



DRAFT REPORT ON POLICY ENVIRONMENTS

31ST MARCH 2024

MARÍA ALONSO-ROLDÁN (UCO), MARÍA MAR DELGADO-SERRANO (UCO)



D6.1 DRAFT REPORT ON POLICY ENVIRONMENTS

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	D6.1 Draft report on policy environments
Status	Final
Dissemination level	Public
Date of creation	2 nd April 2024
Keywords	Digital literacy, digital uptake, farming technologies, digital ecosystems, digitalisation.
Authors	María Alonso-Roldán (UCO), María Mar Delgado-Serrano (UCO)
Work Package Leader	WP6 - BSC
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 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.

Content

Acknowledgements	2
List of Acronyms.....	3
1. Key messages.....	5
2. Methodology	6
3. EU and national policy initiatives regarding digitalisation in agriculture and rural areas	8
3.1 Contributions from DESIRA.....	8
3.2 Digitalisation in the Common Agricultural Policy National Strategic Plans.....	9
3.3 New policy areas	9
4. Policy recommendations from previous projects	10
5. Interviews with policy-makers.....	13
5.1 Digitalisation in CODECS countries	13
5.2 Digitalisation in agriculture.....	16
5.3 Digitalisation in the CAP NSP.....	18
5.4 Other policy areas influencing digitalisation in agriculture.....	20
6. Baseline of policy environments for digitalisation in agriculture.....	21
7. Conclusions and next steps	23
8. References	24
9. Annexes.....	25
Annex 1. EU-funded initiatives with relevant policy recommendations	25
Annex 2 – Interview Guide – Policy-makers at EU level	30
Annex 3 – Interview Guide – Policy-makers at EU, extra EU and national level.....	32

Acknowledgements

This deliverable draws on the views of a diverse array of European, national, and regional stakeholders from the agriculture and digitalisation sectors. Representatives from Belgium, Czechia, Germany, Greece, Italy, Latvia, North Macedonia, Poland, Serbia, Slovakia, Slovenia, Spain, The Netherlands, DG AGRI, DG CNECT and the BCO Network participated in this study.

We would like to thank the 26 interviewees who took the time to share their views on digitalisation in agriculture and all the CODECS partners who facilitated their reach. We would also like to acknowledge the continuous support of the project coordinator, Professor Gianluca Brunori, the project Policy Officer, Francesco Iadecola, the CODECS ethical team, and our WP6 colleagues from the BSC. Special thanks to our UCO colleagues, Mélina Granet and Lucía Allen García, for their support in improving the final outcome of this document.



List of Acronyms

AKIS	Agricultural Knowledge Information System
AI	Artificial Intelligence
AMS	Agricultural Monitoring Systems
BCO	Broadband Competence Office
CAP	Common Agricultural Policy
D	Deliverable
DEP	Digital Europe Programme
DG AGRI	Directorate General for Agriculture and Rural Development
DG CNECT	Directorate General for Communications networks, Content and Technology
DIAS	Copernicus Data and Information Services
DIH	Digital Innovation Hub
DSS	Decision Support System
DT	Digital Transformation
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
EIP-AGRI	European Innovation Partnership or Agricultural Productivity and Sustainability
EO	Earth Observation
ERDF	European Regional Development Fund
EU	European Union
FAS	Focal Action Situation
GDPR	General Data Protection Regulation
GPS	Global Positioning System
FAS	Focal Action Situation
FMIS	Farm Management Information Systems
FNS	Food and Nutrition Security
IACS	Integrated Administration and Control System
ICT	Information and Communication Technology
IoT	Internet of Things
JRC	Joint Research Center
MAP	Multi Actor Platform
NIS	Network and Information Systems
NSP	National Strategic Plan
R&I	Research and Innovation
RDP	Rural Development Programme
RRF	Recovery and Resilience Facility
RTK	Real Time Kinematics
SFT	Smart Farming Technologies

SMEs	Small and Medium-sized Enterprises
T	Task
UAV	Unmanned Aerial Vehicles
WP	Work Package



1. Key messages

POLICIES PLAY A CRUCIAL ROLE IN (AGRICULTURE) DIGITALISATION

Europe needs a proactive policy approach to guide digital investments across sectors, fostering collaboration between public and private entities while ensuring digital sovereignty and protecting citizens' rights. Crucial issues like data governance and cybersecurity must continue to be regulated at the EU level, supported by investments in research and innovation.

DIGITALISATION IN THE AGRICULTURE SECTOR AND RURAL AREAS REQUIRES SPECIFIC AND TAILOR-MADE POLICIES

Digitalisation in agriculture demands specific and tailor-made policies that align with broader EU and national strategies, encompassing infrastructure, education, health, etc., and leveraging existing funding channels (RRF, ERDF, CAP, DEP, Horizon Programmes). These policies should ensure accessibility for all sectors, including small-scale farmers. The CAP and agricultural public administrations should increase their support and be seen as facilitators, not controllers, in advancing digitalisation.

DIGITALISATION IN AGRICULTURE IS A PROCESS

There is societal pressure on farmers to support EU green goals, with digitalisation as a crucial tool. However, the understanding of digitalisation in farming varies, lacking Europe-wide data. Digitalisation in agriculture can be understood as a process involving three stages -initial, advanced, and full-. All stages are affected by technology costs, digital skills, and the readiness of supportive digital ecosystem. Tailored support at each stage is essential for farmers' digitalisation progress.

FARMERS' SKILLS AND COMPETENCIES EMERGE AS A CRUCIAL CHALLENGE

Improving digital skills among farmers is key to foster digital uptake, yet increasing digital literacy presents a challenge in older farmers particularly. While there is available training, innovative approaches like demo farms and videos may boost participation. Additionally, digital education is crucial across all educational levels.

AKIS, AGRICULTURAL ADMINISTRATIONS AND FARMING ADVISORS NEED TO UPSKILL AND RESKILL THEIR COMPETENCIES TO GIVE ANSWERS TO THE NEW NEEDS

Agricultural administrations and farming advisors must enhance their skills to address emerging needs. This includes improving advisory systems and training staff to transition to more effective AKIS systems. Additionally, user-friendly platforms, transparent data usage, and clear communication of public procedures are essential to support agricultural digitalisation.

AGRICULTURE DIGITALISATION IS AFFECTED BY DIFFERENT DIVIDES

While progress has been made in bridging the urban-rural gap, ensuring connectivity in remote areas and fields remains a challenge. Age significantly affects the adoption of digitalisation in European agriculture, with younger generations more open to it but less represented in the sector. Access to affordable and tailored farming technologies is crucial, but many farmers encounter obstacles to join the digital transition. Furthermore, farmers' lack of digital awareness leads to distrust in digital technology and to recognise its benefits.

2. Methodology

Task 6.1 (T6.1) *Analysis of policy environments in the EU*, led by UCO, is a component of CODECS Work Package 6 (WP6) *Policy Analysis and Roadmap*, coordinated by BSC. This task, spanning from month 1 to month 36, aimed at three main activities: (i) screening EU and national policy initiatives on digitalisation in agriculture and rural areas, (ii) reviewing policy recommendations from relevant past projects, and (iii) conducting selected interviews with policy-makers at EU, non-EU, and national levels to describe, compare, and contrast different policy environments. The current Deliverable 6.1 (D6.1) *Draft Report on Policy Environments* reflects the work undertaken in the initial 18 months and presents preliminary outputs that should be improved and strengthened in the final report due by month 36.

(i) EU and national policy initiatives regarding digitalisation in agriculture and rural areas

The UCO leading team, drawing from their experience in the DESIRA project (see 3.1 Contributions from DESIRA), possesses substantial knowledge of the status of EU and national policy initiatives concerning digitalisation in agriculture and rural areas. To stay updated on evolving policy areas -like digitalisation-, we monitored the progress of previously analysed policy areas from DESIRA and identified new relevant ones linked to CODECS Living Labs. Each of the 20 Living Labs, with specific Focal Action Situation (FAS) problems, was associated with corresponding policy areas and EU policies and strategies (see example below).

Living Lab Focal Action Situation Problem	Policy Areas	Policies and strategies
Decrease transaction costs and increase environmental, social, and economic benefits of virtual and physical market-place interactions between buyers and sellers in a defined geographical space	• Agriculture and Rural Development • Digital Single Market • Environment and sustainability	• Common Agricultural Policy • Cohesion policy • Digital Single Market Strategy • EU Digital Innovation Hubs • E-commerce Directive • EU Green Deal • Farm to Fork Strategy

Additionally, we examined the Common Agricultural Policy National Strategic Plans (CAP NSP) of participating EU CODECS countries. As these NSPs are available only in native languages and the latest versions are found on national websites, we finally collected 16 CAP NSPs from Belgium-Flanders, Belgium-Wallonia, Czechia, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Poland, Slovakia, Slovenia, Spain and The Netherlands. Due to their extensive nature, we extracted sections related to digitalisation for automatic translation, which posed challenges such as a 1M character limit.

The chosen sections of the CAP NSP were:

- Strategic Statement

- Assessments of needs and intervention strategy, including target plan and context indicators

2.1. SO2 Enhance market orientation and increase farm competitiveness, both in the short and long term, including greater focus on research, technology and digitalisation

2.1. XCO Cross-cutting objective of modernising the sector by fostering and sharing of knowledge, innovation and digitalisation in agriculture and rural areas, and encouraging their uptake

- 8 Modernisation: AKIS and digitalisation



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.

We used the GDPR-compliant DeepL Pro software. The translated documents, ranging from 11 to 78 pages, may have limitations in translating figures and images, which are pertinent in some plans -like the NSP from The Netherlands-. A sample of these documents underwent quality assessment by CODECS partners, with the resulting documents prepared for comparison in the next phase of this activity.

(ii) Reviewing policy recommendations from relevant past projects

Firstly, an initial list of projects related to digitalisation in agriculture and food systems, funded under the EU-funding *Programme for Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research, and the Bioeconomy*, was compiled using the CORDIS portal. As the project descriptions and structures were reviewed, additional projects were discovered and included in the list, resulting in a total of 147 projects. Subsequently, policy recommendations from each project were sought through the project websites, the CORDIS portal, and general web search tools. If policy recommendations were identified, they were categorised based on their relevance to CODECS. Additionally, other pertinent resources, such as roadmaps or useful documents, were considered. An analysis of the relevant policy recommendations was then conducted, as outlined in Section 5 Interviews with policy-makers.

(iii) Conducting selected interviews with policy-makers at EU, non-EU, and national levels

Throughout the duration of the task, the CODECS project aimed to conduct interviews with five policy-makers per partner country, encompassing 15 EU countries (Belgium, Czechia, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Poland, Slovakia, Slovenia, Spain, and The Netherlands) and three non-EU countries (North Macedonia, Scotland-UK, and Serbia), accounting for 90 interviewees at the national/regional level, in addition to 10 policy-makers at the EU level. In this initial phase of the task, the goal was to secure one or two interviewees per partner country and a few policy-makers at the EU level to establish a baseline understanding of policy environments in Europe.

At the 2023 CODECS General Assembly in Almería, a list of interview topics was shared and tested with CODECS partners, who were grouped based on their expertise, including digital technologies, the Common Agricultural Policy (CAP), agriculture, and other areas influencing digitalisation in agriculture. This exercise helped refine the interview guide for subsequent use.

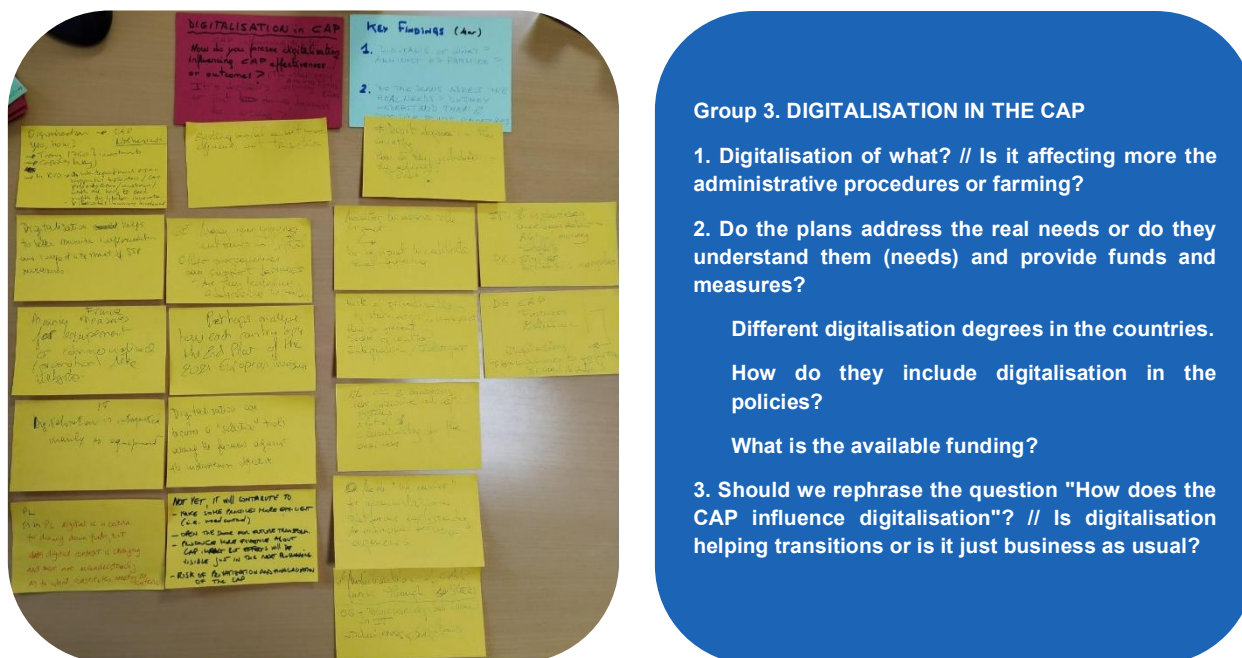


Figure 1 Result of exercise with CODECS partners during General Assembly. Group 3. Digitalisation in the CAP

A list of potential interviewees was compiled, taking into account their expertise, accessibility, familiarity with project partners, and proficiency in English or Spanish – the spoken languages of the UCO team. Partners proposed interviewees who were then contacted to arrange potential interview dates.

The identified profiles for interviewees included:

- **Profile 1:** Individuals involved in drafting or implementing the **CAP National Strategic Plans** (NSP), particularly the digitalisation aspect.
- **Profile 2:** Experts in **digitalisation in agriculture**.
- **Profile 3:** Individuals with experience related to the **CODECS Living Labs**.
- **Profile 4:** Individuals involved in **digitalisation** efforts at the national level.

Given the leading researchers' previous experience with interviews and the exploratory nature of the activity, semi-structured interviews (see Annex 2 – Interview Guide – Policy-makers at EU level and Annex 3 – Interview Guide – Policy-makers at EU, extra EU and national level) were conducted online, mostly individually.

Between February and March 2024, a diverse array of national and regional stakeholders in the agriculture and digitalisation sectors were interviewed, including government officials such as ministers, senior policy officers, and heads of digital inclusion divisions, alongside representatives from agricultural research centres, rural support services, and lobbying institutions. The participation of interviewees was voluntary. Before the interviews, each participant received an information sheet prepared by the CODECS ethical team, which outlined general information on the treatment of personal data for the CODECS project. Additionally, they signed a Consent form indicating their agreement to participate.

The interviews were transcribed using GDPR-compliant software, Amberscript, and subsequently reviewed for accuracy to facilitate further analysis. Key points from each interview were organised into tables corresponding to relevant topics such as digitalisation, digitalisation in agriculture, digitalisation in the Common Agricultural Policy (CAP), and other factors influencing digitalisation in agriculture. These key points were then synthesised and summarised as outlined in Section 5 Interviews with policy-makers

3. EU and national policy initiatives regarding digitalisation in agriculture and rural areas

The CODECS project leverages insights generated by the H2020 project [DESIRA](#) (Digitisation: Economic and Social Impacts in Rural Areas), which extensively examined policy areas related to digitalisation in agriculture across European and national contexts. In the following sections, we highlight key findings from DESIRA and identify policy areas that require further exploration in relation to the Focal Action Situation of the CODECS Living Labs, along with brief notes on the National Strategic Plans of the current Common Agricultural Policy.

3.1 Contributions from DESIRA

The DESIRA project -finished in May 2023- conducted National Policy Analyses on rural and agricultural digitalisation in 15 countries¹, revealing challenges in policy implementation and impact assessment. The analyses identified an urban-rural digitalisation gap, citing issues like limited rural and agricultural data availability, difficulties in ex-post policy impact assessment, rapid technological changes, and coordination challenges, together with the limitations in digital skills and how they affect boosting the intake of digital technologies in the rural, agriculture and forestry sectors. The research also showed a significant influence of European policies on digitalisation (e.g. Digital Europe Programme), rural development (II Pillar of the Common Agricultural Policy -CAP-) and regional development (Cohesion policy) on the national policies supporting rural digitalisation. Looking at the national policies, all study countries developed strategies in key policy areas, namely:

¹ Austria, Croatia, Finland, Flanders (Belgium), France, Germany, Greece, Hungary, Italy, Latvia, Poland, Scotland, Spain, Switzerland and The Netherlands.

- **Infrastructure:** all countries deployed broadband programmes, initially prioritising easy-to-access areas and later incorporating rural and less profitable locations, aligning with European objectives. However, access to high-speed connections in rural areas and at farmhold/field levels has not yet been achieved in most countries.
- **Digital competencies, literacy:** recently gaining attention, countries implemented strategies to enhance digital literacy, addressing dimensions like age, gender, and education. Standalone national strategies in France, Italy, Poland, and Spain targeted digital skills but did not specifically address rural areas. Skill gaps in farmers and rural dwellers curb digital adoption.
- **Rural digitalisation:** varying approaches were observed, with Greece, Hungary, and Spain deploying dedicated programmes. Italy, Austria, Germany, and Latvia integrated rural digitalisation objectives into wider rural development policies. Such strategies consider agriculture within.
- **Digital trust:** aligned with Europe's Digital Future strategy, policies related to cybersecurity, interoperability, and data governance were essential. Countries transposed the European NIS Directive into national legislation, but cybersecurity maturity levels differed. Interoperability guidelines were present in all countries, yet challenges remain. The agricultural sector presents many challenges.

The European Commission (EC) plays a leading role in guiding digital transformation, prioritising human-centric approaches and protecting rights. Rural areas have gained prominence in the political arena through the Long-Term Vision for Rural Areas and the rural proofing mechanism.

3.2 Digitalisation in the Common Agricultural Policy National Strategic Plans

Digitalisation is a cross-cutting objective of the current Common Agricultural Policy (CAP). Member States have been tasked with developing digital strategies as part of their National Strategic Plans (NSPs). In the forthcoming months, our focus will be on examining how digitalisation in agriculture is addressed within the NSPs of CODECS Member States. Our goal is to assess the level of priority given to digitalisation and to identify elements that support policies aimed at advancing digitalisation in agriculture.

The aspects we will review include:

- Whether digitalisation, Agricultural Knowledge and Innovation Systems (AKIS), or innovation are mentioned in the Strategic Statements of the NSPs.
- Description of AKIS and other digitalisation elements within the NSPs.
- Identifying digitalisation and AKIS-related objectives from sections SO2 and XCO of the NSPs, as well as assessing the extent and detail of these sections.
- Comparing information with other sources, such as the Result Indicators dashboard of DG AGRI or the report "Taking stock of how CAP strategic plans contribute to the objectives of the long-term vision for the EU's rural areas" elaborated by Ecorys, Metis, and Agrosynergy in June 2023.
- Comparing findings with the perspectives of policymakers on the role of digitalisation in the CAP.

3.3 New policy areas

The analysis of the Living Labs' Focal Action Situation has highlighted emerging policy areas in health and food safety, including e-commerce and specific sectors like wine production. Over the coming months, there will be a comprehensive review of existing regulations in these domains, with a particular emphasis on the role of digitalisation.

The *Farm to Fork Strategy* has exerted a significant influence on policies pertaining to health and food safety, particularly in primary production, food processing hygiene, packaging, labelling, and quality controls.

In terms of **animal welfare**, there is a proposal to overhaul EU regulations concerning animal protection during transportation, announced in December 2023. This initiative aims to enhance animal welfare during transit and harness digitalisation tools such as positioning systems for trucks to streamline administrative processes.

Regarding **food safety**, new legislation will be proposed alongside revisions to current laws to advance more sustainable food systems. This includes revisiting the **Pesticides Directive**, introducing harmonised front-of-pack nutrition **labelling**, and establishing **nutrient profiles** that impact regulations on nutrition and health claims. These endeavours are closely linked to transparency and traceability, areas that stand to benefit from digitalisation. Furthermore, insights from the *European Health Data Space* will inform future analyses.

Plant health and **biosecurity** are pivotal aspects of food safety policy, necessitating thorough checks and controls where digitalisation plays a vital role. For instance, the "Information management system for official controls to ensure compliance with agri-food chain rules" integrates four information systems, facilitating data exchange and interoperability. The current functionality of this system will be scrutinised.

The optimisation of **fertiliser** use in Europe to ensure food security and regulatory compliance is supported by digital tools such as the "Farm sustainability tool for nutrients". These tools are expected to enhance decision-making processes and contribute to sustainable agricultural practices. A review of its functionality will be conducted.

Furthermore, several regulations impact **e-commerce** in the EU, including the Directive on Contracts for the Supply of Digital Content and Digital Services, the Digital Services Act, and the Digital Markets Act. Relevant updates to these regulations will also be reviewed.

Finally, the potential implications of the recent Artificial Intelligence Act in the agriculture sector will be explored.

4. Policy recommendations from previous projects

From a total of 145 EU-funded projects and initiatives reviewed (see Figure 2), 27 prove to have policy recommendations that directly or indirectly relate to digitalisation in agriculture or rural areas (see Annex 1. Annex 1. EU-funded initiatives with relevant policy recommendations). Thirteen other projects also addressed the issue but have not yet delivered policy recommendations. Hence, we will follow up with them and include their outcomes in the final deliverable. Additionally, three projects requiring close monitoring were identified during the interviews: [Chameleon](#), [Spade](#) and the CODECS-sister project [Quantifarm](#), all of which are funded through Horizon Europe. Less than fifty projects (46) did not present relevant resources either due to being not yet produced or unavailable, while 26 were unrelated to CODECS. The main recommendations can be organised into the following topics:

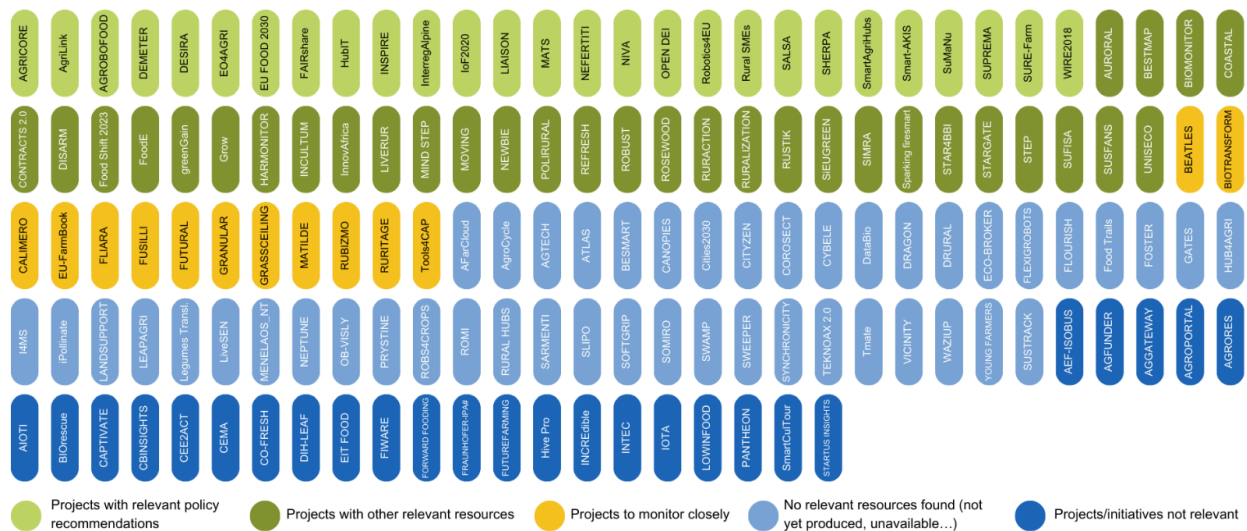


Figure 2 EU-funded projects and initiatives reviewed

Infrastructures: Different projects underscored the importance of connectivity and stable and reliable connections in the rural areas at the farm level (FAIRshare, IoF2020, NEFERTITI, OPEN DEI, DESIRA) as a first and essential step for digital transformation. SHERPA, WIRE2018 and Interreg Alpine Space Smart Villages recommended investing and developing digital infrastructures according to the needs and the technological possibilities of farmers. The latter project supports the role of smart villages in the smart transformation of mountain, rural and peripheral villages. The development of secure platforms where farmers can manage their data appropriately is a demand in the EU FOOD 2030 and SUPREMA projects.

Data and data governance: Even if some projects, such as AGRICORE, have found increases in farmer reliance on data and models, most of the project recommendations highlight that important changes and advances are still needed. Aspects such as facilitating access to public and open data, establishing clear rules on data ownership and usage of shared data, ensuring and facilitating data protection and privacy and farmer's consent, advancing the standardisation of data, or the need for data sharing are mentioned in the recommendations of projects such as IoF2020, NEFERTITI, OPEN DEI, SHERPA, SmartAgriHubs, EU FOOD 2030 and DESIRA.

Other aspects mentioned are the need for granular data adapted to the reality of farms (AGRICORE) or the importance of data spaces and interoperable solutions as good practices for increasing trust and transparency along the supply chain, as recommended by OPEN DEI. SmartAgriHubs also puts emphasis on the importance of creating data spaces and pushing towards interoperability in data spaces, together with developing robust standards for building semantics and agrifood-specific vocabularies/ontologies for data sharing and data spaces.

NIVA suggested developing and agreeing upon semantic and technical standards for enhancing data exchange. Interoperability standards and interconnection of data to provide transparency and reliable and traceable information are demanded by projects such as DEMETER, EU FOOD 2030 and DESIRA. SUPREMA underscored the need for quality control, (cross) validation, and transparency of the models used in the agriculture system, which are crucial topics given the growing importance and plurality of models and modelling approaches. The need for adapted models to individual needs and characteristics is also highlighted.

AKIS, skills and capacity building: The need to increase digital literacy and skills in different actors is a common recommendation in many projects. AKIS and advisory services play a key role in reaching this goal. Public and independent advisory services are needed, and advisors must upskill and reskill their digital knowledge. Farmers demand independent, well-trained, and updated advisory services, as well as inclusive approaches to give answers to their different needs (AgriLink, FAIRshare, OPEN DEI, DESIRA). Advisory services must tackle the digital training of advisers from updated knowledge to new approaches to training and advising based on demonstration activities and the use of harmonised methodologies on the performance of

smart farming technologies (Smart-AKIS). New ways of providing information on digital technologies should be provided, such as specific training campaigns, field trials, demonstrations, and demo farms (FAIRshare, IoF2020, NEFERTITI, OPEN DEI, Robotics4EU). Specialised competence centres providing technical assistance and need-based services dedicated to crucial sectors identified at the local level (e.g. agriculture, forestry, and also tourism and leisure as complementary sectors) should be established (SHERPA). SuMaNu recommended the use of digital tools to control the use of fertilisers.

Digital technologies advance at a very high speed and are expensive. To boost technology adoption, farmers need access to updated and easy-to-understand information on the different existing options and access to funds. Innovation/digital ecosystems are needed as supportive environments aiming at promoting a culture of innovation (NEFERTITI) and promoting the creation of spaces for the co-design of locally adapted digital strategies that include members and organisations from civil society, policy, tech providers and researchers (SHERPA).

Smart-AKIS advocates that solutions should be farmer-centred and use digital tools tailored to the farm size. Concerns are mentioned about the need to ensure that digital tools are both accessible and affordable for smaller-scale producers (SALSA, DESIRA). SHERPA endorses the need to promote and ensure the deployment of adequate resources for the continuous generation and update of basic digital competencies in rural areas, paying specific attention to the digital inclusion of low-skilled and vulnerable groups (e.g., migrants and refugees, the elderly, the hard-to-reach), to ensure the process benefits the whole society. SALSA also encouraged the need to build digital skills among young and older farmers. Smart-AKIS underlined the need to review and update educational curricula at different levels to mainstream smart farming and digital technologies. Changes are needed at different stages, from university programmes to vocational training programmes, to address the broadening range of educational needs in ICT technologies in agriculture and boost the digital transformations of farming practice.

Political, Financial and Legal frameworks: The projects recognise that ensuring connectivity and skills acquisition is a national responsibility, even if it should be promoted at the EU level. Hence, national, regional, and local policies have a very important role in addressing these aspects and ensuring that enough funds and political will are allocated together with efforts to reduce bureaucracy and create friendly and easy-to-use environments (FAIRshare, IoF2020) and integrate commercial and public software to decrease the burden of filling applications, providing mandatory statistics or using aggregated datasets in farming management (NIVA). The role of both CAP pillars in boosting digital transition for competitiveness and promoting sustainability is proposed by several projects (Smart-AKIS, SUPREMA, EO4AGRI, NIVA).

Different aspects are mentioned in relation to the legal frameworks needed to support digital transformation and digital technology adoption: aspects such as interoperability standards, transparency and trust among agrifood actors and technological providers, and data interconnection to provide reliable and traceable information need to be regulated (DEMETER, EU FOOD 2030).

NEFERTITI proposed specific Public-Private Partnerships or agreements that provide targeted funding for digital facilities and combine different types of funding (CAP, ERDF, EIP-AGRI operational groups, R&I funds), while Rural SMEs demanded providing direct financial support to farmers through dedicated programmes, including e.g., vouchers, grants for innovation and transformative projects or subsidised loans aiming at reducing the risk for significant digital investments and WIRE2018 demanded the alignment and simplification in the use of funding instruments. SmartAgriHubs proposed shifting from subsidising product/equipment acquisition to a process-oriented approach based on equipment + advice/service acquisition. The need for financial support for farmers and the importance of sustaining small-scale farmers in their digital transformation pathway are proposed by OPEN DEI, Robotics4EU and SHERPA projects. The MATS project raises a specific concern related to the fact that intellectual property rights on digital tools and platforms are in the hands of providers that have positions of dominance, creating a new barrier to farmers' access.

Tools and technologies: Technologies cannot be the end but the means for specific aims (DESIRA, INSPIRE). Technological/ICT offers need to be tailored according to the specific farmer's need (SmartAgriHubs). The last decades have seen an amazing advance in the development of digital technologies. However, LIAISON acknowledges the EU innovation gap and claims for investments, R&I and political will to address it. The

technologies that have a bigger impact on the agricultural sector are robots, AI, big data, IoT, blockchain, and data-based solutions (agROBOfood, DEMETER). IoF2020 project supports the reusability of IoT components.

Other relevant tools are the advances in earth observation (EO) and data gathering triggered by Copernicus and Sentinels satellites. However, using these tools requires high-level computing skills. Projects such as EO4AGRI, and NEFERTITI advocate for better and easier-of-use information tools, claim for the EC to provide algorithms for Agricultural Monitoring Systems (AMS), develop a knowledge database shared among the EU Member States, incorporate references in AMS regulations regarding conditionality and urge EC leadership in conditionality and agri-environmental schemes, proposing more suitable EU legislation for Copernicus Sentinels, updating EC Regulations to lower monitoring approach requirements, improving standards for "GeoTag" tools, endorsing initiatives for in-situ data collection tools, promoting education for EO end-users, and emphasising follow-up actions by DG-AGRI and JRC on Copernicus Data and Information Services (DIAS) production capabilities. Other projects, such as NIVA, acknowledge Farm Management Information Systems' data (and precision farming data in general) as useful and acceptable tools in the management of CAP payments and encourage data exchange between commercial agricultural software (like FMIS) and information systems used by government agencies (like IACS) to advance in technology adoption.

Social aspects: The EU FOOD 2030 project claimed the need to incorporate Responsible Research and Innovation and greater use of social science and humanities disciplines in digital transformation. Research is needed to understand the reasons farmers distrust data sharing and foster experimentation with data sharing through research projects that should include individual farmers as participants. This project also advocated the participation of the farmers and the agriculture sector in designing digital technologies and policies. DEMETER also backs the approach, and SmartAgriHubs proposed paying attention to the farmer's needs and expectations as the weak ring of the chain and not deploying digital solutions «per se» but services needed and demanded. OPEN DEI, FAIRshare, and HubIT projects highlighted the importance of better communication and raising awareness of the opportunities for the digital transformation of the agriculture sector. The HubIT project recommended greater attention to the ethical aspects of data processing, the importance of risk assessment, and the need to integrate ICT and social experts when designing digital tools and advancing knowledge. DESIRA project proposed an ethical code for digitalisation. Finally, Robotics4EU campaigns for responsible robotics, engaging a wide array of actors in formulating robotics policies and developing product safety, data, ethics and sustainability.

5. Interviews with policy-makers

During the initial phase of *Task 6.1 Analysing policy environments in the EU*, the University of Córdoba (UCO) worked closely with CODECS partners to engage a diverse range of profiles from participant countries. This collaboration aimed to establish a baseline understanding of policy environments supporting digitalisation in agriculture across Europe.

The interviewees comprise a total of 26 individuals, with 20 originating from countries participating in the CODECS project and six representing European-level entities such as the Commission's Directorate-General for Agriculture and Rural Development (DG AGRI), the Commission's Directorate-General for Communications Networks, Content and Technology (DG CNECT), and Broadband Competence Offices (BCOs) Network. Thirteen countries are represented in this initial phase, including 11 EU Member States (Belgium, Czechia, Germany, Greece, Italy, Latvia, Poland, Slovakia, Slovenia, Spain, The Netherlands) and two recognised candidate countries for membership of the EU (Serbia and North Macedonia).

5.1 Digitalisation in CODECS countries

The interviews with policy-makers provided valuable insights into the state of digitalisation across European and EU candidate countries, highlighting a diverse spectrum of efforts and challenges. Despite the progress made in the digitalisation journey by individual countries, the COVID-19 pandemic has accelerated digitalisation efforts worldwide. This has led to the rapid development of digital solutions and services across various sectors, especially in public administration and service delivery, as well as increased adoption of digital technologies.

However, several longstanding challenges persist, including addressing the urban-rural gap in terms of access to high-quality connectivity, enhancing digital skills, and ensuring equitable access to digital transformation initiatives. Additionally, newer challenges such as interoperability, data governance, and cross-border collaboration are now being taken into consideration. From the interviews, three distinct groups emerged: countries excelling in digitalisation, those with average performance, and those facing significant obstacles.

Among the frontrunners in digitalisation, including Belgium-Flanders, Latvia, Slovenia, Spain, and The Netherlands, there is a clear governmental commitment to advancing digital transformation. These countries display well-established infrastructure, widespread connectivity, and efficient digital administration, often supported by comprehensive policy frameworks. Interviewees highlighted ongoing efforts in data governance and data management. Operating under a “digital first” principle, they offer alternatives to the widely-used digital -public and private- services. Challenges in this group primarily revolve around enhancing digital skills, reducing the urban-rural digital gap, improving interoperability, and fostering digital adoption in businesses.

Belgium - Flanders:

- Positioned at the head of digitalisation, with robust infrastructure, fully-functioning digital public administration and policies in place.
- Challenges include addressing the digital skills gap among the elderly and overcoming economic barriers to access digital devices.

Latvia:

- Placed as a frontrunner in digitalisation of public services, following principles like “Open by default” and “once only” principle for public data. Critical state data is stored internally, and there are ongoing efforts to develop a Data Governance Strategy aimed at standardising the management of public data.
- Challenges include digital transformation of businesses, addressing the digital skills gap among older demographics and enhancing cross-border interoperability.

Slovenia:

- Surpasses the EU average in digitalisation, particularly excelling in connectivity, with a universal service that receives continuous support from governments. The government also operates a cloud platform for public data storage. Cybersecurity and data transparency rank among the country's highest priorities.
- Challenges include increasing digital skills, enhancing data privacy measures, and ensuring usability of digital public services.

Spain:

- Performs notably above average, particularly stands out in connectivity, with significant efforts directed towards rural broadband access. Significant investments in skills training for both people and businesses.
- Challenges include standardising interoperability and enhancing technology adoption in businesses.

The Netherlands:

- Frontrunner in digital transition. Widespread use of digital services in public administration. Ubiquitous and affordable connectivity.
- Challenges include ensuring digital safety, data protection, and inclusivity in digital transformation efforts.

In the second group, countries such as Czechia, Germany, and Italy demonstrate average performance in digital transition. Despite prioritising digitalisation at governmental level, these countries face challenges in implementation and effectiveness, often due to the absence of comprehensive guidelines. The primary challenge lies in the digital transformation of the public administration, where paperwork remains the preferred choice among citizens. Additionally, bureaucratic complexities and disparities in urban-rural connectivity hinder the progress of digital agendas.

Czechia:

- Digitalisation is a governmental priority, with recent efforts to centralise coordination through the Digital Information Agency and provide clear guidance.
- Challenges include bridging the urban-rural connectivity gap, increasing digital skills and the number of ICT specialists, and improving trust in digitalisation.

Germany:

- Average progress in digitalisation, especially low in digital public administration and infrastructure, notable efforts in capacity building.
- Challenges include improving education for digitalisation, overcoming bureaucratic obstacles, and managing data effectively.

Italy:

- Digitalisation strategies lag behind actual implementation, with policies emerging after digitalisation processes.
- Challenges include streamlining digital administration and maximising the impact of digitalisation across sectors.

The third group consists of countries that are falling behind in digitalisation, including EU members such as Greece, Slovakia, and Poland, as well as recognised EU candidates, North Macedonia and Serbia. These countries are still in the process of preparing for the ongoing digital transition, particularly intensified after the COVID-19 pandemic. They face challenges including low and uneven connectivity levels across their territories and a significant shortage of digital skills within public administration. While EU countries in this group have developed digital agendas, they struggle to translate these plans into tangible progress, often due to prioritising other issues over digitalisation. Non-EU countries like Serbia and North Macedonia are striving to align with EU digitalisation standards.

Greece:

- Digitalisation progress accelerated by COVID-19, with significant improvements in public services.
- Challenges include enhancing user-friendly applications in the public sector and increasing awareness of digitalisation benefits among citizens.

Slovakia:

- Lagging behind in digitalisation, with challenges such as poor connectivity and bureaucratic obstacles. Digitalisation lags behind other priorities.
- Opportunities exist for digitalisation to address rural challenges, but political will and a cohesive digital strategy are lacking.

Poland:

- Rapid digitalisation progress, particularly accelerated by COVID-19. Digitalisation is a priority, as demonstrated in the current digital strategy.
- Challenges include aligning digitalisation strategies with EU standards and addressing disparities in digital skills across demographics.

North Macedonia:

- Moderately prepared for digitalisation, digital strategy at a very early stage.
- Challenges include improving digital literacy in public administration and raising awareness regarding digitalisation.

Serbia:

- Recent increasing digitalisation efforts, with disparities across regions and age groups. Low digital skills, digital public administration in development.
- Challenges include enhancing digital skills among both government officials and citizens.

The interviewees from the European Commission highlighted the significant impact of policies on the digital transition. Specifically, the development of EU policies such as the Digital Data Act, the Digital Governance Act, and the Digital Markets Act has played a crucial role in preparing and supporting Member States in addressing key aspects of the digital transition, particularly data sharing. Furthermore, Member States that have made proactive political decisions to advance digitalisation made additional progress. It is also essential to mobilise both public and private investments to achieve the objectives outlined in the digital agendas. The role of

connectivity as an enabler for digitalisation is recognised, particularly in rural areas. While the urban-rural gap is narrowing and therefore considered a short-term problem, challenges such as high investment costs and electromagnetic emission limits persist.

5.2 Digitalisation in agriculture

Irrespective of a country's overall digitalisation level, the agricultural sector is still lagging behind. Connectivity, especially terrestrial connectivity, plays a crucial role in enabling digitalisation, but rural and remote regions often lack adequate access. Although data on rural connectivity have been collected for some time, they primarily focus on households and sometimes farms, overlooking measurements in the field, thereby challenging digital transformation.

“Cutting-edge digitalisation in farms requires a right connectivity. Farms will be left behind from the technological development that the rest of society is already making, but this will become much more dramatic soon. They deserve to be connected, and they deserve the best technology.”

Interviewees generally view digitalisation as a means to an end rather than an end goal itself. There is widespread recognition of the potential benefits of digitalisation -such as enhanced efficiency, productivity, and sustainability and to support the European Commission's greening ambitions- but in agriculture, its full potential has not yet been realised.

Adoption rates vary greatly among countries, regions, sectors, type of farms or farmer demographics. Between countries for example, farming practices in the Netherlands are highly digitalised, while those in Slovakia are still in the early stages. Regional differences can also be appreciated, with northern Serbian or German farms showing higher digitalisation levels compared to southern ones. Regarding the sectors, digitalisation is more prevalent in certain ones, such as horticulture, row crops and high-volume production greenhouses. Only in Germany and North Macedonia livestock farms are more digitalised, according to interviewees. Farms with high revenues, such as viticulture in Italy and larger farms, are more willing to invest. Finally, young farmers tend to be more receptive to adopting digital technologies.

The motivations for farmers to embark on the digitalisation journey vary, as reported by interviewees. Some seek to comply with current regulations, such as the animal welfare and traceability requirements in animal husbandry. Others see digitalisation as a solution to specific challenges, such as Greek farmers' increasing demand for precision fertiliser equipment due to rising fertilising prices or automation to address labour shortages on farms in North Macedonia. Digitalisation could offer farmers greater control over their operations, facilitating improved decision-making and resource management. It can also present opportunities to reduce costs by optimising inputs and enhancing overall cost-effectiveness. Additionally, farmers may recognise the importance of adapting to market changes and consumer preferences to remain competitive, motivating them to embrace digital technologies.

“Digitalisation has to be there to help farmers do better. Not just to look at how they are doing but to help them do it better. And that focus is sometimes not enough.”

Limited data availability on digitalisation in agriculture, coupled with diverse interpretations of the concept of “digitalisation” among interviewees, complicates efforts to categorise countries based on their digitalisation levels in agriculture. Nonetheless, EU Member States, with Dutch farms as frontrunners, tend to exhibit higher digitalisation levels compared to non-EU countries.

Interview insights suggest different stages along the digitalisation journey in agriculture, closely linked to technology uptake and development (see Figure 3). Uptake of digital technologies relies on factors such as affordability (availability of public funding, perceived benefits versus investment costs, with machinery often more expensive than software), digital literacy, and readiness of the supportive environment -including political and legislative frameworks favouring trust in the digital ecosystems and the Agricultural Knowledge and Innovation Systems (AKIS) generating awareness- for subsequent exploitation, maintenance and update. As technology

development increases, so does complexity, with a greater number of software and hardware devices in use demanding more specialised digital solutions. This complexity also leads to an increase in data generation, highlighting the growing need for interoperability among digital tools.

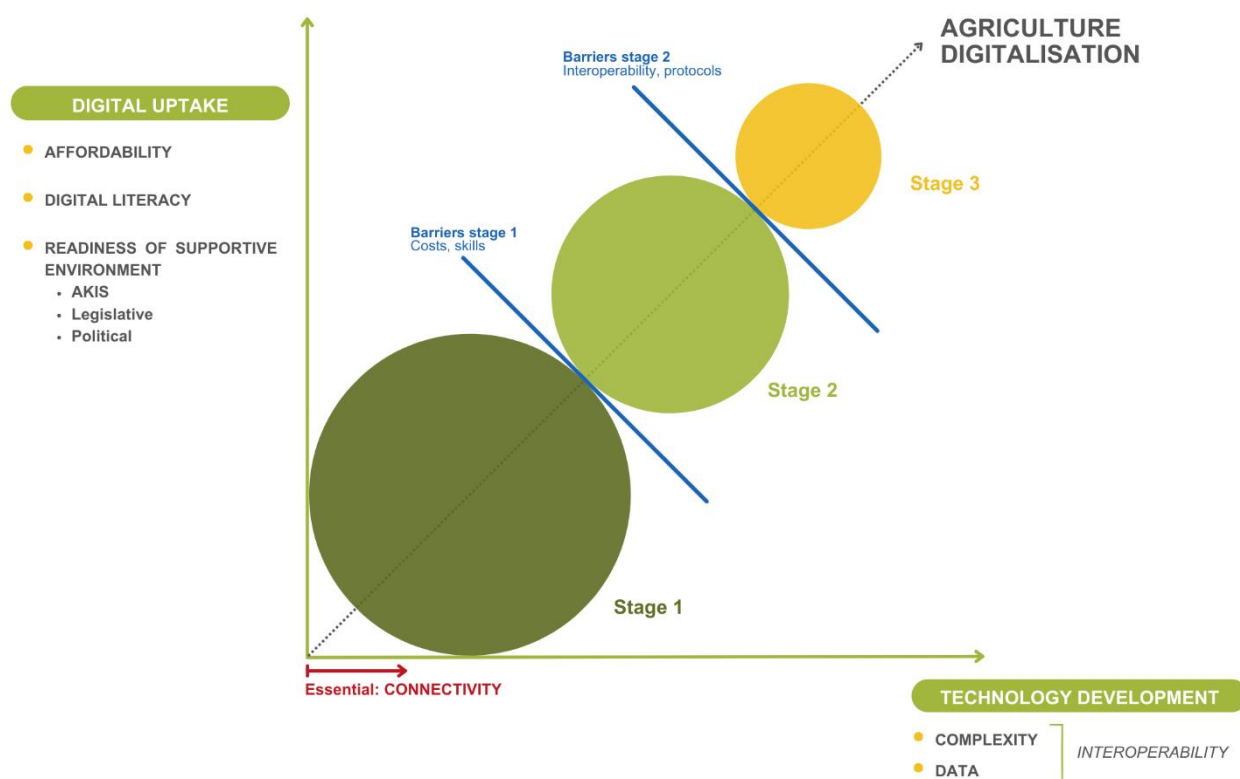


Figure 3 Stages of digitalisation in agriculture.

The different stages of digitalisation in agriculture are outlined below:

Stage 1: Initial digitalisation.

In this early phase, farmers predominantly adopt widely-used software, not specific for the farming sector and potentially linked to the ongoing digitalisation process, alongside specific digital technologies or machinery tailored for agriculture. They utilise digital tools independently or with support from their surrounding environment, such as peers, family members, or the AKIS system. This constitutes the majority of farmers.

“Everybody has a smartphone. Okay, so if you have a smartphone, it's sure that you have a certain degree of digitalisation in your life.”

Popular smartphone or tablet applications are utilised to address various farming needs:

- **Communication:** Instant messaging platforms like WhatsApp are commonly used for receiving advice (a majority of Italian farmers rely on this method, as suggested by an interviewee). These platforms also facilitate customer relationship management and communication with peers.
- **Access to information and training:** Farmers access crucial information, such as weather forecasts, stock prices, and relevant events, and participate in webinars or training sessions.
- **Participation in the digital economy:** Electronic payment systems and e-commerce services enable activities such as establishing short food supply chains for small farmers in Poland or participating in digital auctions for Flemish farmers.

Certain digital technologies or machinery tailored for agriculture can also be present at this initial stage:

- **Automation of farm labour/tasks:** Technologies such as automatic irrigation systems based on humidity levels streamline farm operations.
- **Compliance with legal requirements:** Farmers adopt technologies to meet regulatory obligations, such as compulsory electronic animal identification in EU farms. Additionally, they utilise digital means to communicate with public administrations, such as the Latvian Rural Support Service, which serves as the CAP-paying agency.

The main barriers to progress with digitalisation at this stage include the perceived high cost of digitalisation, insufficient digital skills, and a lack of awareness implying reluctance towards adopting digital technologies.

"The more digitalisation progresses, the more new issues arise."

Stage 2: Advanced digitalisation

During this stage, farms intensify their adoption of more specialised digital technologies, encompassing both hardware and software, initially to support farm operations and, subsequently, farm management. Farming operations still rely on farmers' knowledge and actions based on the data they obtain.

- **Digital technologies for farm production processes:** This includes precision farming technologies for tasks such as irrigation, fertilisation, and pesticide application, as well as GPS-guided tractors, RTK (Real Time Kinematics) systems, sensors, Artificial Intelligence (AI), and UAVs (Unmanned Aerial Vehicles).
- **Digital technologies for farm management:** This category encompasses Farm Management Information Systems (FMIS), which are digital tools that assist farmers in managing efficiently various aspects of their agricultural operations. These systems typically integrate data from multiple sources to provide farmers with valuable insights and decision-making support.

Some farmers in Europe are currently operating at this stage of digitalisation. Farmers' increased digital literacy during this phase introduce new challenges such as data governance, data ownership, and system interoperability.

"Precision farming does not necessarily mean smart farming; the second demands data interoperability."

Stage 3: Full digitalisation or *smart* farming

This represents the final stage of digitalisation in agriculture, where the full potential of current digital technologies is realised. Achieving this stage requires high interoperability of systems -both within the farm systems and with the public systems- and the uptake of digital technologies. Highly specialised and neutral advisors are required at this stage, as well as a strong innovation ecosystem to support ad hoc solutions. Automatic Decision Support Systems, powered by data, can streamline farm management, allowing farmers to focus more on overseeing operations. Farmers at this stage are typically the most digitally skilled, albeit relatively few in number, and are often associated with large agro-industrial or experimental farms.

"Having different machineries from different companies and being bound to their advisory services instead of being able to hand over data farm to independent advisors, remains a challenge."

5.3 Digitalisation in the CAP NSP

Interviewees highlighted significant changes in the current CAP regarding digitalisation compared to the previous programming period. They also sustain that reforms have resulted in a rise in bureaucratic procedures, causing frustration and prompting protests among EU farmers.

For the first time, Member States were tasked with developing **digital strategies** as part of their CAP National Strategic Plans (NSPs). The scope and depth of these strategies varied significantly, ranging from succinct one-page documents to comprehensive frameworks, reflecting each EU country's prior experience with digitalisation in agriculture and agriculture policy priorities. Notably, EU countries such as Italy and Poland lacked prior digital strategies specific to agriculture, whereas Spain and Flanders-Belgium presented more detailed and comprehensive plans. Despite the absence of rigid legal requirements, this exercise induced Member States to reflect on the implementation of digitalisation within agriculture, establishing a foundational framework that was previously lacking. During the interviews, stakeholders from Italy expressed concerns about the complexity of the digital strategy, noting its emphasis on investment interventions over knowledge-based approaches, as well as a higher focus on individual investments than on collaborative investments. Moreover, there is scepticism among stakeholders in Greece and Slovakia regarding the extent to which these digital strategies are effectively being implemented.

Digitalisation within the current CAP is promoted through three key mechanisms: eco-schemes, investments, and knowledge-sharing or advisory services.

Regarding **eco-schemes**, several EU countries, approximately six or seven, have incorporated precision farming into their CAP NSPs. For example, Flanders-Belgium's introduction of a new eco-scheme specifically targeting precision farming for plant production provides ongoing support to farmers, replacing previous one-off payments funded through CAP II Pillar. To qualify for eco-scheme support, farms must adhere to competitiveness and sustainability criteria, including considerations for climate, environment, and animal welfare.

Investments under the CAP II Pillar continue to facilitate digitalisation efforts, subject to sustainability criteria. Notably, in Greece, the 2023 call for innovation investments, including digitalisation, saw approximately half of applicants allocating funds towards digital initiatives -and 10% of the total budget spent on digital-related investments-, representing a significant increase compared to the year 2018 call. Future evaluations will need to distinguish between digital and non-digital investments to assess their impact on agricultural digitalisation.

Farmers across the EU are increasingly interested in precision farming technologies. For instance, *Agriculture 4.0* initiative in Poland, launched in autumn 2023, saw a substantial response, with 150M zlotys allocated within the first eight hours primarily for purchasing tractors equipped with satellite feeds. A similar programme in Italy -finished in late 2023- was partly funded by the CAP and enabled a notable proportion of farmers to acquire internet-connected farm machinery, resulting in approximately 8-10% of the Italian agricultural surface being digitalised.

EU countries have shown a strong interest in integrating digitalisation into **knowledge-sharing and advisory services** within their CAP NSPs. EU farmers increasingly seek guidance on suitable technologies, applications, and investment costs, as they often lack the digital literacy needed and time to develop digital skills. For example, in Italy, although free digitalisation courses are offered through the Rural Development Programmes (RDs), participation rates remain low.

Stakeholders from EU countries have highlighted the need to enhance advisory services for digitalisation, which are currently fragmented, predominantly private, and often lack in-depth knowledge. The initial step involves upskilling and reskilling both public and private farm advisors in digitalisation. Additionally, providing access to independent advisory services is crucial, as farmers are typically limited to the services offered by the machinery or equipment providers. Achieving this requires interoperability of data, robust data governance frameworks, and data literacy among advisors and farmers. Furthermore, public administration should ensure a diverse portfolio of advisors and topics.

“How to transform agricultural advising into AKIS approach as opposed to these agricultural advisory centres trying to have the answer to every problem?”

This shift entails transitioning from traditional advisory services to Agricultural Knowledge and Innovation Systems (AKIS), aimed at providing a holistic approach to promoting digitalisation in agriculture. This approach is particularly relevant given the rapid pace of changes in the sector. Interviewees widely acknowledge the key role of effective AKIS systems across the EU, noting that while AKIS may not always focus solely on digitalisation, digitalisation often features prominently on the AKIS agenda. Successful AKIS rely on collaborative networks,

promoting governance factors, diversity, openness, and long-term relationships. Current CAP funding mechanisms can support this transition by favouring collaborative and demonstrative approaches, which have historically proven effective.

Digitalisation is not only evident in the objectives of the CAP but also in its **procedural aspects**, such as funding applications and monitoring.

Digitalising **CAP funding applications** and other agricultural procedures, like sharing information about crop types planted in specific plots, can help reduce errors -for example, avoiding plot overlaps- thereby accelerating payment processes. However, persistent calls for simplifying procedures highlight the complexity and challenges farmers encounter when accessing EU funds. For instance, filling in the Farm Sustainability Tool can be difficult and timely. Moreover, not all European farmers receive CAP funds. In Italy, due to the large number of existing farms, only a small proportion apply for CAP support, or Slovak farmers are reluctant to apply due to weaknesses in their national administrative system.

The current CAP reform has mandated all countries to develop new algorithms and implement additional checks to accommodate the new measures (e.g. geotag, electronic field books). Even in countries where CAP funding applications are processed digitally -including Belgium, Czechia, Latvia, Spain, The Netherlands, and Germany- challenges with data integration or underutilisation of gathered data persist. The limited digital literacy of public sector workers is one of the elements slowing down progress towards the implementation of online CAP funding applications. In Italy and Slovakia, the digitalisation of CAP funds applications is scheduled for 2024, while online applications have been compulsory for Latvian farmers since 2016.

“Digitalisation requires too much time, sometimes the State Institute does not use all the data collated.”

Monitoring and inspections are increasingly digitised, even in countries where CAP payments have not yet transitioned to digital formats. Farmers are currently unaware of the changes regarding digital monitoring, as these initiatives have only recently been introduced. While some, like farmers in Germany, may express concerns about increased data usage potentially leading to more control and reduced payments, others, such as Dutch farmers, view it as an opportunity to easily showcase implemented good practices and reduce administrative burdens. For example, GPS systems uploading data directly into CAP paying agency systems to increase the speed of payments. Greek farmers, on the other hand, do not perceive data as a significant issue.

To conclude, future assessments of CAP interventions incorporating digital components in the Member States will pose challenges, as they are dispersed, not clearly defined, or funded through alternative sources (such as the Recovery and Resilience Facility, Horizon Europe, Digital Europe Programme, private investment, etc.).

5.4 Other policy areas influencing digitalisation in agriculture

Understanding the broader policy landscape is crucial for grasping the influences of digitalisation in agriculture beyond agricultural policies. Interviewees agreed that policies at various levels, from regional to European, shape digitalisation in agriculture. Similarly, several key areas influence digitalisation efforts, such as infrastructure, education, and innovation. For instance, in Czechia, agricultural high schools have been providing IT training for over two decades, enhancing digital literacy in the sector. Likewise, in Serbia, the State Institution of Application of Science in Agriculture offers train-the-trainer programmes focused on digitalisation.

Intersecting policies can either support or hinder digitalisation initiatives. In Slovenia, for example, the "Intervention measures to deal with the consequences of floods Act" facilitated the deployment of mobile-based stations to improve connectivity in remote areas. On the contrary, Slovenia also pursues a project for data openness and transparency in public administration in which users could see who is having access to their data, facing opposition from certain Ministries.

Successful collaborations between different policy areas have positively influenced digitalisation in agriculture. Examples mentioned by interviewees include continuous data exchange between the Latvian CAP paying agency and various agencies -such as the State Forest Service or the State Revenue Service- to streamline payment processes, as well as the establishment of national bodies like AKIS in North Macedonia, involving

multiple institutions and stakeholders. However, in many countries, such collaborations face challenges due to limited communication among different policy areas or bureaucratic hurdles, as seen in Germany.

EU initiatives play a crucial role in promoting digitalisation in agriculture, evident in projects like the Common European Agricultural Data Space, which will share its first conclusions in April 2024. Funding programmes such as the Digital Europe Programme facilitate, among others, testing and experimentation on AI, while schemes from the Recovery and Resilience Facility (RRF) support digitalisation efforts across Member States towards improving connectivity, digital literacy, hardware or software. Furthermore, Research and Innovation funding in Slovakia contributes to developing a vision for rural areas in line with EU objectives, which will have a positive impact on digitalisation in agriculture.

Regarding policies, the EU has taken steps to regulate key aspects of digitalisation. For instance, the Digital Markets Act indirectly impacts agriculture, addressing players found in both the agriculture sector and elsewhere. The Data Act -together with the Data Governance Act package- recognises the value of data and addresses users' rights, including farmers', although challenges persist, such as incomplete coverage of data ownership issues by existing legislation. Additionally, the Interoperable Europe Act, while potentially burdensome, holds promise for long-term benefits. Finally, the EC's approach regarding artificial intelligence, which regulates use cases, seems appropriate to allow the technology to develop while protecting citizens' rights.

Technologies from non-agricultural sectors can be adapted to address farming challenges, such as robotisation in contexts of labour shortages, and innovation policies could support transdisciplinary knowledge exchange. Efforts are ongoing to strike a balance between enabling a comprehensive view of farming through digitalisation and mitigating potential side effects. Continued evaluations, including those of the European Space for Agriculture Data, shall inform future digitalisation policies.

6. Baseline of policy environments for digitalisation in agriculture

Europe needs a **proactive policy approach** to steer both public and private investments in digitalisation, particularly in agriculture. The **interconnectedness between digitalisation in agriculture and the broader digital landscape** underscores the **importance of robust digital infrastructure**, which is often more prevalent in countries with higher levels of digitalisation. Efforts must not only focus on closing the urban-rural connectivity gap but also on bridging the divide between fields and households to fully unlock the potential of digitalisation in agriculture. While progress has been made in rural connectivity, the emergence of a wider array of connectivity solutions offers promise in extending connectivity to remote and hard-to-access areas, which remain a challenge for most of the countries. Policies should **facilitate collaboration between the public and private sectors**, demanding arrangements with telecommunication and energy operators and innovative funding mechanisms to reach white areas and market-failure areas.

Countries with an advanced level of digitalisation generally have **comprehensive policy frameworks** for digitalisation, encompassing collaboration among different Ministries **breaking down siloed approaches**. More digitalised countries also acknowledge the guidance and obligations provided by the **EC** in favour of the digital transition.

Policy formulation should strike a **balance between safeguarding individuals' rights and fostering technological advancement**. Irrespective of a country's current level of digitalisation, the EC plays a leading role in regulating key aspects such as interoperability and data governance to protect citizens' rights. On the other hand, the EC support of European technology developers and providers as well as research and innovation is crucial to keep pace with digital progress and therefore, working towards **ensuring digital sovereignty in Europe**.

More specifically, **agriculture digitalisation** requires careful planning, **specific policies** and **purpose-driven strategies**. Generic policies, one-size-fits-all approaches, or reliance solely on market forces prove ineffective. Furthermore, policies regarding digitalisation in agriculture should **align fully with and complement other EU and national policies**, spanning areas such as digitalisation, education, healthcare, and environment, as well

as various **funding instruments** like RRF², ERDF, CAP, DEP, and Horizon Programmes. While such initiatives aim to enhance the various aspects of digitalisation, their impact on agriculture is yet to be quantified and will need future assessment.

The **CAP and agricultural public administrations** play a key role in driving the sector's digitalisation. For the first time, the CAP National Strategic Plans include a **digitalisation strategy for Member States**, prompting countries to engage with the topic, which was not always addressed previously. Although it is premature to assess the impact of these strategies, Member States have integrated digitalisation as a **cross-cutting objective** within their eco-schemes, investments, and advisory services. However, the evaluation of CAP interventions integrating digital elements is anticipated to present challenges, often intertwined with sustainability measures. Despite these efforts, concerns regarding increased bureaucracy and complexity within the current CAP are fuelling dissatisfaction and protests among EU farmers. Digital transition in the CAP should be **perceived by farmers as a support for their work**, rather than controlling or punitive. Finally, CAP should introduce incentives to stimulate digitalisation and **support collective options** alongside individual ones. Collaborative efforts among farmers can help alleviate the high costs associated with digital technologies, facilitate learning, and ensure access to tailored data, thereby enhancing efficiency and sustainability. **Small farmers**, constituting the majority of Europe's farming sector (Eurostat, 2022), are often excluded from CAP funding mechanisms, hindering their access to incentives for digitalisation. Conversely, larger farms, associated with intensive production systems, are better equipped to invest in innovation and digitalisation, exacerbating existing disparities. The interviews confirmed this sector divide.

There is significant **societal pressure for farmers** to contribute to the EU's green and sustainability objectives, with digitalisation seen as a key enabler rather than an objective. However, the **concept of digitalisation in farming varies**, and there is a **lack of data to evaluate its status** across Europe.

Access to digital transition remains limited for many farmers, highlighting the need for further attention to understand their **motivations** for embracing digitalisation. **Technology uptake depends** on several factors, including **affordability**, digital **literacy**, and the **readiness of a supportive environment** to foster trust and increase awareness.

The **age gap** significantly impacts digital uptake, especially considering the ageing farming demographic in the EU. Younger generations, more tech-savvy due to daily exposure, are more inclined to implement digital solutions on farms. However, bridging the gap by enhancing digital literacy and encouraging uptake among older farmers poses a significant challenge. Despite the availability of training and digital education opportunities in most countries, few farmers participate, viewing them as an added burden to their already busy schedules. Introducing **innovative training methods** like demo farms, living labs, videos, storytelling, company visits, on-site tests, or experimental trips can boost progress. Education in digital technologies is **vital across all educational levels**, from basic schools to university or vocational training. Although agriculture digitalisation courses have recently been introduced at universities, they typically remain elective rather than core subjects. Furthermore, there is a substantial **shortage of ICT experts** in most countries, emphasising the urgent need to generate interest and make farm digitalisation an appealing career path to ensure a capable workforce for managing digital transitions.

The readiness of digital ecosystems significantly influences digital uptake, often tied to the presence of **clear and supportive legislative and political frameworks** governing digitalisation in agriculture, as well as **effective AKIS systems**, both contributing to increased digital trust and awareness. Farmers need to realise the value of digitalisation in streamlining farm management and administrative tasks. Therefore, **user-friendly platforms**, **transparent data usage and ownership**, and clear **communication** of public procedures are crucial. While **current advisory systems** play a crucial role in agricultural digitalisation, they often lack preparedness for new demands. Although many farmers rely on advisors for digital guidance, public, impartial advisors with the requisite digital skills are often scarce, leading farmers to resort to private advisors or paid services. The learning curve associated with digital tools demands continuous effort and updates, and the advisory system is currently ill-prepared to meet these needs. **Traditional advisors require specific training** to adapt to new opportunities and emerging demands. They should not only advocate for digitalisation in agriculture but also integrate with

² Member States must allocate at least 20% of the total RRF funds to digital measures (EC, 2023)

other policies and establish connections between needs and opportunities. Additionally, public agricultural staff must enhance their digital competencies to effectively support the digitalisation process. In essence, policies should support **a transformation towards effective AKIS systems** ensuring a well-functioning connection between those who produce knowledge and those who use it and fostering digital innovations.

Digital uptake requires time and engagement of farmers, alongside increasing digital literacy. **Digitalisation in agriculture can therefore be presented as a multi-stage process** (presented in 5.2 Digitalisation in agriculture), each entailing distinct requirements, therefore identifying and tailoring support is crucial to facilitate farmers' ongoing farming digitalisation journey. Policies should aim to **increase technology uptake across all farming sectors and types**, by supporting the provision of affordable and **tailored technologies** to meet their needs. Collaboration between farmers and developers is essential to ensure that tools are adapted to farmer's requirements and capabilities. Furthermore, significant investment is needed to **make data accessible and develop user-friendly** displays and visual tools. Policymakers and farmers alike require digital solutions and datasets that offer ready-to-use and easy-to-read information for evidence-based decision-making.

The policy recommendations from previous projects propose pathways to both longstanding challenges, such as infrastructural development for connectivity, which has persisted for almost a decade, and emerging issues, like improving access to AI and Earth Observation tools due to rapid technological advancements. There is a clear call for a comprehensive approach that incorporates technological progress and addresses the various factors necessary for facilitating or participating in the digital transition.

7. Conclusions and next steps

An adequate policy environment is crucial to address the twin transitions and boost digitalisation intake in the farming sector. The sector faces challenges due to disparities in digital infrastructure and policy frameworks across countries, hindering equal access for all farmers. Efforts are needed to bridge urban-rural and field-farmhold connectivity gaps to fully harness digitalisation's potential. While EU initiatives and funding programmes aim to promote digitalisation, challenges such as bureaucracy and limited access for small farmers persist. Understanding farmers' motivations and tailoring support at different digitalisation stages are crucial for a successful transition.

While digitalisation holds great promise for supporting agriculture in a more sustainable transition, granting farmers equal access to the digital transition demands comprehensive approaches, robust political commitment, and coordinated efforts from all stakeholders.

To enhance the understanding of digitalisation in agriculture, this preliminary report on policy environments will evolve over the coming months. We intend to expand our reach by conducting additional interviews with stakeholders across all sectors in every CODECS country. Additionally, we plan to engage farmers in the interview process to capture their perspectives and insights into digitalisation across diverse farming systems. Furthermore, we aim to explore the potential for interviews with farm machinery manufacturers and agricultural technology providers to enhance our understanding of digital developments in farming. We will also continue to analyse upcoming legislation and closely monitor relevant projects to facilitate knowledge exchange. Lastly, the final report will address the policy implications of the different Focal Action Situations addressed in the Living Labs and the cost-benefit analysis of the different technologies adopted.

8. References

- EC. (2023). *Recovery and Resilience Facility - European Commission*. https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en
- Eurostat. (2022, November). *Farms and farmland in the European Union - statistics - Statistics Explained*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics#Farms_in_2020



9. Annexes

Annex 1. EU-funded initiatives with relevant policy recommendations

PROJECT	FULL NAME OF THE PROJECT	SHORT DESCRIPTION	DURATION	WEBSITE	
1	AGRICORE	Agent-based support tool for the development of agriculture policies	The EU-funded AGRICORE project aims to use an agent-based approach to improve on traditional methods with modelling and information and communication technology (ICT). It will use computational modelling to simulate farmers' actions as autonomous or collective entities, with contexts ranging from local to global scales. Artificial intelligence, Big Data, cloud services will be involved in the process. This open source tool will permit more efficient, optimised policies with its predictive and monitoring capabilities while ensuring transparency and constant improvement.	1 Sept. 2019 - 29 Feb. 2024	https://cordis.europa.eu/project/id/816078 https://agricore-project.eu/
2	AgriLink	AgriLink. Agricultural Knowledge: Linking farmers, advisors and researchers to boost innovation.	AgriLink aims to enhance sustainability transitions in European agriculture by analysing and enhancing the role of farmer advice in eight areas of innovation that address the challenges identified in the Strategic Approach to EU Agricultural Research & Innovation.	1 June 2017 - 30 Nov. 2021	https://cordis.europa.eu/project/id/727577 https://www.agrilink2020.eu/
3	agROBOfood	agROBOfood: Business-Oriented Support to the European Robotics and Agri-food Sector, towards a network of Digital Innovation Hubs in Robotics	The agROBOfood project aims to accelerate the sector's digital transformation through the adoption of robotic technologies. To boost the uptake of robotic solutions, it will establish a sustainable network of digital innovation hubs (DIHs).	1 June 2019 - 29 Feb. 2024	https://cordis.europa.eu/project/id/825395 https://agrobofood.eu/
4	DEMETER	Building an Interoperable, Data-Driven, Innovative and Sustainable European Agri-Food Sector	The EU-funded DEMETER is a large-scale project deployed in 18 countries, 15 of which are EU Member States. The project will analyse data obtained from a wide range of actors (production sectors and systems) to provide an integrated interoperable data model enabling optimal resource management in the European agri-food sector.	1 Sept. 2019 - 31 Aug. 2023	https://cordis.europa.eu/project/id/857202 https://h2020-demeter.eu
5	DESIRA	Digitisation: Economic and Social Impacts in Rural Areas	The DESIRA project will develop a methodology - and a related online tool - to assess the impact of past, current and future digitalization trends, using the concept of socio-cyber-physical systems – which connect and change data, things, people, plants and animals. Impact analysis will be linked directly to the United Nation's Sustainable Development Goals, and will contribute to the promotion of the principles of Responsible Research and Innovation. Involving 25 partners across Europe, the consortium will organise 20 Living Labs and one EU-level Rural Digital Forum. The project will ultimately contribute to policy development across the EU.	1 June 2019 - 31 May 2023	https://cordis.europa.eu/project/id/818194 https://desira2020.eu/

6	EO4AGRI	Bringing together the Knowledge for Better Agriculture Monitoring	EO4AGRI will combine Copernicus satellite observation data with exploitation of associated geospatial and socio-economic information services to improve operational agriculture monitoring from local to global levels. The project will support the implementation of the EU Common Agricultural Policy (CAP), focusing on the CAP2020 reform, the requirements of Paying Agencies, the Integrated Administration and Control System processes, and specifications of data-driven farming services in interaction with farmers, farmer associations and agro-food industry. EO4AGRI will consider EC investments employment into Copernicus Data and Information Access Services to assess information concerning land use and agricultural service needs.	1 Nov. 2018 - 31 Oct. 2020	https://cordis.europa.eu/project/id/821940
7	EU FOOD 2030 Project Family	Collaboration of five EU Horizon Projects (FoodSHIFT2030, FUSILLI, FoodE, CITIES2023, FOOD TRAILS)	The EU FOOD 2030 Project Family is a collaboration of five EU Horizon projects coordinating synergistic cross-project initiatives towards a sustainable transformation of the European food system aligned with European Commission's FOOD 2030 and Farm to Fork Strategy.		https://foodshift2030.eu/eu-food-2030-project-family/
8	FAIRshare	Farm Advisory digital Innovation tools Realised and Shared	The EU-funded FAIRshare project will engage, enable and empower the independent farm advisor community by sharing digital tools, services, expertise and motivations. The project will allow advisors to integrate digital tools in diverse advisory and farming contexts across the EU.	1 Nov. 2018 - 31 Oct. 2023	https://cordis.europa.eu/project/id/818488 https://www.h2020fairshare.eu/
9	HubIT	The HUB for boosting the Responsibility and inclusiveness of ICT enabled Research and Innovation through constructive interactions with SSH research	The EU-Funded HubIT project aims to improve Horizon 2020 by ensuring ICT-related innovations remain responsible and inclusive. To do so, they plan to develop a hub that will help the social sciences and humanities and ICT disciplines co-create a vision of inclusivity.	1 Sept. 2017 - 28 Feb. 2021	https://cordis.europa.eu/project/id/769497 https://www.hubit-project.eu/
10	INSPIRE	Towards growth for business by flexible processing in customer-driven value chains	The main focus of this project is the development of innovative business models creating flexible networks through the use of intensified processing that would promote more local production in Europe within the 5 years after the end of this study. Expected outcome of this project would be the description of the current European landscape and link between intensified processing and flexibility, development of innovative business models for different sectors in general, and providing a guideline to measure the performance of such novel models under different scenario	1 Sept. 2016 - 31 Aug. 2018	https://cordis.europa.eu/project/id/723748 https://www.inspire-eu-project.eu/
11	Interreg Alpine Space Smart Villages	Smart digital transformation of villages in the Alpine Space	Alpine rural communities often lack a good provision of services as well as a favourable climate for entrepreneurship and social innovation. Digitalisation is a promising approach to counter the situation, but remains unexploited. SmartVillages unlocked the potential of local actors to make their region a more attractive place to live and work through new forms of stakeholder involvement, by bringing together policy makers, business, academia and the civil society. Finally, the transfer of the project results to the policy level contributed to improve the political framework conditions for digital innovation, for both the organisational / societal part and the technical part.	Apr. 2018 – Oct. 2021	Smart Villages Policies: Past, Present and Future (published 4 Feb 2021): https://www.mdpi.com/2071-1050/13/4/1663

12	IoF2020	Internet of Food and Farm 2020	The EU-funded IoF2020 project will lead the charge in accelerating the adoption of Internet of Things (IoT) technology. With a consortium of 73 partners, including Wageningen University & Research and previous key project partners, IoF2020 aims to foster a symbiotic ecosystem of farmers, food industry stakeholders, technology providers, and research institutes.	1 Jan. 2017 - 31 Mar. 2021	https://cordis.europa.eu/project/id/731884 https://www.iof2020.eu/
13	LIAISON	Better Rural Innovation: Linking Actors, Instruments and Policies through Networks	LIAISON aims to make a significant and meaningful contribution to optimising interactive innovation project approaches and the delivery of EU policies to speed up innovation in agriculture, forestry and rural areas. Researchers, policy advisors, actors from interactive innovation projects, initiatives and networks, farm/forestry advisors, decision-makers and administrators will jointly investigate the design and implementation of interactive innovation project approaches. Looking with the eyes of a larger number of interactive innovation initiatives we will assess the infrastructure of H2020 and Rural Development Programmes at the project, national and European levels.	1 May 2018 - 30 April 2022	https://cordis.europa.eu/project/id/773418 https://liaison2020.eu
14	MATS	Making Agricultural Trade Sustainable	The EU-funded MATS project will explore how to improve trade at private sector, national, EU, African and global levels. Specifically, it will carry out case studies on 15 countries to understand the conditions for sustainability as food is traded from surplus to deficit areas. The findings will shed light on the interactions between agricultural markets, trade, investments, policy, environmental sustainability and human well-being. With this information, the project will design a new benchmark in trade policy analysis.	1 July 2021 - 31 Dec. 2024	https://cordis.europa.eu/project/id/101000751 https://sustainable-agri-trade.eu/
15	NEFERTITI	Networking European Farms to Enhance Cross Fertilisation and Innovation Uptake through Demonstration	NEFERTITI focuses on creating added value from the exchange of knowledge, actors, farmers and technical content over the networks in order to boost innovation uptake, to improve peer to peer learning and network connectivity between farms actors across Europe, thus contributing to a more competitive, sustainable and climate-smart agriculture.	1 Jan. 2018 - 30 Sept. 2022	https://cordis.europa.eu/project/id/772705 https://nefertiti-h2020.eu/
16	NIVA	A New IACS Vision in Action	The EU-funded NIVA project is based on interactive planning to ensure faster turnaround, increased flexibility and further participation of stakeholders. The project is undertaken by nine EU member administrations at national, multi-national and pan-European levels. It aims to accelerate innovation, diminish administrative obstacles, support cooperation in an innovative environment, and increase the flow of information to all stakeholders.	1 June 2019 - 30 Nov. 2022	https://cordis.europa.eu/project/id/842009 https://www.niva4cap.eu/
17	OPEN DEI	Aligning Reference Architectures, Open Platforms and Large Scale Pilots in Digitising European Industry	The EU-funded OPEN DEI project aims to detect gaps, encourage synergies, support regional and national cooperation, and enhance communication among the Innovation Actions implementing the EU DT strategy. The project aims to compare reference architectures and enable a unified data platform, to create large scale pilots and contribute to a digital maturity model, to build a data ecosystem and to strive for standardisation.	1 June 2019 - 31 Dec. 2022	https://cordis.europa.eu/project/id/857065 https://www.opendei.eu/

18	Robotics4EU	Robotics with and for Society – Boosting Widespread Adoption of Robotics in Europe	The EU-funded Robitucs4EU project will apply responsible robotics principles amongst the EU robotics community, envisaging the societal acceptance of (artificial intelligence-based) robotics solutions in the application areas of healthcare, inspection, maintenance of infrastructure, agri-food and agile production.	1 Jan. 2021 - 31 Mar. 2024	https://cordis.europa.eu/project/id/101017283 https://www.robotics4eu.eu/
19	Rural SMEs (Interreg Europe)	Policies to develop entrepreneurship and innovative SMEs in rural areas	To improve the policies on regional support systems for entrepreneurs through exchange of experiences and identification of good practices, implementing the lessons learnt in regional action plans to increase the creation of innovative SMEs in rural areas.	1 Jan. 2017 - 30 June 2021	https://projects2014-2020.interregeurope.eu/ruralsmes/
20	SALSA	Small farms, small food businesses and sustainable food security	SALSA will assess the role of small farms and small food businesses in delivering a sustainable and secure supply of affordable, nutritious and culturally adequate food. SALSA will identify the mechanisms which, at different scales, can strengthen the role of small farms in food systems and thereby support sustainable food and nutrition security (FNS).	1 Apr. 2016 - 31 July 2020	https://cordis.europa.eu/project/id/677363
21	SHERPA	Sustainable Hub to Engage into Rural Policies with Actors	SHERPA project aims to create long-lasting science-society-policy interfaces that engage in developing policy recommendations at European, national and regional levels, and in designing concrete proposals for future research agendas that fill knowledge gaps and meet the needs of rural actors. SHERPA will gather relevant knowledge and use results of past and present research projects (from FP6, FP7, H2020 and other funding streams) to engage stakeholders in discussions in 40 Multi-Actor Platforms (MAPs) around 20 EU countries, and at EU level.	1 Oct. 2019 - 30 Sept. 2023	https://cordis.europa.eu/project/id/862448 https://rural-interfaces.eu
22	SmartAgriHubs	Connecting the dots to unleash the innovation potential for digital transformation of the European agri-food sector	The EU funded SmartAgriHubs project will create a network of digital innovation hubs (DIHs) to boost the adoption of digital solutions by the sector by consolidating, activating and extending the existing ecosystem. The project will integrate technology and business support in a local one-stop-shop method involving all regions and stakeholders in Europe.	1 Nov. 2018 - 30 Nov. 2022	https://cordis.europa.eu/project/id/818182 https://www.smartagrihubs.eu/
23	Smart-AKIS	European Agricultural Knowledge and Innovation Systems (AKIS) towards innovation-driven research in Smart Farming Technology	Smart-AKIS is the Thematic Network focusing on Smart Farming. Smart-AKIS has researched farmers' interests and needs vis-à-vis Smart Farming, disseminated Smart Farming technologies (SFTs) through an online platform, and involved more than 900 stakeholders in 7 EU countries.	1 March 2016 - 31 Aug. 2018	https://cordis.europa.eu/project/id/696294 https://www.smart-akis.com/
24	SuMaNu (Interreg Baltic Sea Region)	Sustainable Manure and Nutrient Management for reduction of nutrient loss in the Baltic Sea Region	SuMaNu (Sustainable Manure and Nutrient Management for reduction of nutrient loss in the Baltic Sea Region) is a platform project which aims to analyse and synthesize approaches to sustainable manure and nutrient management promoted by four international projects. These are Interreg Baltic Sea Region projects Baltic Slurry Acidification and Manure Standards, Interreg Central Baltic project GreenAgri and BONUS Programme project BONUS PROMISE.	Oct. 2018 – Sept. 2021	https://balticsumanu.eu/

25	SUPREMA	SUpport for Policy RElevant Modelling of Agriculture	Sectoral policies are becoming more and more interrelated. Hence, there is a need to improve the capacity of current models, connect them or redesign them to deliver on an increasing variety of policy objectives, and to explore future directions for agricultural modelling in Europe. SUPREMA comes to address this challenge by proposing a meta-platform that supports modelling groups linked already through various other platforms and networks. SUPREMA should help close the gaps between expectations of policy makers and the actual capacity of models to deliver relevant policy analysis.	1 Jan. 2018 - 30 June 2020	https://cordis.europa.eu/project/id/773499 https://suprema-project.eu/
26	SURE-Farm	Towards SUsustainable and REsilient EU FARMing systems	The EU-funded SURE-Farm project is developing a comprehensive framework that aims to strengthen the agricultural sector. By adopting a resilience-focused approach, the project aims to tackle the multifaceted economic, social, and ecological challenges facing the agricultural sector, offering innovative solutions and a path towards a more resilient and sustainable future. By placing stakeholder collaboration at its core, SURE-Farm goes beyond assessments, equipping farmers with novel risk-management tools and facilitating entry into the sector.	1 June 2017 - 31 May 2021	https://cordis.europa.eu/project/id/727520 https://surefarmproject.eu/
27	WIRE2018	Smart Choices für innovative regional ecosystems. The Power of Connectivity, Entrepreneurship and Science & Research.	WIRE 2018 will cover two intersecting issues: digitisation and its impacts on R&I, economy and society, and Alpine challenges. The overall aim of the conference is to raise awareness about the importance of regional innovation ecosystems allowing regional stakeholders to obtain synergies with multilevel policies.	1 Feb. 2018 - 31 Jan. 2019	https://cordis.europa.eu/project/id/814427 https://www.wire2018.eu/page.cfm?vpath=index

Annex 2 – Interview Guide – Policy-makers at EU level



1. INTRODUCTION TO THE TASK

The *Task 6.1 Analysis of policy environments in the EU*, led by University of Córdoba -UCO-, includes a **selected number of interviews with policy makers at EU level**. These interviews have got the aim of *describing, comparing, and contrasting* the different policy environments.

Ten policy makers at EU level will be interviewed along the duration of this task (month 1 to month 36), including people with different profiles:

Profile 1: Digitalisation experts.

Profile 2: People with experience in digitalisation in agriculture.

Profile 3: People involved in evaluating the CAP National Strategic Plans, especially the digitalisation part.

2. ETHICS

The UCO team will ensure the appropriate treatment of the data gathered according to both CODECS and the University of Córdoba Data Management Plans.

Researchers responsible for the task: Mar Delgado (mmdelgado@uco.es) and María Alonso (malonso@uco.es).

3. INTERVIEW GUIDE

3.1. Digitalisation in the EU.

To understand how advanced and promoted is digitalisation in the EU.

To identify key policies/policy initiatives that have given a push to digitalisation.

- How would you describe the current state of digitalisation in the EU? Any key dates or milestones in digitalisation? How is digitalisation in the different Member States?
- Can you highlight key policies or initiatives that have significantly advanced digitalisation in the EU?
- In what ways has digitalisation impacted various sectors or areas in the EU?
- What are the major challenges or barriers hindering further digitalisation efforts?

3.2. Role of digitalisation in agriculture.

To understand the views of stakeholders about the role of digitalisation in agriculture and farming.

To which aspects of agriculture is digitalisation contributing the most?

Which type of agriculture/farming is digitalisation currently supporting the most?

- How do you perceive the role of digitalisation in the current agriculture and farming practices within the EU?
- Could you elaborate on specific aspects where digitalisation has made the most significant contributions to agriculture?
- Which types of agriculture or farming practices have primarily benefited from digitalisation, and why?
- What are some potential drawbacks or challenges associated with implementing digitalisation in agriculture?



Co-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. 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. CODECS has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101060179. Views and opinions

Page | 1



3.3. Role of digitalisation in the CAP NSP.

To understand the role of digitalisation in the CAP NSP (e.g., has it got a key role, is it an add-on, an obligation, perhaps?).

- How do you see the role of digitalisation within the CAP National Strategic Plans in the different Member States?
- How is the CAP influencing digitalisation in agriculture in the Member States?
- How do you foresee digitalisation influencing the effectiveness or outcomes of the NSP in the agricultural sector?

3.4. Role of other policy areas regarding digitalisation in agriculture.

To understand the EU policy environment, to identify other policy areas influencing digitalisation in agriculture.

- Aside from agricultural policies, what other policy domains or areas do you believe significantly impact digitalisation in the agricultural sector? E.g., Infrastructure, education, innovation, etc.
- How do these intersecting policies complement or potentially conflict with efforts to enhance digitalisation in agriculture?
- Can you provide examples of successful collaborations between different policy areas that have positively impacted digitalisation in agriculture?



Co-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. 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. CODECS has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101060179. Views and opinions

Page | 2



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.

Page |

31

Annex 3 – Interview Guide – Policy-makers at EU, extra EU and national level



1. INTRODUCTION TO THE TASK

The *Task 6.1 Analysis of policy environments in the EU*, led by University of Córdoba -UCO-, includes a **selected number of interviews with policy makers at EU, extra EU (UK, Serbia, North Macedonia) and national levels**. These interviews have got the aim of *describing, comparing, and contrasting* the different policy environments.

Five policy makers per partner country will be interviewed along the duration of this task (month 1 to month 36), including people with different profiles:

Profile 1: People involved in drafting or implementing the CAP NSP, especially the digitalisation part (only EU countries).

Profile 2: People with expertise on digitalisation in agriculture.

Profile 3: People with experience regarding the CODECS Living Labs.

Profile 4: People involved in the digitalisation in general at national level.

2. ETHICS

The UCO team will ensure the appropriate treatment of the data gathered according to both CODECS and the University of Córdoba Data Management Plans.

Researchers responsible for the task: Mar Delgado (mmdelgado@uco.es) and María Alonso (malonso@uco.es).

3. INTERVIEW GUIDE

3.1. Digitalisation in the country. (All interviewees)

To understand how advanced and promoted is digitalisation in the different countries.

To identify key policies/policy initiatives that have given a push to digitalisation.

- How would you describe the current state of digitalisation in your country? Any key dates or milestones in digitalisation? How is digitalisation compared to other EU countries?
- Can you highlight key policies or initiatives that have significantly advanced digitalisation within your country? Policies at any level: EU, national, regional, local.
- In what ways has digitalisation impacted various sectors or areas within your country?
- What are the major challenges or barriers hindering further digitalisation efforts?

3.2. Role of digitalisation in agriculture. (Only agri experts)

To understand the views of national stakeholders about the role of digitalisation in agriculture and farming.

To which aspects of agriculture is digitalisation contributing the most?

Which type of agriculture/farming is digitalisation currently supporting the most?

- How do you perceive the role of digitalisation in the current agriculture and farming practices within your country?
- Could you elaborate on specific aspects where digitalisation has made the most significant contributions to agriculture?
- Which types of agriculture or farming practices have primarily benefited from digitalisation, and why?



Co-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. 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. CODECS has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101060179. Views and opinions

Page | 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.

Page |

32



- What are some potential drawbacks or challenges associated with implementing digitalisation in agriculture?

3.3. Role of digitalisation in the CAP NSP. (Only CAP experts, EU countries)

To understand national perceptions on the role of digitalisation in the NSP (e.g., has it got a key role, is it an add-on, an obligation, perhaps?).

- How does your country view the role of digitalisation within the Common Agricultural Policy's National Strategic Plan (CAP NSP)? Is digitalisation considered a pivotal component of the NSP, or is it perceived as an additional feature or obligation?
- How is the CAP influencing digitalisation in agriculture in your country?
- How do you foresee digitalisation influencing the effectiveness or outcomes of the NSP in the agricultural sector?

3.4. Role of other policy areas regarding digitalisation in agriculture. (Only agri experts)

To understand national policy environments, to identify other policy areas influencing digitalisation in agriculture.

- Aside from agricultural policies, what other policy domains or areas do you believe significantly impact digitalisation in the agricultural sector? E.g., Infrastructure, education, innovation, etc.
- How do these intersecting policies complement or potentially conflict with efforts to enhance digitalisation in agriculture?
- Can you provide examples of successful collaborations between different policy areas that have positively impacted digitalisation in agriculture?



Co-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. 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. CODECS has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101060179. Views and opinions

Page | 2



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.

Page |

33