REPORT ABOUT THE LIVING LAB SETUP AND RESULTS, DRAFT AT M18

31 MARCH 2024

LIVIA ORTOLANI (UNIPI), KATRINE SOMA (WR), FEMKE MEULMAN (WR)

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

D8.5 REPORT ABOUT THE LIVING LAB SETUP AND RESULTS, DRAFT AT M18

Project name	**Maximising the CO-benefits of agricultural Digitalisation through conducive digital ECoSystems**
Project acronym	CODECS
Horizon Europe Topic ID	HORIZON-CL6-2021-GOVERNANCE-01-22
Project ID	101060179
Website	www.horizoncodecs.eu
Document Type	Deliverable
File Name	DEL_ReportLivingLab_Setup&Results_DraftM18
Status	Final
Dissemination level	Public
Date of creation	29 March 2024
Keywords	Living Labs, LL facilitators, annual LL workshop, technologies, Focal Actual Situation, mutual learning process, cycle approach, guidelines, theory and practice
Authors	Livia Ortolani (UNIPI), Katrine Soma (WR), Femke Meulman (WR)
Reviewers	Gianluca Brunori (UNIPI), Tiziana Nadalutti (UNIPI)
Version n.	1
Following updates	D8.6 (Report about the Living Lab setup and results, update at M36);
Work package	WP8 - Coordination
Task number and title	8.4 - Living lab coordination
Work Package Leader	WP8 – Coordination (UNIPI)
Contributors	-
Project Coordinator	University of Pisa

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101060179. UK participants in Project CODECS are supported by UKRI grant numbers 10039965 (James Hutton Institute). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

This license enables reusers to distribute, remix, adapt, and build upon the material in any medium or format, so long as attribution is given to the creator.

REPORT ABOUT THE LIVING LAB SETUP AND RESULTS, DRAFT AT M18 – VERSION 1

History of changes			
Version	**Date**	**Changes**	**Authors(s)**
0.1	15 March	First draft	Livia Ortolani
0.2	22 March	Internal Review	Gianluca Brunori, Livia Ortolani, Katrine Soma, Femke Meulman
0.3	28 March	Document review after consortium check and suggestions	Livia Ortolani, Katrine Soma, Femke Meulman
0.4	29 March	Typos removed and formatting with EC template	Tiziana Nadalutti, Merveille Ntabuhashe
1.0	29 March	First version approved and released	Gianluca Brunori, Livia Ortolani, Katrine Soma

Contents

1. Introduction 2

2. Methodology for Living Labs coordination 3

3. Living Lab activities 4

3.1 Introduction 4

3.2 The initial setting-up of the Living Labs – M1-M8 5

3.3 The identification of Focal Action Situation – M8-M15 7

3.4 The Annual LL workshop M12-14 8

3.5 Perception of Cost and Benefits of Digitalisation – M12-15 11

3.6 Mapping digital ecosystems – M12-M15 12

3.7 Interaction among Living Labs 13

3.8 Process modelling and cost-benefit analysis 14

4. Living Labs descriptions 15

4.1. Introduction 15

4.2. Short summaries of the Living Labs 16

4.3. Evolution of selected living labs 18

4.4. Technology use across the 20 Living Labs in CODECS 19

5. Conclusions and ways forward 21

6. Annexes 1

A.1. Overview of the 20 CODECS Living Labs 1

A.2 Living Labs Focal Actual Situation Statements 1

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

1. Introduction

CODECS has the ambition to strengthen the digitalisation of farming to arrive at increased productivity, improved efficiency and quality of work, reduced pressure on natural resources, and promoted market integration. Moreover, CODECS strives to enhance farmers' access to knowledge, foster peer-to-peer learning, support innovation networks, improve rural-urban and producer-consumer links, and reduce bureaucratic burdens. At the same time CODECS focuses on avoiding or reducing risks for disadvantages that could follow the process of digitisation. These include reduced opportunities of economic, social, and environmental prosperity for specific vulnerable individuals, communities, and regions across the EU. However, the real benefits and costs are highly unclear from a societal point of view. Therefore, CODECS also strives to improve the collective capacity to understand, assess and foresee the full range of benefit and costs of farm digitalisation, and to build digital ecosystems that maximise the net benefits of digitalisation.

CODECS develops a vision of "sustainable digitalisation", supported by concepts, methods, tools, and evidence. Sustainable digitalisation describes the process of transformation that affects the physical, the social, the technical spheres of multilevel human activities, as well as contributions to the socio-economic transition needed for future agri-food system to respond to upcoming economic, social, and ecological challenges. To support these broader processes of transition, CODECS takes up the challenge of improving the capabilities needed to meet the demands of sustainable digitalisation by outreach strategies to the 20 Living Labs in CODECS, contributing to enhanced co-creation of a common vision, a conceptual framework, a methodological framework, and evidence of costs and benefits of digitalisation across Europe, representing a large variety of the agricultural sector in Europe.

This Deliverable 8.2, *first of three versions,* is in this document reporting on the activities that took place in Task 8.4 on Living Lab coordination until Month 18, 31 March 2024 (Lead: WR, UNIPI; Contrib: INRAE, UAL, CNR, CHIEAM All LL, M9-M48).

The activity of Living Lab coordination was crucial in the first phase of the project as it took some time to have all the LL facilitators "on board" and in contact with the rest of the project consortium partners. The activity of supporting Living Labs did not consist only of carrying out the Living Labs workplan for each project year, but also the constant and continuous monitoring of such workplan in the 20 Living Labs. The Living Labs coordinator is also in contact with WPs and Tasks leaders in order to assure that the activities of the Living Labs will be consistent with the theoretical activity of the project.

Setting up, monitoring and managing Living Labs required an intense activity that was parallel to the one of the project coordinator. The preparation of the Living Labs workplan, with the relative timeline ask for a close relationship with the Task leaders and a clear overview of the project while the monitoring of data collection ask for a continuous interaction with LL facilitators.

Additional activities of this Task are related to provide feedback on the proposed methodologies, contribute to homogenise data collection for digital technology assessment, contribute to result analysis, reflect on coherence of the conceptual framework as well as facilitating internal communication.

The main aim of this *first part* of Deliverable 8.2., is to report on the Living Labs setup and results obtained so far, which will be followed up in M36 and M48. As such, this is a first draft of recurring and upgrading over time when new findings have been obtained. Accordingly, the main objectives of this report are:

- To explain the methodological approach used to support the Living Labs;
- To provide a sound overview of the Living Lab activities that took place until month 18 of CODECS;
- To provide an overview of Living Lab descriptions and explain what Living Labs contribute in CODECS.

The main Living Lab activities are distinguished into a total of four phases, for which phase 1 was to set up the Living Labs, cantered around a problem and a technology. This was followed by phase 2, to identify the Focal Actual Situation (FAS) within each Living Lab, and phase 3, to collect data on resources, capabilities, cooperation and innovation (RCCI) as well as on perception of costs and benefits of digital technologies in each Living Lab, during the first annual workshops that took place at local level in the 20 Living Labs. Phase 4 is taking place in 2024, which

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

belongs to the preparation of the second period of Living Labs data collection on process modelling and cost and benefits analysis, with the first training in February 2024.

2. Methodology for Living Labs coordination

The workplan of the first year of the CODECS project in Task 8.4 was to facilitate and coordinate the setting up of the 20 Living Labs and the identification of the demonstration technologies. The Living Lab setup process was based on an iterative process of mutual learning based on the identification of the technology and of the relevant stakeholders to be involved at local level in order to assess cost and benefits of digitalisation.

The purpose of the Task 8.4 is to keep the theoretical part of the CODECS project constantly connected with the inputs provided by stakeholders at local level. The development of knowledge in CODECS is considered a social practice and the Living Labs members proceed, together with the researchers involved in the project, in a continuous process of looking at their own context with different perspectives in order to achieve an always deeper understanding of the potential of using digital technologies in agriculture and rural areas.

Digital solutions are new tools that can be applied in different contexts with different purposes. Living Labs in CODECS are based on networks of actors that at local level already experimented with some digital technologies and are exploring possibilities to use digital technologies, considering their costs and benefits. Researchers involved in CODECS are interested in assessing the costs and benefits of digitalisation in agriculture using different theoretical approaches. Mutual learning allows to embed the theoretical discussion in the practices of the Living Lab members, leading to a better outcome due to the consideration of multiple voices and perspectives (Kensing and Greenbaum, 2013[1]).

This iterative learning process in CODECS was set up with subsequent cycles based on the following steps:

1. Developing guidelines and reporting templates by CODECS Task Leaders;
2. Online training sessions to present the documents prepared to all LL facilitators;
3. Small groups meetings between the Task 8.4 leaders and all LL facilitators (4-5 meetings with maximum 5 LL facilitators) for clarification and questions on the activities that Living Labs should carry out at local level but also for collecting their input to be reported to researchers;
4. On field activities of data collection in 20 locations across Europe coordinated by the 20 Living Labs facilitators;
5. Reporting to Task leaders, following the reporting template presented in point 1 by the 20 Living Labs;
6. Analysis of the 20 reports by the researchers (Task Leaders).

While the researchers that developed the guidelines and reporting template for a specific cycle are working on the analysis of the 20 reports, the other researchers (Task Leaders) start a new cycle that ask Living Lab to go deeper on the analysis of their own context or to consider another perspective or angle to identify cost and benefits of digitalisation in agriculture and rural areas.

[1] Kensing, F. and Greenbaum, J. Heritage – Having a Say. In Simonsen, J. and Robertson (eds) 2013, 21-36

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Figure 1 illustrates the iterative learning process developed for CODECS by Task 8.4.

Figure 1 – The CODECS iterative mutual learning process involving researchers and stakeholders

3. Living Lab activities

3.1 Introduction

In CODECS a Living Lab is defined as a network of farmers, knowledge intermediaries, stakeholders, policy makers, constituted around an emerging problem within a given application scenario and willing to develop solutions through collaboration. For instance, “irrigation of permanent crops” is an application scenario, and the problem can be formulated as a question: “how to increase farm’s value creation by minimising irrigation costs and save water?”. However, considering the specific goal of the CODECS project, the specific technological solutions identified by the members of each Living Lab to contribute to solving the identified issue is also a key element which contribute to define the Living Lab.

Living Labs facilitators are active partners in the CODECS consortium, and they are responsible for connecting the project consortium members with the local stakeholders that are directly involved in the Living Labs activities in the 20 different EU locations and that are not directly funded by the CODECS project.

The Task 8.4, led by WUR and UNIPI, provided a year workplan for Living Labs with a clear list of activities to be carried out by Living Labs facilitators and a relative timeline. As described already in the methodology section of this document, each activity for Living Labs includes also specific training events and dedicated meetings of T8.4 leaders with Living Labs facilitators in small groups in order to clarify any doubt and monitor the work done on the field by Living Labs.

Funded by the European Union

CODECS has received funding from the European Union’s Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

3.2 The initial setting-up of the Living Labs – M1 - M8

Starting from a first self-presentation of the 20 Living Labs facilitators, UNIPI and WUR identified a workplan for 2023 that asked to each Living Lab for an always more accurate description of the digital technology they will assess and the objectives that the Living Lab aims to achieve with the use of such technology.

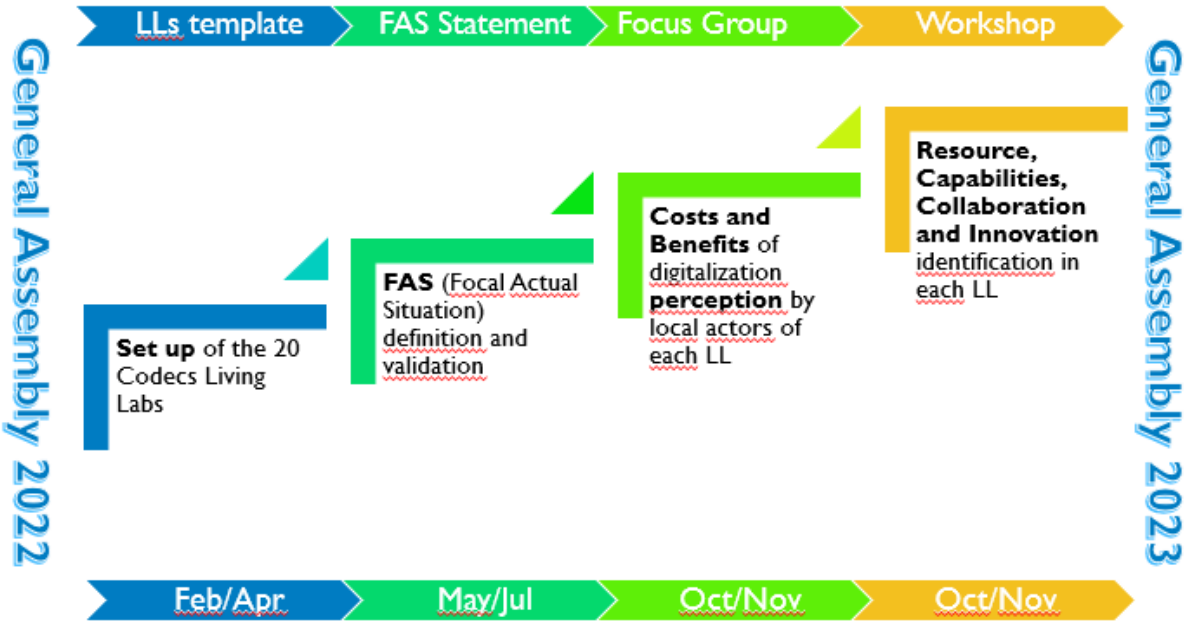

Figure 2 – Living Labs workplan for 2023

In the first phase of the project the main role of Living Labs coordination was to facilitate and coordinate the setting-up of the 20 Living Labs. This activity has been carried out on the base of the capacity of Living Lab facilitator to describe its local network and context and to improve his own knowledge of the application scenario, problem and technology used to contribute to solving the problem. Every time the T8.4 asked the Living Lab facilitator to describe their own context, they had to go back to local stakeholders and collect further and more detailed information on processes, problems, technologies.

Starting from the first description of the Living Labs provided during the project proposal phase, the Living Labs has been asked to present themselves during a specific session organised in breakout rooms during the project **Kick off meeting that took place online in October 2022.** These presentations made evident that the 20 Living Labs were different by application scenarios, which was one of the aims of the project proposal, to cover as much problems as possible, and, more important and critical, that different Living Labs were at a different stage of technology development and application at local level. After this meeting the Task 8.4 made a first proposal to cluster the Living Labs. Considering the differences among Living Labs it was evident since the beginning that it was not possible to have a single clustering system and depending on the purpose of the clustering different criteria could be used to cluster CODECS Living Labs. The focus, more than clustering them, was to have a better understanding of the contexts and the technology used.

During the **first CODECS General Assembly, that took place in Pisa in December 2022** a specific workshop for Living Labs facilitators was held and it was organised in working groups, following a first exercise of Living Labs clustering. The main objectives were: (i) to improve the LL facilitators capacity to describe the farm process being digitalised, (ii) to improve the LL facilitators capacity to assess the sustainability performance of the process, (iii) to improve the LL facilitators capacity to analyse the environmental components that affect the process, (iv) to improve the LL facilitators capacity to assess the role of digital technologies in the performance of the process.

The LL facilitators were asked to present again their activities going more deeply in the problem that each Living Lab aims to address, the actors involved, the operation and equipment used by such actors etc. They also made a first

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

attempt of saying how digitalisation contributed to improve the performance of the activities in the specific Living Lab context.

After the workshop in the General Assembly, it was again evident that in order to proceed in the setting up of Living Labs for the CODECS project there was a need to have a **more detailed description of the Living Labs**.

A specific reporting template to develop detailed Living Lab profiles was developed by Task 8.4 leaders in order to better define the Focal Actual Situation and the specific focus on the application of digital technologies. The main aim of the template for description of Living Labs were to:

- Define a general characterisation of the Living Lab in terms of geographical contextualisation, characteristics, trends and challenges of the rural areas where the Living Lab is located.
- Define the rationale for using the digital technology.
- Describe the specific technology that the Living Lab want to assess in the CODECS project,
- Identify the map of stakeholders that will be part of the Living Lab,
- Briefly describe the demo farm, if already identified in which the selected technology will be assessed.
- Present the specific workplan of the Living Lab.

The information required by the document were collected by LL facilitators by organising one or more in-person or online meetings (e.g. open discussions, focus groups, interviews with key informants etc.) with a group of relevant stakeholders already involved in the networks on which the Living Lab is based and, when possible, a new group of actors that during the first activities of stakeholders engagement manifested their interest in the project activities.

All this process of successive description of the Living Labs, as already said, represented an important iterative process that allowed all the 20 LL facilitators to align with the project activities and with their local stakeholders expectation and needs. The Living Labs have been defined in the proposal phase as potential networks of actors working on digital technologies in agriculture in different contexts, however the process of setting them up within the specific context of the project required sometimes and still it is an ongoing process that will take place during the whole project duration. Living Labs are dynamic networks that change over time and there are not linearly following the project activities, other external events can influence their evolution and the involvement and commitment of specific actors.

The activity of developing the 20 Living Labs profiles was based on the following online meetings with LL facilitators organised by Task 8.4, see Table 1.

Table 2 – Meetings for the LL profiles definition

Date	Type of Meeting	Brief Description
6 February 2023	LL facilitators plenary training	In this meeting the template to describe more in detail the 20 Living Labs was presented and launched with a deadline in April 2023
10 May 2023 (2 groups) 11 May 2023 23 May 2023	LL facilitators small groups meetings	4 different meetings of one hour each took place online with small groups of LL facilitators, maximum 5 of them attended each meeting in order to discuss and clarify the process of FAS definition

The following figure illustrates the timeline of the work done for setting up the Living Labs in CODECS and first iterative learning cycle completed between January 2023 and April 2023.

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

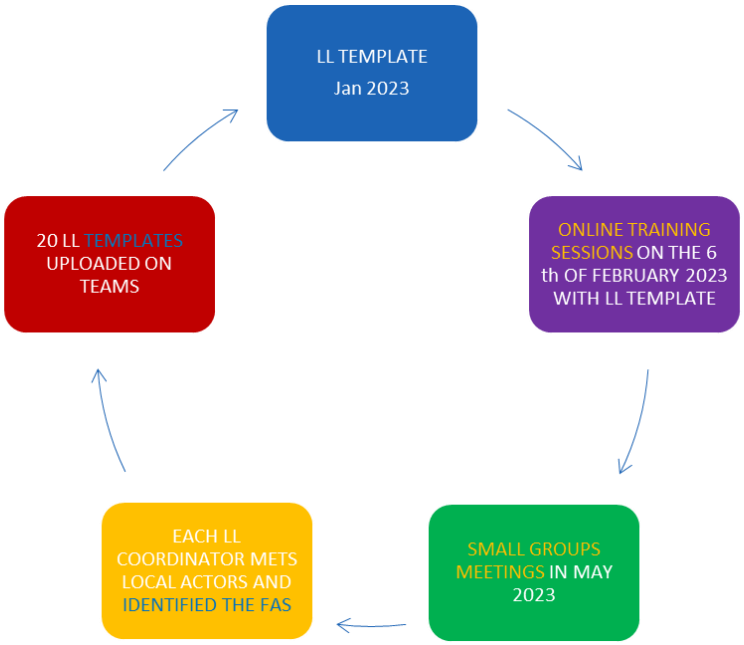

Figure 3 – The iterative cycle of the LL profiles definition

The analysis of the 20 Living Labs Profiles gave the LL coordination team the idea that more support was needed by the LL facilitators to align with the project theoretical framework and describe their specific Focal Actual Situation.

3.3 The identification of Focal Action Situation – M8-M15

In May 2023, in order to better define the Focal Actual Situation (FAS) of each Living Lab and connect the Living Lab profiles with the need to map the socio-ecological system of each Living Lab (T3.3), the Task 8.4 developed a method to homogenise the first description of the 20 FAS. The FAS is defined as a situation where components of a socio-ecological system interact to mobilise digital technologies in order to provide an intended outcome, change or state. The figure below underlines the component of the system that are directly connected to the FAS.

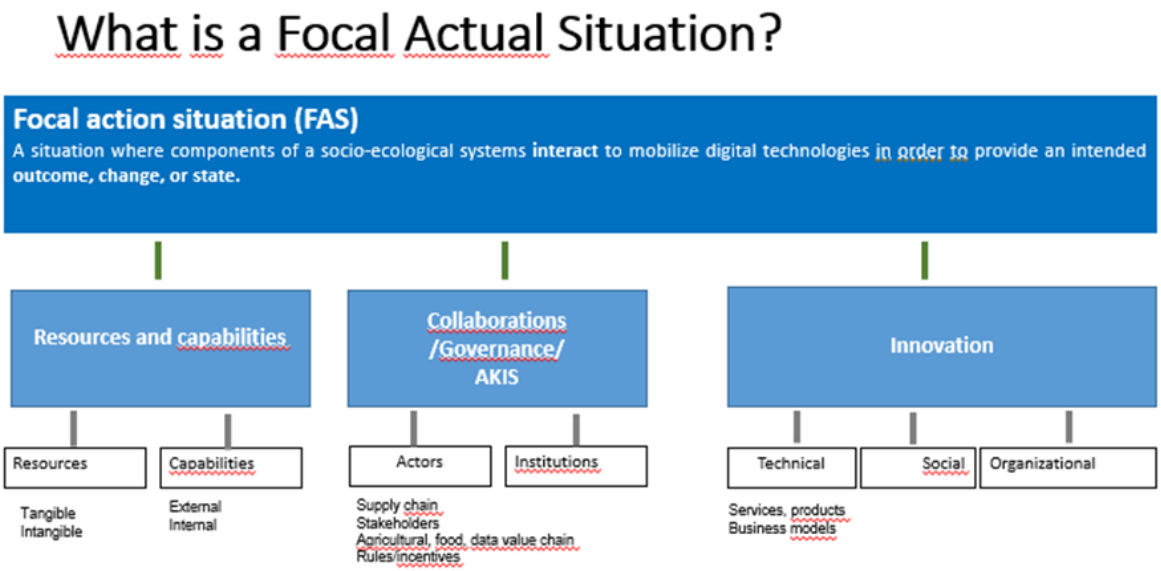

Figure 4 – Definition of the Focal Actual Situation

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Reading the LL Profiles, it was clear that different Living Lab were at different stage of development and identification of the components of their system that could contribute to provide an outcome using digital technologies. In some LL Profiles the list of stakeholders was missing, in some other cases the expected benefits were not properly described and in some others the technology was not clearly identified. The Task 8.4 contacted each individual Living Lab to ask for clarification when needed, and Task 8.4 worked to develop and homogeneous description of FAS of the 20 CODECS Living Labs. The choice of Task 8.4 was to focus on specific issues in order to align all Living Labs description and make sure that some common elements allow to have an overview of the 20 CODECS Living Labs. In particular, the chosen issues were, as shown in Figure 5, the sector of production, the expected benefits, the stakeholders involved, the technology identified and the specific problem that the technology contribute to solve.

The LL [NAME] in [COUNTRY] works on [SECTOR] and use digital technology to [EXPECTED BENEFIT].

[ACTORS] and [INSTITUTIONS] interact to test [TECHNOLOGY] in order to contribute to [PROBLEM].

The LL [Pecorino Toscano DOP] works in [Italy, Tuscany] on [cheese production from sheep milk] and use digital technology to [Improving the management of the supply chain of «Pecorino Toscano DOP» production]. [Technical advisors (veterinary, Agronomist), Farmers, farmers' cooperative, cheese making factory, technology developers] and [University of Pisa and Tuscany Region] interact to test [a Farm Management Information System (FMIS) that stores sheep-level information and integrates together new and existing databases managed by different actors related to several parameters such as sheep health, feeding information, quantity and quality of milk production] in order to contribute to [monitoring the sheep milk production, supporting decision of public and private actors, communicating among actors and, eventually, tracking the production

Figure 5 – Example of guidelines to develop the 20 FAS statements of the CODECS Living Labs

A first version of the FAS Statements was drafted by Task 8.4 in June 2023 on the basis of the information available in the LL Profiles made by the LL facilitators from February to April 2023.The 20 statements were shared with the LL facilitators in summer 2023 for validation and used to give to all the CODECS WP leaders an overview of the 20 CODECS Living Labs. Individual facilitators used the FAS statement as a starting point for the discussion in the Annual LL workshop as requested by Task 3.3. The current version of the 20 FAS statements is available as annex A.2 at the end of this document.

3.4 The Annual LL workshop M12-14

One key activity of CODECS Living Labs is the Annual LL workshop that will take place three times during the project period in order to collect data, validate analysis and discuss the assessment of digital technologies carried out by the project.

During the small groups meetings that took place in May 2023 it was clear that not all LL facilitators were fully aware of the need to organise the annual LL workshop and the Task 8.4 leaders took the opportunity to explain then what the workshops was about and that they needed to organise it themselves involving all the local Living Labs members.

In the meantime, the CODECS Steering Committee started the discussion about the opportunity offered by the 20 annual workshops and the activities to be organised at local level.

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

In July 2023 the first training on the Annual LL Workshop took place in order to provide an overview of the activities to carry out on WP3 – digital ecosystems mapping, WP4 – Costs and benefits perceptions - and WP5 (demo farms) and finally to discuss the Ethical issues related to data collection, data privacy, photos etc. The meeting had 49 participants in total.

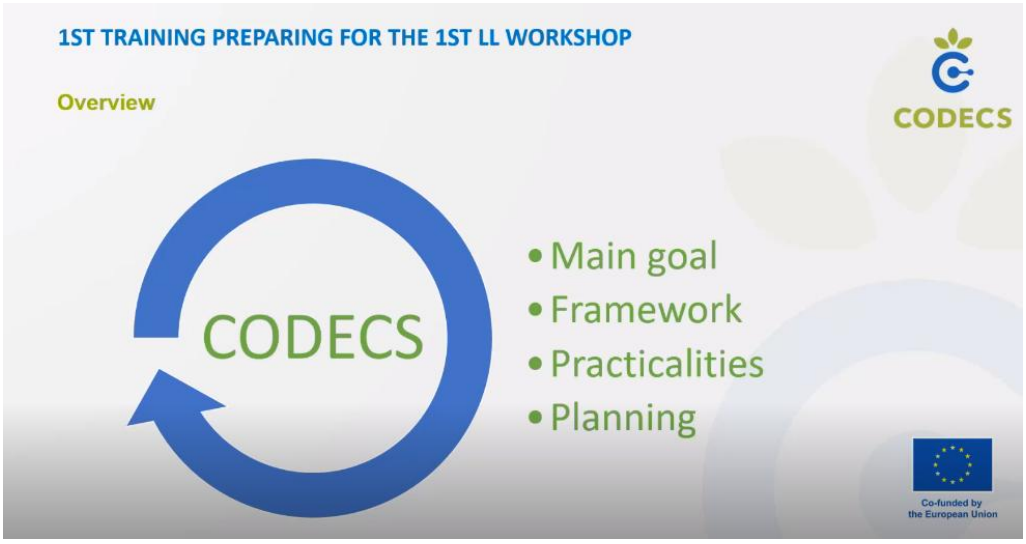

Figure 6 – the LL facilitators training on the 4th of July 2023

In September 2024 a second training on the Annual LL Workshops took place online with 64 participants. The final version of the guidelines developed to carry out the activities by individual LL facilitators have been presented and explained.

In order to make the 20 Annual LL workshop to happen at the same time a constant monitoring and interaction with LL facilitators was carried out by the Task 8.4 leaders.

Table 2 – The meetings for the organisation of the first Annual LL workshops

Date	Type of meeting	Description
4 July 2023	Living Labs facilitators plenary training	In this meeting a first presentation by Task 3.2 and Task 4.1 on the activities of the Living Labs annual workshop took place
7 September 2023	2nd Living Labs facilitators plenary training	In this meeting all the LLs facilitators resulted more aware of the work that needs to be done in the annual workshop, worked during the summer to define locations, invitation, and they focused more on the activities to be organised
3 October 2023, 4 October 2023, 12 October 2023	Living Labs small groups meetings	4 different meetings of one hour each took place online with small groups of Living Labs facilitators, maximum 5 of them attended each meeting in order to clarify doubts and discuss with them the organisation of the annual workshop at local level

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

The table below give an overview of the Living Labs and the date when the annual workshop of the 20 CODECS Living Labs took place. The Task 8.4 monitored during the whole Autumn the Living Labs in order to make sure that all of them organised a physical meeting at local level in order to carry out the activities proposed by T3.2 Mapping of digital ecosystems and T4.1 Perceptions of Cost and Benefits of Digitalisation.

Table 3 – Living Labs and Annual Workshop dates.

Living Lab	Country	Partner	Annual Workshop date	
1	Pecorino Toscano	Italy	UNIPI + Pec. Toscano	8/11/2023
2	Greenhouse smart sensor laboratory	Serbia	BIOS	19/10/2023
3	Organic table grapes	Italy	CIHEAM-IAMB	26/10/2023
4	Appetit	Poland	ISOTECH	21/11/2023
5	Scottish farms and digital platforms	Scotland	HUTTON	30/11/2023
6	Cloughjordan Food Hub	Ireland	SUST	Planned for 24/03/2024
7	Agrifood Technology	Belgium	EV ILVO	6/11/2023
8	Almería Agroecology	Spain	UAL + COEXPHAL	27/10/2023
9	Smart Villages Network	Slovenia	UL	15/11/2023
10	Artificial Irrigation Management System	Slovakia	NEWEDU	13/10/2023
11	LIT Ouesterel	France	ACTA+IFIP	31/10/2023
12	Local beef cattle farming	Latvia	BSC + ZSA	10/11/2023
13	Open Lab Sheep	France	INRAE + IDELE	14/03/2024
14	Occitanum Viti	France	INRAE + IFV	9/11/2023
15	Spraying drones	Greece	AUA	14/11/2023
16	Automation of orchard management	Czech Republic	CSITA+CZU	23/11/2023
17	Agri-digital Bildung	Germany	UNI HOHENHEIM	10/12/2023
18	Grassland Management	Estonia	EMU	7/11/2023

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Living Lab	Country	Partner	Annual Workshop date	
19	RAMAS	North Macedonia	AGFT	30/10/2023
20	Innovative Soil Scanner	Hungary	SZE	6/12/2023

With the conclusion of the 20 Annual Workshops of CODECS Living Labs a second cycle of the iterative learning process of CODECS was concluded between July and December 2023.

Figure 7 – Iterative cycle of the Annual LL workshops

3.5 Perception of Cost and Benefits of Digitalisation – M12-15

The first part of the annual workshops organised by the Living Labs was aiming at contributing to Task 4.2 - Analysis of costs and benefits perception. The focus was on collecting data on the perception of farmers, policy makers, advisors, regarding the various costs and benefits associated with farm digitalisation.

The methodology proposed by Task 4.2 to collect qualitative information from stakeholders on each dimension of cost and benefits (i.e. social, economic and environmental) was the focus group.

Focus group can provide in-depth knowledge and profound insights. A well-conducted focus group creates a welcoming atmosphere that enables participants to feel comfortable and express their thoughts in their own words, adding significance to their answers. Focus groups allow then a deeper comprehension of people perceptions.

The AGRERI team presented the selected methodology and developed guidelines to support Living Labs coordinators that presented during the training sessions on the 4th of July 2023 and on the 9th of September 2023.

AGRERI gave to Living Labs coordinators clear indications on the semi-structured questions to use in order to guide the discussion in the focus group.

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

The questions used by Living Labs are the following:

A. Engagement questions:

1. What comes to your mind when you hear the term “farm digitalisation”?

B. Exploration questions:

2. Bearing in mind the proposed tool/service, do you think it might work? Why? Under what conditions?
3. How do you think this innovation would change farming activities (operations, organisation, relations in the supply chain, relations with advisers, relations with suppliers)?
4. How would this innovation contribute to environmental sustainability? Under what conditions?
5. How would it contribute to farmers’ income and welfare, quality of work, and gender equality? Under what conditions?
6. What do you think are the economic, social, and environmental costs associated with the introduction of the proposed digitalisation innovation and who will incur each type of cost?
7. Would you be willing to pay the associated costs? Up to which level would you be willing to pay?
8. What kind of problems do you expect to face as more and more farmers will become digitalised in the future?
9. What kind of benefits (economic, social, environmental) do you expect from digitalisation? Please provide some examples.

C. Exit questions:

10. Is there anything else you would like to share with us regarding farm digitalisation that you have not shared so far?

3.6 Mapping digital ecosystems – M12-M15

Concerning WP3, the Task 3.2 proposed to conduct a participatory mapping exercise during the Annual LL Workshop. The objective of the Session on participatory mapping of digital ecosystem of the LL the first year was to characterise and analyse the digital ecosystem using the Ostrom’s SES framework, working with a resources and capabilities approach to understand the dynamics and comparison at both the system and the FAS level.

The participatory workshop proposed by T3.2 to the 20 LLs aimed at answering the following question “*How do the 4 subsystems of the SESF and the AKIS enable/foster/ser conditions for Resources, Collaboration, Communication and Innovation?*”. A methodology to identify resource units, actors and their capabilities, resource systems and governance systems within the social-ecological system has been developed by UAL and presented to the Living Labs coordinators during the trainings that took place on the 4th of July and the 9th opf September 2023.

The Living Labs facilitators were asked to have a key role in the workshop, moderating a dialogue among stakeholders with multiple perspectives while documenting the groups’ opinions and agreements.

The Living Labs facilitators were responsible for:

- Selecting and inviting the participants (10-20 participants);
- Preparing and translating materials necessary to guide the discussion;
- Identify a date and place suitable for the participation of relevant stakeholders;
- Facilitate the session;
- Document the activities that took place during the workshop;

Funded by the European Union

CODECS has received funding from the European Union’s Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

- Report the discussion using a specific template provided by Task 3.2;

The figure below gives an idea of the structure of the workshop activities proposed by Task 3.2

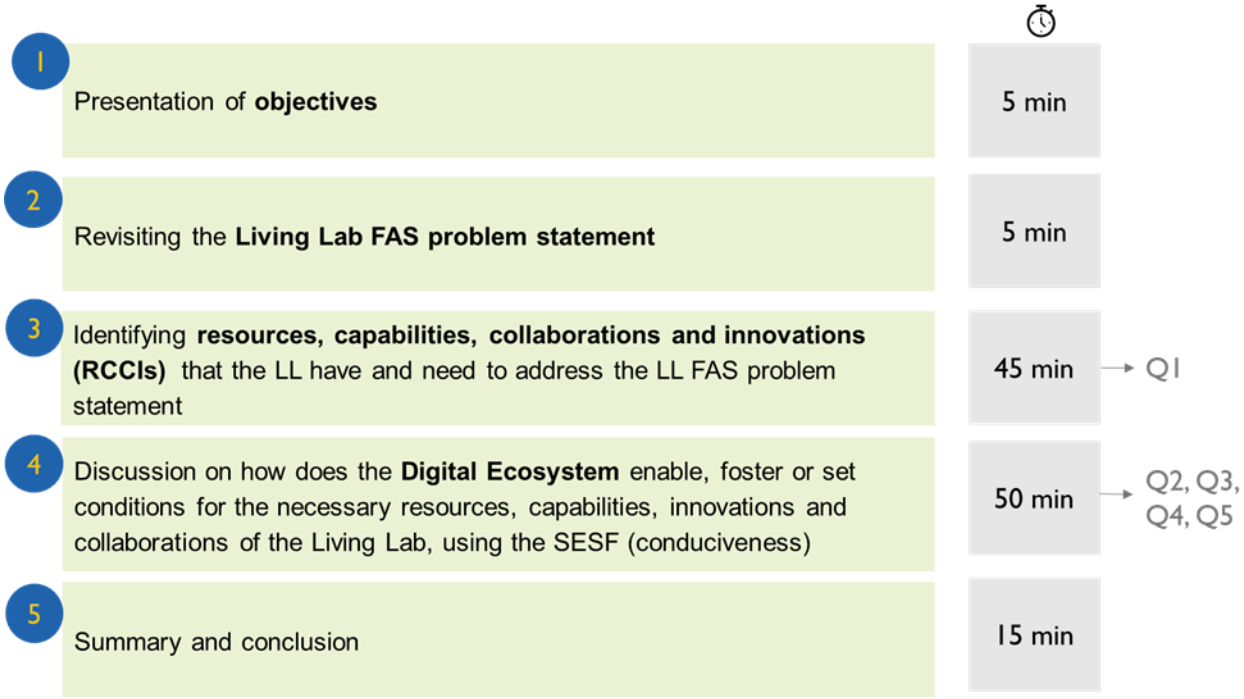

Figure 8 – Overview of activities to be conducted during the workshop.

Following the indication of UAL, Living Labs collected data on Task 3.2 with aim of contributing to the CODECS Objective (SO3) Analysing and understanding the implications of the role of different contexts in the generation of costs and benefits of digitalisation through the analysis of "digital ecosystems".

3.7 Interaction among Living Labs

The interaction between different Living Labs started with the two General Assembly (GA) organised in December 2022 in Pisa, Italy and in December 2023 in Almeria, Spain. These occasions represented important opportunities for LL facilitators to meet each other and plan possible interactions and synergies for the future. While in the first GA in 2022 the Living Labs presented themselves in parallel sessions and had the opportunity to interact only with some of the others, in the second GA, in Almeria in 2023 a specific activity was organised by UAL in order to facilitate knowledge exchange among Living Labs and all other project partners.

Each Living Lab prepared a poster, with a specific template, to describe their Objectives, the problem they contribute to solve with the technology they decided to test in CODECS and the Focal Actual Situation.

This activity was a good opportunity for all LL facilitators to know the activity of the others and to identify technologies that could be of potential interest in their specific context. Some of them told us that they had the opportunity to understand with which Living Labs they are potentially interested to collaborate with.

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Figure 9 – The Living Labs Marketplace in the CODECS General Assembly in Almeria.

3.8 Process modelling and cost-benefit analysis

A first draft of the Living Labs workplan for year 2024 has been developed by the Task 8.4 leaders:

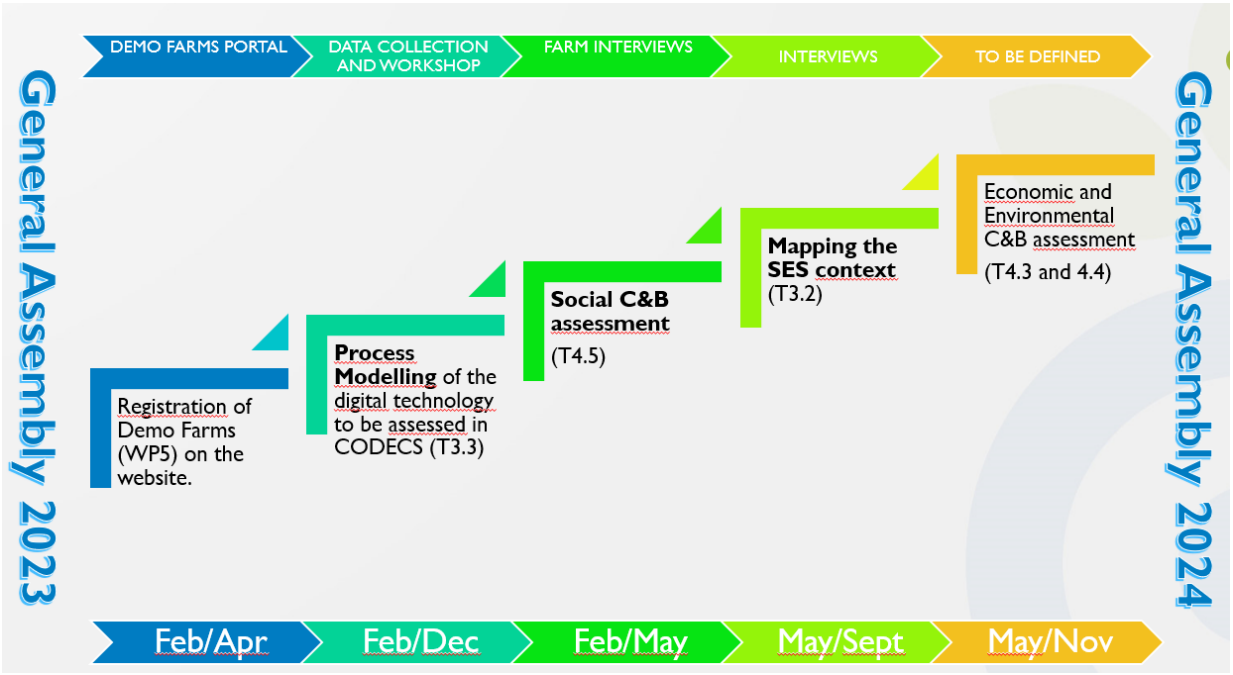

Figure 10 – The 2023 LL workplan

The activities to be carried out by the Living Labs the second year include to start the assessment of their respective digital ecosystems, map the process of their Living Labs demo technologies and describe and assess the digital ecosystems related to their Focal Actual Situations. The Living Labs are asked to carry out data collection for the analysis of the environmental, economic and social costs and benefits.

The first two training sessions of the second year took place on the 9th of February, on WP5 Demo Farms and Demo Events and on the 22nd of February on WP3, Task 3.3 Process Modelling and on Task 4.5 Social Cost and Benefits

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Analysis. The Living Labs are currently working on the data collection requested by such trainings, and beginning a new cycle of iterative learning process between researchers and local stakeholders.

Starting from February 2024 the Living Lab will register their Demonstration Farm in the specific portal developed by WP5. They will also start the data collection for the process modelling of the 20 digital technologies and make farmers interviews for social C&B analysis.

In May 2024 there will be an additional training that will open a new data collection phase for Living Labs focusing on Mapping the SES context and Assessing (T3.2) the Economic and Environmental Costs and Benefits (T4.3 & T4.4).

The second annual workshop, that will take place between the autumn and the winter 2024 will have a session on process modelling and other specific sessions that will be defined on the basis of the results from the first data collection phase.

The first two training meetings tool place in February 2024 and the new small groups meetings with LL facilitators are planned for April 2024.

Table 4 – The meetings for the process modelling and cost benefit analysis

Date	Type of meeting	Description
9 February 2024	Living labs training	In this meeting the WP5 leader explained more deeply the activities related to demo farms and demo events, which ACTA already presented during the GA in December 2023 in Almeria
22 February 2024	Living Labs facilitators plenary training	In this meeting CNR, the leader of Task 3.3 presented the guidelines for data collection for the process modelling activity. INRAE presented the data collection process for Task 4.5 on social C&B analysis

4. Living Labs descriptions

4.1. Introduction

The description of the 20 CODECS Living Labs is based on the activities done on the first stage of the project in which they had the opportunity to identify their focus more precisely on the base of the indications and interactions with CODECS Task leaders. This description is based on the information available at this stage of the project, given the activities carried out by the Living Labs until now.

This section will describe the LL as follows: first (1) a short description of individual Living Labs was made on the base of the posters presented at the CODECS General Assembly in Almeria in December 2024, then (2) a section on a cross-cutting analysis of the Living Labs by geographical coverage, agricultural sector or transversal topic, and (3) a specific paragraph on the use of technologies by different Living Labs and finally a paragraph on the services offered by different Living Labs.

The section is completed by the table in the annex A.1 presents an overview of the 20 CODECS Living Labs with a specific description of the sector of activity of each Living Lab, the expected benefits in the application of digital technologies, the problem that the application of digital technologies contribute to solve and the technology that will be demonstrated and tested in the specific Living Labs.

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

4.2. Short summaries of the Living Labs

1) **Pecorino Toscano, Italy:** This Living Lab in Tuscany aims to support sheep farmers by providing digital solutions that increase the efficiency of cheese making and sheep management. This digital solution is a new farm management information system that can integrate new and existing databases related to multiple agricultural parameters, such as sheep health, feeding information, and quantity and quality of milk produced. Ultimately this simplification of agricultural practices should prevent further decline of sheep farmers in this region, and possibly make it more attractive for younger generations.

2) **Greenhouse smart sensor laboratory, Serbia:** This Living Lab in Serbia aims to achieve optimal, efficient, and sustainable agricultural production in greenhouses through smart sensor technology. Using traditional methods, current greenhouse farmers have high consumption of inputs and low profits. With this smart sensor technology and the use of a digital platform, farmers can get remote and timely access to the readout of sensors so they can react appropriately to information given. Different types of sensors will be able to monitor different indicators and conditions and will provide farmers support to better plan agricultural activities.

3) **Organic Table Grapes, Italy:** This Living Lab in the south of Italy implement digital solutions to increase the quality and quantity of table grape production while reducing the pressure on water and soil in grape orchards. These solutions include sensors in the orchard to collect data, and the implementation of a decision support system (DSS) to manage the means of production (such as irrigation, fertilisation, and pest and disease control), while also reducing water costs and the use of pesticides.

4) **Appetit Living Lab, Poland:** The Appetit Living Lab in Poland serves five local markets for locally produced food in four locations over Poland. The main target of the Living Lab is to pilot novel short food chain solutions, where producers and consumers are connected through an IT-enabled intermediary service. APPETIT is a platform for enabling a digital ecosystem that co-creates a virtual and physical marketplace for local producers and consumers. Special attention is given to how this platform could work as a (self)organising collaborative market arrangement, which can increase the number of users involved, the range of products offered and the sales volumes.

5) **Scottish farms and digital platforms, Scotland:** Located in the North East of Scotland, this Living Lab aims to support small- and medium sized farms to understand the role of digital platforms and digital tools, by exploring a range of tools and creating a supportive environment for knowledge exchange and social learning. These farms often face challenges that can potentially be improved with the use of digital solutions. Digital tools and platforms can help them to support sustainable agricultural practices, diversify activities, reach broader audiences and markets, develop community relations, and improve awareness of agricultural challenges, thereby strengthening their resilience.

6) **Cloughjordan Food Hub, Ireland:** Situated in the midlands of Ireland, this Living Lab aims to provide direct routes to markets for small scale local food producers, while simultaneously increasing the availability of good quality local produce and promoting the local food economy. The Living Lab tries to extend the reach and uptake of an open-source digital platform that functions as online marketplace, bringing together producers and consumers.

7) **Agrifood Technology, Belgium:** Located near Ghent lies the Living Lab Agrifood Technology. This Living Lab aims to innovate agri-food processes in the whole agricultural sector. In this project, the Living Lab aims to develop tools that help to reduce the use of chemical plant protection products, for sustainable and efficient cultivation of arable crops. These tools involve, on the one hand, the detection of weeds, diseases and pests using ultra-high-resolution images on drones and AI. On the other hand, the Living Lab will demonstrate site-specific spraying with the use of task maps that result from drone images.

8) **Almería AgroEcology, Spain:** In this Living Lab, the challenge of bringing different sources of heterogenous data together, and the need for integration of data on a centralised platform is recognised as this will allow for more sustainable natural resource management. Their digital tool supports centralised data management by

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

bringing together data from multiple types of sensors and actuators, thereby facilitating improved plant management and more efficient, sustainable, and cost-effective farming systems.

9) **Smart Villages Network, Slovenia:** The Smart Villages Network operates in different parts in Slovenia, aiming to connect winemakers and beekeepers all over the country, to enhance environmental, social, and economic sustainability through agricultural practices. With regards to viticulture, the Living Lab focusses on identifying optimal IoT infrastructures for informed decision making on vineyards. In addition, regarding beekeeping, solutions are sought to foster research and innovation through establishing a demo IoT beehive environment.

10) **Artificial irrigation management system, Slovakia:** This Living Lab from Slovakia is committed to revolutionising agricultural irrigation practices through the development, evaluation, and testing of an innovative application designed to automate irrigation dose determination. Leveraging a combination of on-farm measurements, extensive databases, and scientific knowledge, the lab utilises cutting-edge algorithms to precisely calculate irrigation requirements tailored to specific crops and environmental conditions. By harnessing real-time data and advanced analytics, the lab aims to significantly reduce water consumption while simultaneously enhancing the quality of agricultural output, and to increase the quality of work.

11) **LIT Ouesterel, France:** Located in the West of France, this Living Lab aims to reconnect pig, cattle, and poultry farming systems with society. For this project, they focus on improving pig welfare through a wide range of digital solutions at different stages of production with the aim of easing farmers' workload, increasing pig health on farms, and showing this to the community as a way to reconnect. These technologies target, for example, the monitoring of feeding and barn environment, or the behaviour and postures of the animals.

12) **Local beef cattle farming, Latvia:** Driven by tackling the precarious market position of local beef cattle farmers with sustainable production methods, this Living Lab aims to develop a marketing application in conjunction with a Grassland Product Label. With the label, the aim is to improve customer awareness of beef production by providing access to information in a user-friendly manner. This way farmers can justify the premium they demand for their products.

13) **Occitanum Sheep, France:** Situated in the Occitanie region in France, this Living Lab aims to provide digital tools and innovative technologies for agroecological transition along the value chain. More specifically, the Living Lab is engaged in building and monitoring animal welfare indicators for dairy sheep in the Roquefort sector through a specific tool for connected tank weight measurement for herd production. Hereby bringing precision livestock farming to species such as sheep that have less economic interest and more extensive management systems.

14) **Occitanum Viti, France:** This Living Lab is dedicated to advancing viticultural practices in response to challenges of climate change adaption and input reduction. Located in the Occitanie region in France, the lab focuses on preserving the distinctive characteristics of local wines while enhancing environmental protection through optimised fertiliser use. By leveraging digital technologies, the lab seeks to test innovative solutions that acquire vineyard images to create maps (measure), facilitates an interface for management of nitrogen fertilisation (decide), and support variable rate application (act).

15) **Spraying drones, Greece:** This Living Lab involves the experimental organic vineyards of the Agricultural University of Athens and aims to use drones to spray plant protection products. They experiment with and evaluate different qualities of these spraying drones in order to optimise their capabilities to apply agrochemicals at a desired rate. This helps farmers to reduce the use of pesticides, and offers a sustainable alternative to conventional spraying methods.

16) **Automation of orchard management, Czech Republic:** This Living Lab is in Central Bohemia in the Czech Republic, focussing mainly on the use of digital technologies in orchard management for improved fruit harvesting. Most importantly, the Living Lab acknowledges the need for improved sensor data collection in orchards, and for effective data processing and decision support tools to improve agro-management and agronomic interventions. Within the project, the Living Lab thus focusses on technological innovation regarding

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

various sensors and weather monitoring stations for data collection, as well as advanced digital systems to guide decision-making in the orchard management.

17) **Agri-Digital Bildung, Germany:** This Living Lab is situated in southwestern Germany and serves as one of the experimental farms of the University of Hohenheim with a primary focus on arable farming. To address innovation and knowledge uncertainties in relation to these technologies, the Living Lab will focus on an educational format. This education format will engage with different types of technologies over the course of the project, including precision fertilisation technologies, precision crop protection technologies, and integrated digital technologies, with the main aim to support knowledge building on digital technologies for prospective farmers and agricultural educators in crop production.

18) **Grassland management, Latvia:** This Living Lab aims to improve the monitoring and maintenance regimes to manage grassland. Here, the Living Lab will test if drones can be effective in managing grassland, to see if they can monitor changes in vegetation and tree covers, or to check other specific issues in grassland maintenance. This could support farmers to validate their maintenance regimes with evidence of effectiveness provided by drones. The drones have been tested for in other areas but need to be refined through machine learning to improve the identification of issue.

19) **RAMAS, Northern Macedonia:** Driven by efforts to improve agricultural production systems, this Living Lab focusses on a model for a centralised advisory system. This system should incorporate different types of environmental monitory technologies to generate and bring together data, that will be used to deliver tailormade advice. This could lead to improved production, promptness in decision-making, traceability of data, energy efficiency and optimisation of processes, and stimulates collaboration between farmers and advisors.

20) **Innovative Soil Scanner, Hungary:** This Living Lab is situated in the Transdanubian region in Hungary and aims to improve nutrient management through fertiliser reduction on a diversity of farms in the region. Therefore, the practical applicability of an innovative soil scanner is tested. This soil scanner recognises and registers the composition of nutrients in the soil and can provide advice in nutrient management for crop production. This data-driven solution should reduce fertiliser use, promote cost-effectiveness, and minimize environmental impacts.

4.3. Evolution of selected living labs

If we take into consideration the table describing the 21 Living Labs in the CODECS Grant Agreement, we can see that there are not significant changes within individual Living Labs since the beginning of the project. There has been, as already mentioned in the methodology and activity session, some improvements and more detailed descriptions of the contexts and specific progresses in focusing on one specific technology to test during the CODECS project. Still, none of the Living Labs made a significant change in the application scenario that they want to contribute to solving with the use of digital technologies at local level.

Notably, the number of Living Labs is now 20 and not 21. There is only one Living Lab in France that did not started to work and is currently not implemented by INRAE. The Occitanum Living Lab 3 was initially chosen as the third LL in Occitanie Région (South of France), along with the two Occitanum Living Labs on Sheep and on Wine. The application scenario of this LL concerned a project to install agro-photovoltaic systems on orchards (kiwi production). Although the community of practice was identified, the project has been put on hold as for this type of installation, there is a restrictive legislative context, which has changed very recently in France. In this context, we consider it was very risky to rely on this Living Lab, for which we would have had very little concrete data to collect.
As INRAE is already coordinating two other LLs in the region (one in viticulture and one on livestock), we decided not to involve a third LL in the CODECS project. Furthermore, this third LL did not involve any other support partners (unlike the other two, which rely on IDELE and IFV, associated partners of ACTA).

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

4.4. Living Labs by geographical coverage and agricultural sector

The 20 CODECS Living Labs are in 17 different countries from Northern Europe (Ireland and Scotland), Eastern Europe (Poland, Slovakia, Czech Republic, Latvia, Estonia, Hungary), Central Europe (France, Germany, Belgium), Southern Europe (Spain, Italy, Greece) and the Balkans area (Serbia, Slovenia, North Macedonia).

The 20 CODECS Living Labs cover different agricultural sectors and focus on specific rural development issues, as showed in the Figure 11 below.

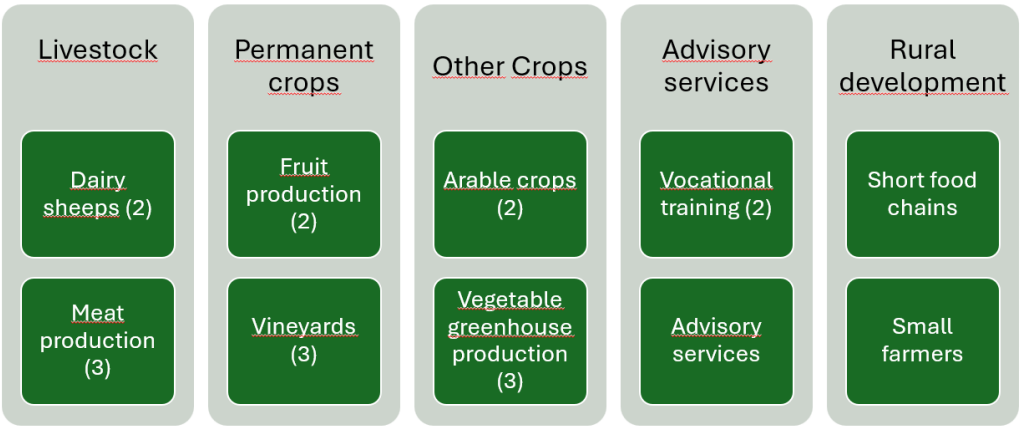

Figure 11 – Sectors covered by CODECS Living Labs

The two Living Labs on Dairy sheep for PDO cheese production in Italy and France are starting a collaboration and exchange on the possibility to use digital technologies in the specific sector. Concerning meat production there is a Living Lab in France working on pig meat production and two Living Labs in Latvia working on organic beef production on semi-natural grassland. Orchards are present in the Living Lab in Czech Republic and in the one in Italy, Puglia Region on organic table grape production. The management of the vineyards, which is one of the most digitalised agricultural sectors is covered by 3 different Living Labs in Greece, Slovenia and France. Finally, vegetable productions include both arable crops, in two Living Labs in Belgium and Hungary and Greenhouse production in Spain, Serbia and Slovakia.

Finally, some Living Labs are focusing on more specific issues that are transversal to all sectors and more related to mixed productions: the development of advisory services based on digital technologies and the support to small scale farmers with the development of local markets.

4.5. Technology use across the 20 Living Labs in CODECS

A total of eight of the 20 use cases have reported to have a technology readiness level of 7, which is relatively high, all aiming at enhancing the sustainability of the Living Labs. In Latvia for the beef production, they employ the ZSA GEO map environment to an emerging food product brand “Grassland Product Label” that focuses on products from semi-natural grasslands characterised by high biodiversity, and in Serbia they make use of IoT sensor node in greenhouses for production of vegetables, to reduce use of water and increase agricultural effectiveness. In France they apply tank weight scales, combined with weather station etc., to investigate sheep, and a so-called Occitanum Viticulture for fertilisation modulation decision support system according to vigour maps to reduce inputs and adapt to climate change by mobilising a pilot territory. In Ireland they have established a market for local product by a digital route to market for local food producers to shorten long supply chains and address the climate and ecological emergency and support accessing markets, whereas in Belgium, they use ultra-high resolution RGB on drones and AI for detection of weeds, diseases, and pests in potato crops. The wine makers in Slovenia use IoT in vineyards and honey production, to establish a demo IoT beehive environment to enable research on new solutions, for

Funded by the European Union

CODECS has received funding from the European Union’s Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

example how to find a queen in the beehive and monitor her behaviour, and in Slovakia they use new sensors to detect mobile application for determining the irrigation dose for agronomists.

Ranging from TRL3 to TRL6, a total of eight Living Labs reported a lower level of readiness of the technologies they use. In Poland they upgrade IT-PLM software for increasing the performance & scale of a virtual marketplace with buyers & sellers (farmers) for local markets for locally produced food, while in Latvia/Estonia they use drones will be used to test their effectiveness for managing different grasslands in Latvia. In Scotland, digital platforms for training and collaboration with small farm producers is used to enable them to adopt relevant digital tools to promote sustainable and transformative applications in their farm practices, and in Almeria, related with greenhouse production, integration of data generated by the IoT ecosystem in a centralised platform facilitates optimised control and management for the generation, storage, reuse and use of resources to control the climate, enrichment, and fertigation. In Macedonia, a remote Agricultural Monitoring and Advisory System, to optimise agricultural inputs and processes, increase effectiveness in decision processes is developed, and in Italy a Farm Management Information System (FMIS) is used to monitor sheep health, feeding information, quantity, and quality of milk production. Whereas a new sensor-based orchard management system for crop protection, remote control of the irrigation system, frost and pollination monitoring and an end-user application for the farmer is employed in the Czech Republic, technologies for pig farming at different stages to improve their welfare: monitor feeding and barn environment, follow the behaviours / postures of the animal is used in France.

Yet, some four more Living Labs have reported advanced TRL levels of 8 and 9. This includes the Living Lab in in Italy, using sensors in orchard and Decision Support System (DSS) to manage the organic table grape production, and use of sensors at field level (soil, environment and crop) interconnected and in communication with a DSS, and the development of vocational education related formats to support knowledge building on digital technologies for prospective farmers and agricultural educators in Germany. In Greece they use a spraying drone, which refers to any UAV, operated manually or automatically, that is capable of applying agrochemicals at a desired rate close to the canopy (commonly <5m), and in Hungary they innovative soil scanner system in soil nutrient management advisory (hardware, software, web-based platform, mobile application) for a more sustainable farming. These two last Living Labs have a TRL of 9 and are thus reported as the highest technological readiness levels.

Concerning the data chain, the technologies mentioned by the Living Labs cover all phases from data sources to data access to end users. Not in all cases there is data analysis phase, while most of the Living Labs use platform of different types for data management. Sometimes the application of digital technologies is just supporting the exchange of knowledge among different actors, without a specific elaboration of data. However, the opportunity to elaborate data in different ways can be considered as a desirable option in some case or as not necessary in other cases. The figure below identifies the digital technologies mentioned by CODECS Living Labs. There is still not a common way of describing the tested technologies.

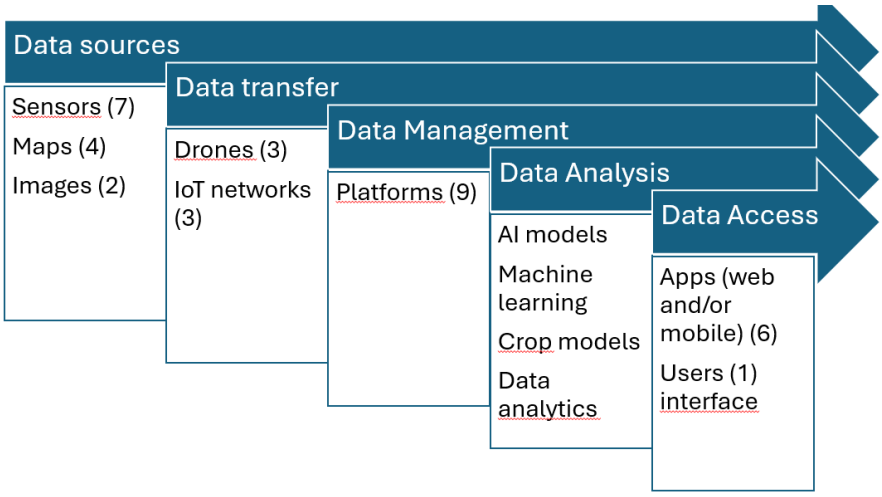

Figure 12 – Digital technologies tested by the CODECS Living Labs

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

5. Conclusions and ways forward

CODECS differs from many other European Horizon project by its focus on co-developed by the entire consortium, following a transdisciplinary approach to theory building towards a shared vision of sustainable digitalisation. Based on the multiple contributions, insights and findings developed across research disciplines, a common research approach will dynamically evolve as the project unfolds.

This Deliverable 8.5 is the first of three versions, with the main purpose to reporting on the activities that took place in Task 8.4 on Living lab coordination until Month 18, 31 March 2024 in CODECS. An important contribution in this Task is to coordinate the organisation of the Annual LL workshops and to monitor the effective realisation of them in 20 different locations. Important in these workshops are the facilitation of the activities to be carried out in the Living Labs to support the work packages 3 and 4. Accordingly, the main objectives of this report are:

1) to explain the methodological approach used to support the Living Labs,
2) to provide an overview of Living Lab descriptions and explain what Living Labs contribute in CODECS, and
3) to provide a sound overview of the Living Lab activities that took place until month 18 of CODECS.

First, the methodological approach developed to facilitate the coordination of the 20 Living Labs in CODECS has been presented. The Living Lab setup process was based on an iterative process of mutual learning based on the identification of the technology to be tested and of the relevant stakeholders to be involved at local level in order to assess cost and benefits of digitalisation. The use of a cycle approach, developed during the first year of CODECS and described in this deliverable, allow to keep the theoretical part of CODECS constantly connected with the inputs provided by LL members at local level.

Second, in this first part of the CODECS it was critically important to understand and set up the Living Labs in ways that are useful not only to the research activities taking place across the work packages, and for the stakeholders who are engaged in the Living Labs themselves. In order to provide a good overview of the differences and similarities across the Living Labs, this part of the deliverable summarises the posters provided by each Living Lab at the General Assembly in Almeria, Spain in December 2023. Notably, the descriptions of some of the Living Labs at this stage differ from the early descriptions collected by this deliverable early 2023, by means of the first template which was used to summarise all Living Labs. After providing a short description of all the Living Labs, a review across them are done to address the technologies used in the demonstration activities in each Living Lab, as well as proving examples of services, system thinking, and conduciveness across the Living Labs in CODECS.

Third, the main Living Lab activities are separated into a total of four phases, for which phase 1 was to set up the Living Labs, cantered around a problem and a technology. This was followed by phase 2, to identify the FAS within each Living Lab, and phase 3, to collect data on resources, capabilities, cooperation and innovation (RCCI) as well as on perception of costs and benefits of digital technologies in each Living Lab, during the first annual LL workshops. Phase 4 is taking place in 2024, which belongs to the preparation of the second phase of Living Labs data collection on process modelling and cost and benefits analysis, with the first training in February 2024.

After this first delivery to the European Commission, a second version of this deliverable will be submitted in September 2025 (M36). The upcoming activities after the training on technology demonstrations (WP5) and training on process modelling data collection as well as on data collection on social/human costs, which is already reported on this deliverable, the guidelines and template of these trainings will be finalised later on, and thus the reporting on these guidelines will take place in the next reporting.

Other core events that will take place and reported on in the next version of this deliverable include the planned small groups meetings to monitor the data collection process and to clarify any problem and issue emerged from data collection which will take place in March and April 2024, as well as the actual data collection of the process modelling (WP3), the individual farmer interviews (WP3 and WP4), as well as the planning of demonstration activities and events (WP5), which will take place in the period February-May 2024. In May there will also be a training on environmental and economic data collection, and in June there will be a training to prepare for the Annual (October) workshops to be arranged by the Living Lab coordinators across the 20 Living Labs. In the period from May to August, actual planning of these workshops will take place, as well as further data collection collected across the

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Living Labs on environmental and economic data. In December 2024, the Living Lab experiences will be presented and explored during the CODECS General Assembly.

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

6. Annexes

A.1. Overview of the 20 CODECS Living Labs

Living Lab	Country	Sector of Production	Expected benefits	Problem	Technology (TRL)
1. Pecorino Toscano DOP	Italy, Tuscany	Extensive dairy sheep farms	Improve the quality of production, the quality of work and the life of farmers, the visibility of the farm and the animal health and welfare	Facilitate farmers in the data collection of data related to farm processes	Farm Management Information System (FMIS) TRL6
2. Greenhouse smart sensor lab	Serbia	Vegetable greenhouse production	Increase yield and preventing damage and plant stress induced by low or high temperatures in greenhouses, reduce the use of water and increase agricultural production	Monitoring the conditions in the greenhouse (soil moisture, soil water potential, soil pH, air temperature/humidity, leaf wetness sensor, photosynthetically active radiation sensor, CO2 sensor)	IoT sensors node, combine with a web platform suitable for pc, tablet and smartphone TRL 7
3. Organic Table Grape	Italy, Puglia	Organic table grape production	Increase the quality and quantity of organic table grape production by reducing the qualitative and quantitative pressure on the soil and water resources	Manage the key factors of production: irrigation, fertilisation patterns, pest and disease control	Sensors in orchard at field level (soil, environment, and crop) interconnected and in communication with a Decision Support System (DSS) TRL 8

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Living Lab	Country	Sector of Production	Expected benefits	Problem	Technology (TRL)
4. Appetit Living Lab	Poland	Short food chains	Growing local markets, decrease transaction costs and increase benefits of virtual and physical market-place interactions between buyers and sellers in a defined geographical space	Provide and automate "intermediary services" essential for connecting many producers to many consumers directly to one another via a virtual marketplace	APPETIT IT-enabled platform for collaborative organisational arrangements TRL 4
5. Scottish farms and digital platforms	Scotland	Small farmers and crofters	Promote and improve economic activities of small farmers and crofters	Develop a supportive environment for knowledge exchange and peer-to-peer learning on available digital tools to boost small farmers understanding the potential of digital technologies	Digital platform for training and collaboration, online social media, QR coding, 360-degree cameras and virtual reality demonstration TRL 3
6. Cloughjordan Food Hub	Ireland	Local communities and small farmers	Shortening long supply chains and underpin a new food system owned and controlled by producers, eaters and local enterprises	Develop an online marketplace to facilitate small scale food producers and people in rural areas in accessing local markets, supporting local economies	Opensource digital platform TRL 7
7. Agrifood Technology	Belgium	Arable crops	Reduce the use of crop protection products through site specific spraying	Weed, disease and pest detection in commercial farms of arable crops	Ultra-high resolution RGB on drones and AI models, task map generation, label tools TRL 7
8. Almeria Agroecology	Spain, Almeria	Vegetable greenhouse production	Develop resilience in the local agricultural sector to create dignified employment and equitable distributed wealth	Facilitate interoperability of heterogeneous data from different sources	Sensors, actuators, centralised platform for data management TRL 5

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Living Lab	Country	Sector of Production	Expected benefits	Problem	Technology (TRL)
9. Smart villages Network	Slovenia	Vineyards sustainable agriculture	Increase sustainability and reduce the use of water and pesticides in vine production	Collect different viticulture parameters and find the best IoT infrastructure for winemakers with different microclimate in the same vineyard	IoT and data analytics, sensors, sever storing collected data, web platform, app for smartphone. TRL 7
10. Artificial Irrigation management system	Slovakia	Vegetable greenhouse production	Improve the irrigation system in order to optimise the watering of plants in term of time and quantity	Provide irrigation doses for the plant according to the phenophase, water reserves in soil and meteorological situation	A mobile application based on new sensors for measure soil moisture placed at the depth where the decisive part of the active plant roots is located and model of the curve of physiological need for irrigation. TRL 7
11. LIT Ouesterel	France, Grand Ouest	Pig meat production	Find non-invasive practice methods and technologies to improve pig welfare and workers 'conditions, ease the farm management and traceability to reinforce food safety and quality control, from farmers to consumers	Facilitate data sharing between equipment and management software	Platform linking farm and equipment data TRL 6
12. Grassland product label	Latvia	Grass-fed beef cattle production	Improve the precarious market position of local beef cattle farmers	Provide an effective and easy-to-use marketing tool to promote an emerging food product from semi-natural grasslands characterised by high biodiversity	ZSA GEO map environment (https://app.smartagro.lv) TRL 7

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Living Lab	Country	Sector of Production	Expected benefits	Problem	Technology (TRL)
13. Open Lab Sheep	France, Occitanum	Dairy sheep farms	Prevent animal health and welfare problems in advance	Automatically collect herd production data through tank weight measurement	Digital milk counter and connected weight milk tank TRL 7
14. Occitanum Viti	France, Occitanum	Vineyards sustainable agriculture	Manage fertilisation to preserve typicality of wines while protecting the environment	Modulate rate of applied fertilisers	Satellite images, vigour maps, user-friendly web interface TRL 7
15. Spray drones	Greece	Vineyards sustainable agriculture	Assess and analyse the best drone spraying configurations for field use and crop protection	Obtain qualitative data on the spraying applications and droplet displacement, applying agrochemicals at a desired rate close to the canopy (commonly <5m)	Spraying UAVs (drones), GIS, sensors, IoT station, LiDAR for altitude adjustment, vision system TRL 9
16. Automation of orchard management	Czech Rep	Fruit crop production	Reduce impact of adverse weather on crops, reduce water and pesticide use, automation of irrigation and facilitate reporting obligations	Collect, store and analyse on farm data	A new sensor-based orchard management system for crop protection, remote control of the irrigation system, frost and pollination monitoring and an end-user application for the farmer TRL 6
17. Agri-digital Bildung	Germany	Knowledge transfer	Increase the application of digital and precision farming technologies in crop production	Support knowledge building on digitalisation in vocational education for prospective farmers and agricultural educators	Digitally-related educational format TRL8

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Living Lab	Country	Sector of Production	Expected benefits	Problem	Technology (TRL)
18. Grassland Management	Estonia	Grassland	Improve monitoring of maintenance regimes of grasslands including both protected grassland and the cultivated ones managed for organic beef production	Capture changes in vegetation/tree cover, support farmers with data in appropriate format	Drones, machine learning, web app TRL 3
19. RAMAS	North Macedonia	Crop production	Improve agricultural professional support	Generate real-time field data that will be used by experts/advisors for delivering tailor-made advice	Farm accountancy form, field repository, user-friendly dashboard, earth observation data, environmental monitoring data TRL5
20. Innovative Soil Scanner	Hungary	Arable crops	Optimise fertilisation and reduce environmental impact, through site specific fertilisers application	Analyse nutrients in soil in a fast, affordable, and reliable way	Soil scanner, NIR sensor, cloud, database, soil analysis, mobile phone TRL9

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

A.2 Living Labs Focal Actual Situation Statements

The LL [NAME] in [COUNTRY] works on [SECTOR] and use digital technology to [EXPECTED BENEFIT].

[ACTORS] and [INSTITUTIONS] interact to test [TECHNOLOGY] in order to contribute to [PROBLEM].

----------Living Lab 1 ----------

The LL [Pecorino Toscano DOP] in [Italy, Tuscany] works on [extensive dairy sheep production] and use digital technologies to [improve the quality of production, the quality of work and life of farmers, the visibility of the farm and the animal health and welfare].

[Technical advisors (veterinary, Agronomist), Farmers, farmers' cooperative, cheese making factory, technology developers] and [University of Pisa and Tuscany Region] interact to test [a Farm Management Information System (FMIS) that stores sheep-level information and integrates together new and existing databases managed by different actors related to several parameters such as sheep health, feeding information, quantity and quality of milk production] in order to contribute to [facilitate farmers in data collection of data related to farm processes.]

----------Living Lab 2 ----------

The LL [Greenhouse smart sensor lab] in [Serbia] works on [vegetable greenhouse production] and use digital technologies to [Increase yield and preventing damage and plant stress induced by low or high temperatures in greenhouses, reduce the use of water and increase agricultural production].

[10 farmers working on vegetable production, associations of agricultural producers, industry from agriculture and IT sectors] interact with [research institutions, policy and decision makers (Vojvodina Province representatives), University of Novi Sad, Finance institutions] to test [the use of IoT sensors node, combined with a web platform suitable for pc, tablet and smartphone] in order to contribute to [monitoring the conditions in the greenhouse (soil moisture, soil water potential, soil pH, air temperature/humidity, leaf wetness sensor, photosynthetically active radiation sensor, CO2 sensor) and reduce the use of water increasing agricultural production optimisation process].

----------Living Lab 3 ----------

The Living Lab [Organic Table Grape] in [Puglia Region, Italy] works on [organic table grape production] and use digital technology to [increase the quality and quantity of organic table grape production by reducing the qualitative and quantitative pressure on the soil and water resources].

The [farmer, the IT company and other farmers and farmers' associations] interact with [researchers from CIHEAM Bari, CREA VE, local administrations,] to test the [the use of sensors in orchards at field level (soil, environment and crop) interconnected and in communication with a DSS] in order to contribute to [manage the key factors of production: irrigation, fertilisation patterns and pest and disease control and reduce water quantity as well as hence pesticide and chemical products].

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

----------Living Lab 4 ----------

The LL [APPETIT LIVING LAB] in [Poland] works on [short food chain] and uses digital technologies to [grow local markets, decrease transaction costs and increase benefits of virtual and physical market-place interactions between buyers and sellers in a defined geographical space].

[Market initiators/organisers, farmers, consumers, APPETIT developers/providers] interact with [market initiators/organisers, researchers, public agencies, regulators and other stakeholders] to test, develop and pilot the [APPETIT IT-enabled platform as a basis for collaborative organisational arrangements for growing local food markets] in order to contribute to [provide and automate "intermediary services" essential for connecting many producers to many consumers directly to one another via a virtual market-place].

----------Living Lab 5 ----------

The LL [Remote rural farming communities] in [Scotland] works with [small farmers and crofters] and use digital technology to [develop promote and improve economic activities of small farmers and crofters].

Local stakeholders interact to test [digital platforms for training and collaboration with small farm producers, online social media, smartphone apps, QR coding, laptops, 360-degree cameras and virtual reality demonstration] in order to contribute to [develop a supportive environment for knowledge exchange and peer to peer learning on available digital tools to boost small farmers understanding the potential of digital technologies].

----------Living Lab 6 ----------

The LL [Cloughjordan Food Hub] in [Ireland] works with [local communities and small farmers] and uses digital technologies to [shortening long supply chains and underpin a new food system owned and controlled by the producers, eaters and local enterprises].

[NGOs/CSOs, Farmers, Customers] interact with [Researchers] to test [an opensource digital platform that serves as an online marketplace] in order to contribute to [develop an online marketplace to facilitate small scale food producers and people in rural areas in accessing local markets, supporting local economies].

----------Living Lab 7 ----------

The LL [Agrifood technology] in [Belgium] works on [arable production] and use digital technologies to [reduce the use of crop protection products through site specific spraying].

[11 farmers, some technology providers, drone pilots, a competence center] interact to test [ultra-high resolution RGB on drones and AI models, task map generation, label tools] in order to contribute to [weeds, disease and pest detection in commercial farms of arable crops].

----------Living Lab 8 ----------

The LL [Almeria Agroecology] in [Spain] works on [vegetable productions in greenhouses] and use digital technologies to [develop and create resilience in the local agricultural sector and to create dignified employment and equitably distributed wealth within it].

[Members of a Producers Organisation, advisors, innovation brokers, NGOs/CSOs, Businesses for technology development] interact with [public authorities and researchers] to test [the integration of sensors and actuators in a centralised platform for data management] in order to contribute to [facilitate the interoperability of heterogeneous data from different sources in order to improve the optimisation of resource management].

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

----------Living Lab 9 ----------

The LL [Mreža pametnih vasi (Smart Villages Network)] in [Slovenia] works on [sustainable agriculture] and use digital technologies to [increase sustainability and reduce the use of water and pesticides in wine production].

[Winemakers, Business and Innovation advisors, local entrepreneur for innovation advice, UX expert] interact with [Policy officer, Researcher developer, Data scientists, Digital Skills manager, SEROI Methodology researcher Big data developer] to test [IoT sensors, with a server storing the data collected and a web platform connected to an app for the final users smartphone] in order to contribute to [collect different viticulture parameters and find the best IoT infrastructure for winemakers that would solve current problems with connectivity and very rugged territory with different microclimate in same vineyards].

----------Living Lab 10 ----------

The LL [Artificial irrigation management system] in [Slovakia] works on [vegetable greenhouse production] and use digital technologies to [improve irrigation systems as plants can suffer from lack of water as they do not receive it when they required it most].

[Technical agronomic advisors and SMEs] interact with [policy makers from two cities, members of the rural parliament in Slovakia, researchers from the faculty of engineering] to test [a mobile application based on new sensors for measure soil moisture placed at the depth where the decisive part of the active plant roots is located and model of the curve of physiological need for irrigation] in order to contribute to [provide irrigation doses for the plant according to the phenophase, water reserves in the soil and meteorological situation].

----------Living Lab 11 ----------

The LL [LIT OUESTEREL] in [Grand Ouest, France] works on [pig meat production] and use digital technologies to [find non-invasive practices methods and technologies to improve pig welfare and workers' conditions, ease the farm management and traceability to reinforce food safety and quality control, from farmer to consumers].

[Farmers, advisors, vets, technology and data providers] interact with [researchers, experimental farm technicians] to test [a platform linking farm and equipment data] in order to contribute to [facilitate data sharing between equipment and management software].

----------Living Lab 12 ----------

The LL [Grassland product label] in [Latvia] works on [the local beef sector] and use digital technologies to [improve the precarious market position of local beef cattle farmers as the producers who follow higher environmental standards find it hard to justify the premium demanded for their products in the local market].

The [researchers] interact with [NGOs, farmer organisations and individual farmers] to test [the ZSA GEO map environment] in order to contribute to [promote an effective and easy-to-use marketing tool to promote an emerging food product from semi-natural grasslands characterized by high biodiversity].

----------Living Lab 13 ----------

The LL [Open Lab Sheep] in [France] works on [dairy sheep farms producing PDO Roquefort] and use digital technologies to [prevent animal health and welfare problems].

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

[5 to 10 farmers] will interact with [IDELE (technical institute), advisors, researchers] to test [digital milk counter and connected weight milk tank] in order to contribute to [automatically collect herd production data through tank weight measurement]

----------Living Lab 14 ----------

The LL [Open Lab Viticulture] works in [Occitanum, France] on [viticulture] and use digital technologies to [manage fertilisation to preserve typicality of wines while protecting the environment].

A [group of farmers] will interact with [researcher, advisors, technicians and service providers] to co-develop and test [a chain of digital technologies, including satellite images, vigour maps, user-friendly web interface] in order to contribute to [modulate the rate of applied fertilizer] .

----------Living Lab 15 ----------

The LL [Spraying drones] in [Greece] works on [vineyard spraying and crop protection] and use digital technologies to [help assess and analise the best drone spraying configurations for field use and crop protection].

[Crop protection companies, farmers and UAV manufacturers, independent advisors] interact with [regulatory bodies, policy makers] to test [spraying UAVs (drones) that incorporate GIS for flight planning, various environmental sensors connected to IoT station for the constant monitoring of weather conditions, navigation sensors for altitude adjustment (LiDAR), vision systems for obstacle avoidance] in order to contribute to [obtain qualitative data on the spraying applications and droplet displacement (spraying drift) applying agrochemicals at a desired rate close to the canopy (commonly <5m)].

----------Living Lab 16 ----------

The LL [Automation of Orchard Management] in [Czech Republic] works on [fruit orchard] and use digital technologies to [increase reduce the impact of adverse weather on crops, reduce water and pesticide use, automation of irrigation and facilitate reporting obligations].
[Farmers (5), CSOs members (4), policy makers (2), farm advisors (2)] interact with [researchers on the IT sector, researchers on orchard management] to test [a new sensor-based orchard management system for crop protection, remote control of the irrigation system, frost and pollination monitoring and an end-user application for the farmer] in order to contribute to [collect,store and analyse farm data].

----------Living Lab 17 ----------

The LL [Agri-digital] in [Germany] works on [knowledge transfer on] digital technologies to [increase the application of digital and precision farming technologies in crop production].

[Researchers, demo farms, agricultural teachers and an agricultural state institute] interact with [students and farmers] to develop [a digitally-related educational format on digital and precision farming technologies in crop production] in order to contribute to [support knowledge building on digitalisation in a sustainable und longterm way].

----------Living Lab 18 ----------

The LL [Grassland Management] in [the border between Estonia and Latvia] works on [Grassland] and use digital technologies to [improve monitoring of maintenance regimes of grasslands, particularly protected grassland but also cultivated ones managed for organic beef production].

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

A group of stakeholders interact with researchers to test [drones and machine learning to supply the farmers with data in appropriate format] to [capture the changes in vegetation/tree cover].

----------Living Lab 19 ----------

The LL [RAMAS] in [North Macedonia] works on [crop production] and use digital technologies to [improve agricultural professional support and energy inefficiency to reduce non-optimised agricultural production in term of inputs and processes].

[6 farmers currently users of RAMAS, members of an NGOs] interact with [Researchers and a VET center] to test [a farm accountancy form for agro-technical operations, improved communication processes, a field repository that is going to be presented on a user-friendly dashboard that will incorporate earth observation and environmental monitoring technologies] in order to contribute to [generate data that will be used by experts/advisors for delivering tailor-made advice].

----------Living Lab 20 ----------

The LL [Innovative soil scanner] in [Hungary] works on [arable crops] and use digital technologies to [optimise fertilisation and reduce environmental impact, through site specific fertilizers application].

[Researchers] interact with [a farmer at test site and a precision agriculture advisor] to test [a NIR sensor that upload data by mobile phone in the cloud, based on the database the soil analysis results are sent back to the mobile phone] in order to contribute to [analyse nutrients in soil in a fast, affordable and reliable way to optimise nutrient management and crop production].

Funded by the European Union

CODECS has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement n. 101060179. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.