CODECS KNOWLEDGE ACCELERATOR

SUSTAINABLE DIGITALISATION IN RURAL AREAS AND AGRICULTURE

HIGHLIGHTS REPORT

16 APRIL 2024

On April 16, 2024, CODECS (CO-benefits of Agricultural Digitalisation through Conducive Digital Ecosystems) hosted its first **science-policy interface meeting** within the CODECS Knowledge Accelerator framework. Organised by the European Association for Innovation in Local Development (AEIDL), the event brought together 85 participants representing EU institutions, research communities, policymakers, and civil society organisations both from EU and non-EU countries.

Serving as a platform for discussions and knowledge exchange, the meeting aimed to foster dialogue on pressing issues in agricultural and rural digitalisation. Serafin Pazos-Vidal, Senior Expert in Rural and Territorial Development at AEIDL, inaugurated the online meeting by providing an overview of CODECS and its overarching objectives.

CODECS, a Horizon Europe project, is dedicated to cultivating sustainable digitalisation by developing concepts, methodologies, tools, and evidence to comprehensively assess and optimise the benefits and costs of digitalisation in farming. The session focusing on **"Sustainable Digitalisation in Rural Areas and Agriculture"**, delved into how digital technologies can enhance economies, agriculture, education, and community well-being.

ORGANISER: aeidl

16 APRIL 2024

ONLINE

85 PARTICIPANTS
(research, public authorities, advisors, business, producers, other EU-funded projects, etc.)

PRESENTATIONS AND RECORDINGS HERE

If you see this icon, click to see the presentation

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Opening speech

Gianluca Brunori

University of Pisa & CODECS Coordinator

Gianluca Brunori, Full Professor of Food Policy at the University of Pisa and Coordinator of CODECS, set the stage with an insightful opening speech. He delved into the concept of an "**agricultural digitalisation utopia**", envisioning a world characterised by ecological agriculture and the prevalence of digital twins representing agro-ecosystems. These digital replicas offer the ability to simulate system functionalities and remotely manage agricultural operations. However, Mr Brunori acknowledged this vision as a utopia, recognising the considerable journey ahead to realise it fully.

He articulated that the initial strides toward this ideal involve the establishment of **connected farms.** These farms are equipped with sensors, gathering data on agricultural processes. This data undergoes analysis, culminating in the development of practical applications. Subsequently, farmers utilise this information to oversee and optimise system performance. While recent advancements signal progress, Mr Brunori underscored the persistent challenges on the path to realising this vision, particularly in comprehending the intricacies and mitigating associated risks.

Moreover, he emphasised the imperative of viewing **digital solutions within the context of a socio-technical network.** This framework integrates human elements with technological infrastructure, encompassing both goods and services, all of which interact with natural resources. He stressed that the successful adoption of digital solutions hinges upon the establishment of a robust socio-technical ecosystem. Additionally, ensuring compatibility with existing components is paramount, guaranteeing alignment of goals, tasks, and operational methodologies within the system.

Additionally, he highlighted that digitalisation is not inherently transformative. Rather, its impact can vary widely, necessitating a thorough examination of the **costs and benefits** associated with each digital solution. This evaluation should encompass not only economic considerations but also social and environmental implications. To illustrate this point, he contrasted the digital solutions required for different farming practices. Conventional farming often emphasises digitalisation for the sake of streamlining operations and promoting homogeneity, whereas agroecological agriculture prioritises digital tools to enhance crop diversity and complexity. Thus, the impact of digitalisation on agriculture varies depending on the paradigms adopted.

Moreover, he underscored the imperative of integrating an **ecological dimension** into the digitalisation of agriculture, framing it as a pivotal trend in agricultural transformation. Sustainable digitalisation necessitates a holistic approach that addresses not only connectivity infrastructure but also **human capital, data sharing protocols, and innovation policy** frameworks. Merely innovating for innovation's sake is insufficient; rather, it is essential to discern the direction in which innovation should progress. Consequently, digitalisation efforts must be meticulously guided and monitored to ensure alignment with broader agricultural goals and sustainability objectives.

Digital transformation of rural areas: perspective from science and policy

Towards a green and digital future

Stefan Muench & Kathrine Jensen
Joint Research Centre

Stefan Muench and **Kathrine Jensen** from the **Joint Research Centre** provided an insightful overview of their foresight study on a green and digital twin transition, which is a projection of the potential landscape of green and digital transitions by 2050. They identified five key sectors (i.e. agriculture, construction and buildings, energy, energy-intensive industries and transport and mobility) and worked in collaboration with a pool of stakeholders to create innovation timelines for green and digital technologies, envisioning their roles in boosting efficiency and sustainability. In addition, they conducted trend analyses for each sector, considering both technological advancements and contextual factors.

The primary objective of the report is to delve into the interplay between green and digital transitions, referred to as the '**twin transition**', and assess how they mutually reinforce or potentially create tension points. Both transitions are pivotal for Europe's competitiveness and prosperity, evolving along parallel timelines. By using a goal-oriented backcasting technique, the study linked its projections to overarching targets, such as the **European Green Deal** and the **Digital Decade Compass.** By reverse-engineering from these objectives, the team **identified actionable steps necessary to achieve these goals,** mapping out a pathway from the present to the envisioned future.

Moreover, **contextual factors** (namely societal, political and economic) were scrutinised, as they play a crucial role in determining the success of any proposed solutions. These contextual factors serve as determinants for the uptake and implementation of green digital solutions in practical settings. Understanding and addressing these factors are imperative for fostering the real-world application of innovative solutions in pursuit of sustainability and progress.

The speakers presented the conclusions derived from the study, highlighting the pressing need for resilience in light of escalating climate change impacts. These impacts include heightened occurrences of droughts and heavy rainfall events, underscoring the necessity for adaptive strategies within agricultural systems. Moreover, with the global population on the rise, there is an anticipated surge in food demand, and shifting consumer preference towards organically grown produce.

In examining the potential of digital technologies to boost the green transition within agriculture, the speakers acknowledged the inherent unpredictability of technological advancements, particularly concerning specific innovations by 2050. However, the research identifies five fundamental functions facilitated by digital technologies:

1. **Monitoring and tracking:** ensuring the preservation of biodiversity to uphold the long-term productivity of agricultural lands.
2. **Simulation and forecasting:** predicting and simulating weather changes to anticipate their repercussions on agricultural operations.
3. **Virtualisation:** leveraging virtualisation techniques to direct livestock towards areas with high weed prevalence, thereby optimising resource utilisation.
4. **System management:** employing digital tools to optimise agricultural systems, with a focus on reducing fertilizer usage while maintaining productivity levels.
5. **Information and communication:** establishing interconnected farming systems equipped with real-time soil health sensors to facilitate informed decision-

Building upon the insights garnered from case studies, the researchers presented a series of recommendations tailored to the twin transition across diverse sectors, with a specific emphasis on the agricultural domain. These recommendations are categorised into distinct thematic domains:

1. **Social:** Ensuring equitable transitions to sustainable agricultural practices while fostering societal commitment to change and safeguarding privacy and ethical considerations surrounding technology deployment.
2. **Technological:** Establishing robust innovation infrastructures and technological ecosystems, characterised by reliability, coherence, and stringent data security measures.
3. **Environmental:** Mitigating potential rebound effects and minimising the environmental footprint associated with the adoption of green and digital technologies within agricultural systems.
4. **Economic:** Cultivating dynamic and inclusive markets conducive to innovation and equipping agricultural stakeholders with the requisite skills to harness digital tools effectively.
5. **Political:** Implementing standardised protocols to ensure interoperability between digital and green solutions, alongside directing investments towards fostering the development and adoption of sustainable digital innovations.

These recommendations provide a comprehensive framework for steering the twin transition within the agricultural sector towards a sustainable and resilient future, underpinned by the synergistic integration of green and digital technologies.

Policy trends in R&I for digitalisation in rural areas & agriculture

Francesco Iadecola

Directorate-General for Agriculture and Rural Development (DG AGRI)

Francesco Iadecola, representing the Directorate-General for Agriculture and Rural Development (DG AGRI, European Commission), provided a comprehensive overview of policy trends, focusing specifically on research and innovation initiatives for digitalisation within rural areas and agriculture.

Horizon Europe projects, alongside other initiatives funded through various EU programs, are geared towards contributing to overarching policy ambitions spanning environmental sustainability, climate action, and digital transformation across different sectors. Mr. Iadecola emphasised the crucial role of these projects in aligning with and advancing ambitious policy objectives throughout their implementation.

Numerous strategies and policy initiatives have been instituted to support these ambitions, including the Better Regulation agenda aimed at fostering informed policy-making and cultivating vibrant rural areas. Examples of initiatives include the European Green Deal and its associated Farm to Fork strategy, the Common Fisheries Policy (CFP), and the Organic Action Plan. Furthermore, digital-related policies, such as the Digital Decade, complement these efforts, collectively guiding the transition towards a greener and more digitally integrated economy. Coherence, both at the policy and program levels, is identified as a key requirement to ensure effective implementation.

Mr. Iadecola highlighted several key EU programs relevant to digitalisation in agriculture and rural areas. Horizon Europe features dedicated calls specifically targeting the digitalisation of rural areas, with the program synergising with other EU initiatives such as Digital Europe, which focuses on the deployment and uptake of digital technologies. Noteworthy initiatives include the Common European Agricultural Data Space, facilitating safe data sharing among diverse stakeholders. Additionally, European digital innovation hubs serve as testing and experimentation facilities for artificial intelligence, accompanied by dedicated calls to enhance digital skills. Moreover, the Common Agricultural Policy offers support for sectoral digitalisation through tailored tools and mechanisms.

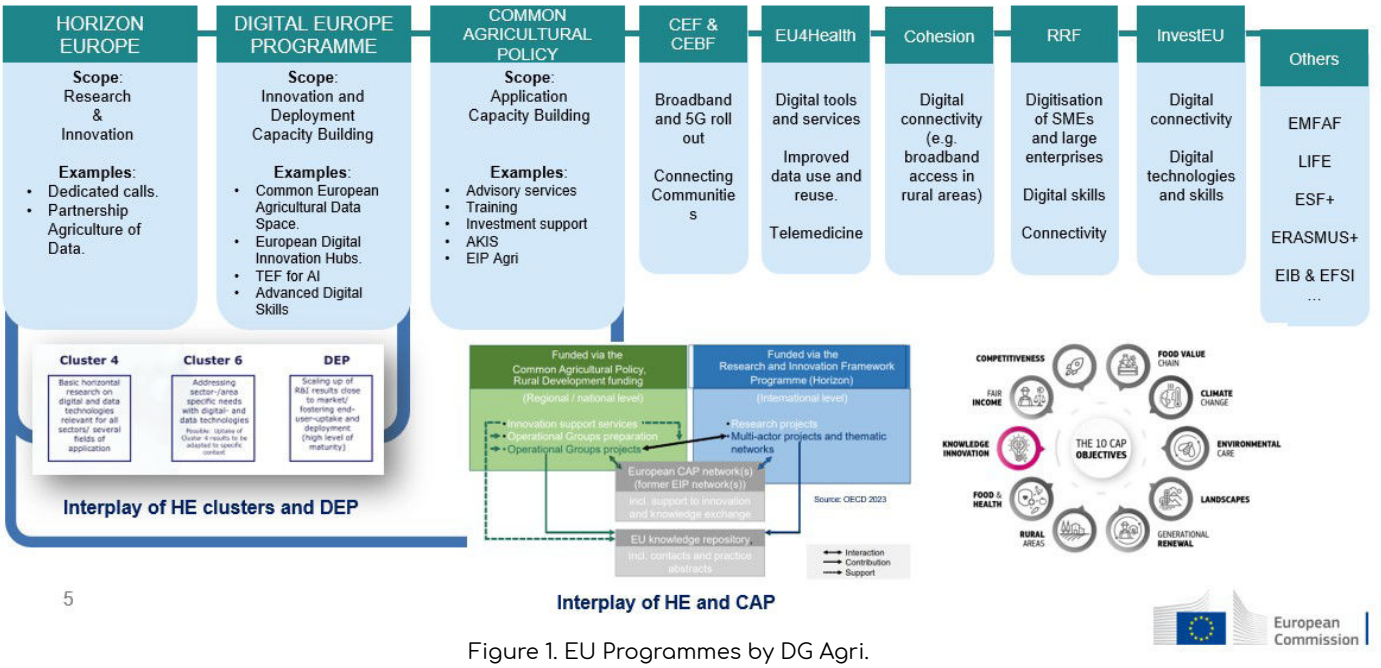

Figure 1. EU Programmes by DG Agri.

Francesco Iadecola, representing the Directorate-General There is a significant emphasis on research and innovation across various domains including food, agriculture, rural development, and the bioeconomy within the EU. Through the implementation of these projects, the EU aims to achieve a multitude of objectives, ranging from the utilisation of drones for forestry and rural transportation to precision spraying on crops, among other applications. A comprehensive framework of policies and projects is in place to ensure the efficiency of digital solutions across diverse contexts. For further insights, the recently published **Strategic Plan of Horizon Europe 2025-2027** serves as a valuable resource.

Mr. Iadecola also highlighted the ongoing **stakeholder feedback consultation on Horizon Europe**, open from 15 April until 6 May 2024, which will play a pivotal role in shaping the agenda for the upcoming period. Additionally, he underscored the crucial role of research and innovation in assessing the environmental impact of emerging technologies, as well as their implications for the well-being of farmers. Challenges such as the digital divide and trust in data sharing were also addressed, emphasising the potential of research and innovation to enhance accessibility, cost-effectiveness, and performance assessment of digital solutions, while concurrently fostering trust and facilitating data sharing.

Digital technologies hold immense promise in empowering farmers to analyse vast quantities of data, facilitating process optimisation and automation. Moreover, Mr. Iadecola emphasised the importance of adopting a **multi-actor approach** involving a diverse array of stakeholders, with a particular focus on placing the end-user at the forefront. This approach ensures that innovations are not confined to the research phase but are seamlessly integrated into mainstream practices, effectively reaching and benefiting end-users.

Research implications in rural digital transition

Elena Toli
Athena Reserach Center

Eleni Toli, research associate at the Athena Research Center, began her presentation by offering a definition of rural areas as articulated by Muys et al. (2023):

> *"Social-ecological **systems** and a **mosaic of land uses** with **various types of human intervention** and productivity and include various degrees of naturalness; they are the less-densely populated areas with less built-up space surrounding the urban areas."*

She emphasised three key words – **systems, mosaic of land uses, and various types of human intervention** – to underscore the inherent **complexity of rural areas.** The interrelation of elements within these systems are often more important than each component alone. This underscores the need for a **systemic approach** to grasp and tackle challenges within these environments. Viewing the digital transition in rural Europe within the context of circular relationships with other systems is crucial, as technology should not be regarded as an end in itself but rather as a means to an end.

Mrs. Toli outlined essential elements necessary for achieving sustainable digital transformation:

- Digital tools that **strengthen social connections** and enhance awareness of rural challenges.
- **Community participation** and co-creation as fundamental for the acceptance and success of any solution.
- Fostering **user-centric ideas** to enable scalability and broader market applications.
- Embracing **open data practices** across the information chain to promote transparency.
- A comprehensive understanding of the **implementation context** of digital technologies.

She underscored the indispensability of combining digital and green initiatives to effectively address climate risks. However, she raised pertinent questions regarding Europe's preparedness for this transition and the requisite skills and human capital needed to facilitate the twin transition. Additionally, she highlighted concerns regarding the potential impact of this transition on the labour market, indicating that 85% of jobs anticipated for 2030 have yet to be created (Institute for the Future, 2019).

Mrs. Toli introduced the study on **Twin Skills from the Twin Transition report**, aimed at addressing skills gaps and mismatches in the green and digital sphere. The study leveraged data analytics and text mining techniques to analyse skills, taxonomies, and occupations regarding actual job positions, extracting trends in the job market and **forecasting future skill requirements.** As a result, the study identified the top six green, digital, and combined skills and occupations, offering valuable insights for informing science, technology, and innovation methodologies to better navigate the labor skill landscape amid the twin transition.

Green & Digital Skills and Occupations

GREEN SKILLS	SCORE
handling and disposing of waste and hazardous materials	100.000
environmental science	90.000
environmental protection technology	90.000
complying with environmental protection laws and standards	84.444
natural environments and wildlife	80.000
advising on environmental issues	65.517
DIGITAL SKILLS	**SCORE**
browsing, searching and filtering digital data	100.000
resolving computer problems	100.000
setting up computer systems	100.000
using word processing, publishing and presentation software	100.000
using computer aided design and drawing tools	100.000
using digital tools for collaboration, content creation and problem solving	100.000
GREEN & DIGITAL SKILLS	**SCORE**
environmental protection technology	6.667
complying with environmental protection laws and standards	4.444
operating agricultural or forestry equipment	3.846
using precision measuring equipment	3.333
designing electrical or electronic systems or equipment	2.500
monitoring environmental conditions	2.381

Figure 2. Green & Digital Skills, Athena Research Centre.

GREEN OCCUPATIONS	SCORE
energy assessor	90.909
natural resources consultant	78.788
energy conservation officer	75.000
environmental policy officer	75.000
energy analyst	70.833
environmental expert	70.588
DIGITAL OCCUPATIONS	**SCORE**
webmaster	98.837
software tester	96.154
user interface developer	93.878
ICT network administrator	93.684
database integrator	93.548
system configurator	93.478
GREEN & DIGITAL OCCUPATIONS	**SCORE**
smart home engineer	6.818
smart home installer	6.667
geothermal technician	4.878
green ICT consultant	4.762
irrigation technician	4.348
environmental education officer	4.000

Figure 3. Green & Digital Occupations, Athena Research Centre.

Practical insights from Multi-Actor approach projects

Digital solutions for rural resilience

Matteo Gerosa
Fondazione Bruno Kessler, SMART ERA

Matteo Gerosa, from Fondazione Bruno Kessler and serving as SMART ERA Coordinator, demonstrated how collaborative efforts among diverse stakeholders drive innovation in SMART ERA (SMART community-led transition for Europe's Rural Areas), an Horizon Europe project launched in January 2024.

The overarching goal of the project is to enhance resilience and diminish vulnerabilities in rural areas. This objective is pursued through the co-creation, development, and validation of digital and non-digital solutions in conjunction with local communities. The project endeavours to analyse and address prevalent socio-economic and environmental challenges, fostering a transition towards smart and community-led initiatives that empower rural inhabitants to instigate change.

With a consortium comprising 25 partners from 10 European countries, the project focuses on a multifaceted approach, integrating both technological and non-technological solutions. Its methodology unfolds across four key phases:

1. Needs assessment and stakeholder expectations: Comprehensive assessments of specific rural areas to discern their needs and understand stakeholder expectations.
2. Co-designing solutions with rural communities: Collaborative workshops and engagements with rural communities facilitate the creation of Smart Innovation Packages (SIPs). These packages embrace a multi-dimensional perspective to address specific rural challenges (encompassing technological, social, and economic aspects), in order to generate contextually relevant and sustainable innovation solutions tailored to rural life.
3. Deployment and evaluation: The SIPs are deployed within the project's six pilot environments, allowing for rigorous evaluation of their efficacy and impact.
4. Replication and testing: Successful innovation packages will be subsequently replicated in four additional regions to assess their adaptability and effectiveness across diverse contexts.

By adhering to this systematic approach, the Smart Era project aims to catalyse transformative change in rural areas while fostering community resilience and empowerment. Through collaborative efforts and a multi-dimensional perspective, the project endeavours to generate contextually relevant and sustainable solutions tailored to rural life.

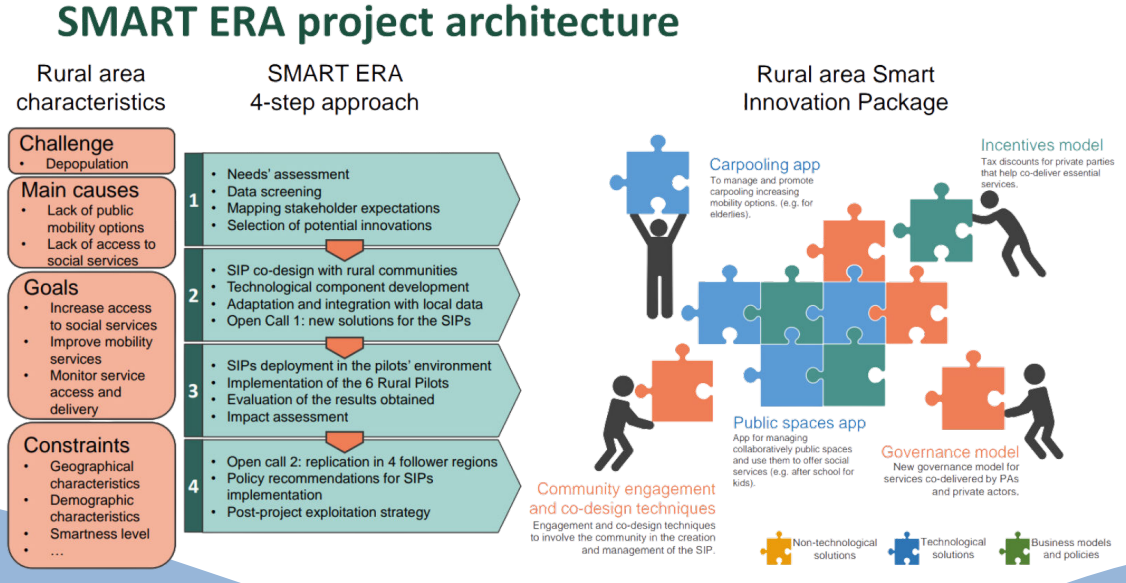

Figure 4. SMART ERA project architecture.

Science and Policy workshop

The second part of the session featured a Science and Policy workshop, where participants engaged in two separate breakout discussions. Serafin Pazos-Vidal facilitated the discussion after the two facilitators reported back.

Multi-Actor Approach for Transformative digital solutions

Facilitated by Emils Kilis

Baltic Studies Centre

The discussions within this breakout room resulted in several significant conclusions regarding the **multi-actor approach** to projects in agriculture and rural development

Firstly, it was emphasised that the development of transformative digital solutions hinges on **ownership of both the problem and the solution.** This can be achieved through community involvement in defining issues and subsequently developing tailored digital solutions, or by leveraging expertise from the digital field to initiate technology development. In addition, facilitators were identified as pivotal in guiding the problem-definition process.

Secondly, participants highlighted the importance of **continuity** in stakeholder groups focused on specific themes or problems. Realistic expectations regarding the capabilities and resources of project partners in digitalisation efforts were deemed essential, particularly in resource-constrained contexts such as rural areas.

Lastly, **improving communication** among diverse stakeholder groups in the multi-actor approach was addressed. Strategies included regular meetings between stakeholders, facilitated discussions, and recognition of evolving perceptions of challenges over time. These insights underscored the complexity and temporality of multifactor projects, emphasising the need for careful consideration of stakeholder dynamics, resource constraints, and communication strategies for successful implementation.

AKIS as a driver of digital and sustainable transformation

Facilitated by María Alonso-Roldán

University of Cordoba

This breakout session began with an exploration of the commonly accepted definition of AKIS, as outlined in the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI):

> *"Well-functioning/effective Agricultural Knowledge and Information Systems -AKIS- connect people and make sure that knowledge is co-created and shared across people who produce it and people who use it (farmers, foresters, advisors, researchers, rural networks, national and regional authorities, businesses, consumers…). Farm advisors play a crucial role providing updated information, acting as information brokers."*

Several key conclusions were drawn regarding the **role of digital technologies in supporting effective AKIS.** It was acknowledged that while digital technologies can play a supportive role in facilitating AKIS systems, they may not necessarily be central to every farming system or accessible to all farmers. Nonetheless, AKIS was recognised as playing a crucial role in the digital and sustainable transition of agriculture.

Various **policy frameworks** were discussed as means to support this transition, including initiatives aimed at increasing digital and entrepreneurial skills among farmers and stakeholders. Emphasis was placed on the importance of **bottom-up approaches** in technology development, advocating for user-friendly and open-source solutions.

Additionally, the issue of **data governance and policy regulations** was addressed, albeit with the understanding that it is still early to determine their full impact on AKIS. The discussion also delved into the balance between EU regulations and Member State flexibility, particularly concerning CAP payment systems.

Overall, it was acknowledged that the diversity of farming systems, farmer capacities, and financial considerations across Europe requires a **nuanced approach to digitalisation** transition, recognising that farmers may join at different stages and for various reasons.

Closing remarks

Gianluca Brunori

University of Pisa & CODECS Coordinator

In his closing remarks, the project coordinator emphasised the abundance of thought-provoking ideas generated throughout the event, which will fuel future endeavours. He highlighted one notable theme that emerged, especially from the workshop, namely the **apparent contradiction between the directional nature of innovation, confronted to the multi-actor approach**. He acknowledged the complexity of this issue, noting that while a multi-actor approach is essential for garnering support, it can sometimes impede progress.

Mr Brunori encouraged further exploration into identifying lead actors and prioritising key issues that truly serve the needs of the people and expressed his optimism for future discussions to not only highlight challenges but also to devise concrete solutions.

This science-policy interface meeting was organised within the framework of **CODECS Knowledge Accelerator**, a network dedicated to promoting knowledge co-creation and enabling stakeholder collaboration. Interested parties can join CODECS KA Community by registering **here.**

Figure 5. CODECS Knowledge Accelerator website.