personnel *(Role: less need for installation)*	Agronomist *(Role: Facilitate service providers),* Advisors *(Role: Facilitate service providers)*
DSC4- HORTA SRL will combine weather and soil data from in situ sensors with Sentinel2 data for better crop monitoring and more precise input for the DSS. Using advanced modelling techniques and based on the farm log, the DSS will calculate the sustainability KPIs of the farms for the selected operations, offering guidance and proof.	RILab 2-Sub 2, Farmers *(Role: Farm management)*	RILab 2-Sub 2 *(Role: Grain evaluators to collect field activities for Agri food needs),* Food companies *(Role: to help farmers to optimize crop activities and get sustainability profile of harvested),* Agronomist *(Role: Monitor field pressure)*	Insurance companies,Public bodies (phytosanitary services) *(Role: to public bulletins during season)*	Policy makers *(Role: Mapping sustainability level of farmers),* Fertilizers/ pesticide Companies *(Role: using data to monitor how their produces work on open field conditions)*	Policy Makers *(Role: use impact calculated of each crop activity to assess where farms can optimize actions),* Geologist *(Role: monitoring soil through soil sensor and data)*	Civil protection bodies *(Role: data to predict human health-exposure to pesticide),* Private companies *(Role: Pragmatic view of their and all food AGRI chain actions needs),* Breeding companies/ seed companies *(Role: development of new varieties to fight climate changes(using data)*
DSC5-WODR & PSNC will combine of data coming from phenological observation stations, weather stations, soil sensors and machinery, and implement the respective AI algorithms and data fusion/integration	Developers of IT system for advisory *(Role : collecting training set for ML*	Farmers *(Role: providing Farm log, photos of pest),* Agricultural advisors *(Role: providing photo of pest),* Plant protection specialist *(Role: providing photo of pest)*		Developers of IT systems for advisory *(Role: having data for training set for ML models)*	Advisors *(Role: lack of workers in agriculture That have knowledge of pest),* Farmers *(may not want to share their data , provided data can be inaccurate)*	Administration/ Government *(Role: collect the data , having it in one place- give instructions)*

DSC6- Estimate the probability of occurrence and identify pests on the fields.	Developers of National pest signaling system *(Role : Use of model to mitigate in national pest signaling system).*	Developers of IT systems for advisory *(Role: Implement model for identification of pests).*		Developers of National pest signalling system *(Role: get prepared pest estimation ML models to integrate into national system).*	Developers of IT systems for advisory *(Role: not enough developers to construct the system in time).*	
DSC7- Enabling early detection of pest infestation in given regions by integrating to a national Pest Signalling System.	Farmers *(Role : collecting final signaling date regarding the pest detection*	Developers of National pest signalling system *(Role: integration of ML models into pest signalling system)*	Advisors& coordinators of signalling *(Role: Can work more efficiently due to more precise information regarding to pest-can focus on other tasks)*	Farmers *(Role: collect more precise info about pest),* Advisors, Signaling coordinators, Government	Developers of national pest signaling systems *(Role: not enough developers to integrate the system in time)*	Plant protection specialist *(Role: support the developers with knowledge)*

7.3.3 RILGrassland

TableA 10. RIL Grassland Stakeholder Mapping

STAKEHOLDERS & ROLES **RIL GRASSLAND DEPLOYMENT SCENARIOS**	**Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors): (Stakeholder Group /Organization & Roles)**	**Stakeholders who will implement (build) the methodological frameworks, prototypes and data products of section 1.1.3.x (Stakeholder Group /Organization & Roles)**	**Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)**	**Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles) (Stakeholder Group /Organization & Roles)**	**Stakeholders who may regulate or otherwise constrain part or all of a ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)**	**Stakeholders who will support the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)**
DSG1- Implement a data-sharing architecture with a sound governance plan to access the data collected and generated over at least 15 sites in 2 European regions.	IFAPA *(Role: User/Data provider), EURAC (Role: User/Data Provider)*	Deimos *(Role: Tech. Developer, ICT)*	IFAPA, EURAC	IFAPA, EURAC *(Research)*, Deimos *(Tech Developer)*		
DSG2- Fuse optical and radar data to improve the temporal resolution of grassland biophysical parameters	IFAPA *(Role : Researchers,* EURAC *(Role: Researchers),* Deimos *(Role: Tech.*	EURAC *(Role: Tech. developer),* Deimos *(Role: Tech. developer),* VITO *(Role: Tech.*	Farmers (Role: need to adapt digital tech. in order to minimize the administrative burden-	Farmer, EURAC *(Role: researcher),* IFAPA *(Role: Researcher),* DEIMOS *(Role:*		DSG2- EURAC *(Role: Tech. developer),* Deimos *(Role: Tech.*

(Biopars fPAR and LAI) derived from Sentinel-2.	*developer),* Other labs *(Role: Researcher)*	*developer),* KUVA *(Role: Data Provider),* DHI *(Role: Data Provider)*	report frequently farm log)	*Provider),*VITO *(Role: Provider),* AGINS *(Role: End user)*		*developer),* VITO *(Role: Tech. developer)*
DSG3- Optimise the Biopar- data products to the local growing conditions by integrating local sensor data.	EURAC *(Role: Researcher),* IFAPA *(Role: Researcher)*	DHI *(Role: Data Provider)*	Tech provider *(Role: Less sensors will be needed to be installed),* Suppliers	Farmer, Policy makers, Researchers	Italian and Spanish Ministry of Agriculture	DEIMOS (Role:Tech. Developer)
DSG4- Evaluate methodologies to estimate grasslands standing biomass and accumulated NPP: (i) standing biomass using a ML solution incorporating satellite Biopars, meteorological information, and soil moisture, and (ii) a biophysically based LUE model for grasslands NPP using previously calibrated Biopars and meteorology. In-situ biomass measurements will be used to validate the results	EURAC *(Role: Researcher),* IFAPA *(Role: Researcher)*	DHI *(Role: Data Provider)*	Insurance companies,Public bodies (phytosanitary services) *(Role: to public bulletins during season)*	Farmer, Policy makers,Researchers	Italian and Spanish Ministry of Agriculture	-DEIMOS (Role:Tech. Developer)
DSG5- Implement a ML upscaling strategy to transfer biomass estimation model to other sites fusion/integration.	Researchers	AUTH, ILVO	Farmers**,** Policy makers	Farmer *(Role: User),* SMEs, Policy makers, Researchers	Policy Makers, JRC, FAO, EUSO	National Goverments, Policy makers, AG Cooperations
DSG6- Assimilate flux tower carbon measurements to improve grassland biomass products, with objectives of incorporating specific growing season conditions and paving the way for regional transferability.	IFAPA *(Role : Researchers)***,** EURAC *(Role: Researchers)***,** Deimos *(Role: Tech. developer)***,** DHI *(Role: Data user)*	Deimos *(Role: Tech. developer),* IFAPAs *(Role: Tech. developer)*		Researchers		

7.3.4 RIL Soil Health

TableA 11. RIL Soil Health Stakeholder Mapping

STAKEHOLDERS & ROLES **RIL SOIL HEALTH DEPLOYMENT SCENARIOS**	**Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors):** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will implement (build) the methodological frameworks, prototypes and data products of section 1.1.3.x** **(Stakeholder Group /Organization & Roles)**	**Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)**	**Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles) (Stakeholder Group /Organization & Roles)**	**Stakeholders who may regulate or otherwise constrain part or all of a ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)**	**Stakeholders who will support the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**
DSS1- Mount hyperspectral sensors on different platforms (tractors, UAVs, robotics) to increase the mapping ability on different soil parameters.	Farmers *(Role : End User), AG Cooperations, AG Cluster, AG Advisors, Researchers*	Auth *(Role: Research),* ILVO, VTT, EGM *(Role: Sensor development)*	Farmers, Policy makers	Farmer *(Role: User),* SMEs, Policy makers, Researchers	Policy Makers, JRC, FAO, EUSO	National Governments, Policy makers, AG Cooperations
DSS2- Application of edge computing to ensure high data quality while at the same time minimising the size of information transmitted to the cloud by different platforms or farmers (handheld sensors), enabling more real-time feedback.	Researchers	Auth *(Role: Research),* ILVO, SMES (VTT+EGM) *(Role: Sensor Development)*	Farmers	Farmer *(Role: User),* SMEs, Policy makers, Researchers	Policy Makers, JRC, FAO, EUSO	National Governments, Policy makers, AG Cooperations
DSS3- Use of Federated AI to topsoil Soil Organic Carbon (SOC) model building at regional and national level.	Researchers	ICCS	Farmers, Policy makers	Farmer *(Role: User),* SMEs, Policy makers, Researchers	Policy Makers, JRC, FAO, EUSO	National Governments, Policy makers, AG Cooperations
DSS4- Combine sensor data with satellite images to produce an optimal estimate of soil parameters.	Researchers	AUTH, ILVO, SMEs (Tech Providers)	Farmers, Policy makers	Farmer *(Role: User),* SMEs, Policy makers, Researchers	Policy Makers, JRC, FAO, EUSO	National Governments, Policy makers, AG Cooperations

DSS5- Apply innovative standardization processes in the development of soil health products that rely on satellite data as a way to increase interoperability, data sharing and reuse.	Researchers, AG Advisors	AUTH, ILVO	Farmers, Policy makers	Farmer *(Role: User),* SMEs, Policy makers, Researchers	Policy Makers, JRC, FAO, EUSO	National Governments, Policy makers, AG Cooperations

7.3.5 RIL Water productivity

TableA 12. RIL Water productivity Stakeholder Mapping

STAKEHOLDERS & ROLES **RIL WATER PRODUCTIVITY DEPLOYMENT SCENARIOS**	**Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors):** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will implement (build) the methodological frameworks, prototypes and data products of section 1.1.3.x** **(Stakeholder Group /Organization & Roles)**	**Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)**	**Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles) (Stakeholder Group /Organization & Roles)**	**Stakeholders who may regulate or otherwise constrain part or all of a ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x: (Stakeholder Group /Organization & Roles)**	**Stakeholders who will support the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**
DSW1- Data sharing and model transferability between two distant regions (Latvia and Israel).	MIGAL, IES *(Role:Model user, Data provider)*	MIGAL, IES *(Role: Data provider)*		Farmer *(user)*	OGC, FIWARE, Data Agri Partnership	
DSW2- Combination of high spatial resolution data from airborne spectral/thermal imagers with available satellite data (e.g. Sentinel-2) to improve temporal resolution.	DHI	Kuva Space, DHI, MIGAL IES *(Role: Data provider),* VTT *(Role: Sensor provider (Hs camera))*				
DSW3- Service prototype through the digital twin concept, combined with data fusion models from different data sources for early prediction and detection of drought caused stress in target crops.	*Farmer (Role: Consumer),* Latvia- Faild and forest *(Role: Consumer),* Israil-Galilee Agriculture company *(Role:Consumer)*	Luke *(Role: Task 4.1 Digital twin concept)*		*Farmer (Role: User)*		

7.3.6 RIL Yield Monitoring

TableA 13. RIL Yield Monitoring Stakeholder Mapping

STAKEHOLDERS & ROLES **RIL YIELD MONITORING DEPLOYMENT SCENARIOS**	**Stakeholders who will use the methodological frameworks, prototypes and data products of section 1.1.3.x within the project (primary actors):** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will implement (build) the methodological frameworks, prototypes and data products of section 1.1.3.x** **(Stakeholder Group /Organization & Roles)**	**Stakeholders whose role and/or activities performed may change as a result of the adoption of methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will benefit from the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who may regulate or otherwise constrain part or all of a ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**	**Stakeholders who will support the ScaleAgData methodological frameworks, prototypes and data products of section 1.1.3.x:** **(Stakeholder Group /Organization & Roles)**
DSY1- Enable the accessibility to harvester data through a data sharing architecture with a sound data governance plan.	*AVR, CNH*	*AVR, CNH, ICCS, ILVO*	AVR *(Role: Customers),* CNH *(Role: Customers)*	AVR, CNH, VITO, Ugent	Government, farmers, AVR-CNH contractors	ICCS
DSY2- Turning yield variability data into essential information on where growth conditions were suboptimal, to the benefit of the farmers, using the Digital Twin concept from section.	Ugent *(Role: model), LUKE (Role: model)*	*U-Gent (Role: Model),* LUKE *(Role: Model),* CNH *(Role: UI),* AVR *(Role: UI), VITO (Role: UI, Implement),* U-Gent *(Role: Support),* LUKE *(Role: Support)*	Farmer,AVR, ILVO, VITO, CNH, Advisors	Farmer, Advisors, Argo -Industry	Contractors	Farmers *(Role: Farm Management data)*, Government associations
DSY3- Setting up a flexible ML-based yield estimation model, capable of incorporating new yield information from the current growing season in order to (i) capture the specific growing conditions and impacts on the yield, and (ii) enable to account for regional differences in growth conditions.	VITO			Public Organizations, Insurance		DHI *(Role: Data provider),* Soil Lab *(Role: Data provider),* Crop Lab (Weather data) *(Role: Data provider)*

DSY4- Privacy preserving AI-technologies will be used as the base model depending on the architecture that will be technically feasible.						