D2.6 DRAFT REPORT OF COPRODUCTION OF ENVISION SERVICES

Project: Monitoring of Environmental Practices for Sustainable Agriculture Supported by Earth Observation

Acronym: ENVISION

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List of Abbreviations

BiHOCS - Bosnia & Herzegovina Organic Control System
CAP - Common Agricultural Policy
CAPO - Cyprus Agricultural Payments Organisation
CB - Certification Bodies'(CBs)
DRXS – Draxis Environmental SA
DT – Design Thinking
ELMs – Environmental Land Management scheme
EO - Earth Observation
ILVO - Flemish Research Institute for Agriculture, Fisheries and Food
INOS – INOSENS doo Novi Sad
IT - Information Technology
LPIS - Land Parcel Identification System
LV - Flemish Region Payments Organisation
NPA - National Paying Agency of Lithuania
OCS - Doo Organic Control System Subotica
PA - Paying Agencies (PAs)
RRI - Responsible Research and Innovation
URDG - University of Reading
XP – Extreme Programming

Executive Summary

This report will present a draft version of the implementation of the coproduction processes. Thus, will outline the outcomes of the series of consultations with the ENVISION end users in regard to their views and comments on the development of the ENVISION services. Coproduction can support the uptake by end users (by addressing issues such as ease of use, trust (evidence based tool), habit and relevance to user) and potentially mitigate issues around lack of expertise in using EO data and remote sensing technologies, supporting the development of a platform accessible to all users and leading them through areas requiring new skills or technical expertise.

- The report follows the work presented in Deliverable 2.2. "Report of customer requirements from ENVISION services" that had produced qualitative information stored in the form of User Stories which have been analysed to identify common themes and patterns in stakeholder responses.

- A brief discussion over the importance of coproduction of services and products in the agri-food sector is presented followed by an outline of the potential stakeholder and challenges to consider in order to safeguard and effective coproduction.

- Moreover, the key principles and considerations for effective coproduction are discussed and the need for a standardised framework of coproduction is described.

- We implemented a coproduction framework that considered the generation and advancement of knowledge overall, stakeholder experiences and networks, and future collaborations as equally important outputs / products.

- For the ENVISION coproduction we have followed the integration of Design Thinking (DT) into Extreme Programming (XP). This approach aims to involve different stakeholders in a continuous, active, and iterative collaboration through five phases. Each phase has specific objectives and uses suitable engagement methods.

- Our goals were to: improve our knowledge of the main challenges in coproduction, inform the agri-food sector stakeholders about their possible roles and benefits in coproducing digital innovation, increase stakeholder active participation, and share our insights with other large EU consortia that use coproduction methods.

- A set of specific themes have been evaluated by the software developers, and consumers and end users in a series of interactive hybrid workshops. The workshops' results guided the ENVISION product development and coproduction processes. We updated the User Stories we had created earlier and found ways to overcome coproduction difficulties (such as improving communication, defining partner roles and responsibilities).

- We have demonstrated that coproduction is a valuable approach for developing innovative products and services for sustainable agriculture that can address complex and wicked problems.

- We have also highlighted some challenges and opportunities for improving coproduction practice and research.

Introduction and Background

This deliverable is the draft version of the final coproduction Deliverable 2.7. We use this Deliverable to report on the methodological steps taken and present some initial findings set within the context of the current state-of-the-art in terms of scientific literature. The coproduction and delivery of ENVISION is a process that last beyond the project lifespan, so we present these initial findings with the proviso that the interpretation of these results may change when analysed as part of the full data set. This report also sets out the remaining tasks for completion of the coproduction process and provides an insight into the outputs that will be produced.

What is coproduction?

> "*Coproduction rejects the idea of service delivery to passive users, proposing instead they be treated as active participants in the production of outcomes*." (Ryan, 2012)

The term "coproduction" was coined in the 1970's by Ostrom et al., (1978) with a focus on developing public services (Police services) through bringing together government officials and the public to coproduce services. This notion of service coproduction was further developed by Bovaird (2007) "*we define user and community coproduction as the provision of services through regular, long-term relationships between professionalised service providers (in any sector) and service users or other members of the community, where all parties make substantial resource contributions*" and later by (Alford, 2014) to include the coproduction of both products and services and expands on the importance of relationships within the development process.

Coproduction also emphasises the need for feedback loops and the use of feedback as part of an ongoing process. The iterative process of collecting and responding to feedback is highlighted as a vital part of effective coproduction and can lead to substantial changes in the project outcomes (Knowles et al., 2021).

The process of coproduction can bring a range of stakeholders together for a range of different reasons. Within the sustainability sector, there are several key reasons why this is an important project management approach which can be characterised into six "*modes of coproduction*" (Chambers et al., 2021):

1. Researching solutions
2. Empowering voices
3. Brokering power
4. Reframing power
5. Navigating differences
6. Reframing agency

Chambers et al. (2021) also highlight two main motivations for the use of coproduction approaches;

1. to solve predefined problems more effectively
2. to reframe problems

Coproduction can be used to describe process of manufacture, so terminology can cause confusion as terms such as "cocreation", "codevelopment" may also be used.

Why coproduction?

Why use coproduction as a process? Involving end-users in the development of decision support systems can support their uptake and use. Rose et al. (2016) proposes a checklist for the production of agricultural decision support tools, to encourage uptake by farmers, the list includes: Ease of use; Trust (is the tool evidence based and do we have user's trust?); Habit (does the tool fit with the existing habits of the farmer?) and relevance to user. Coproduction can support these aspects of production and potentially mitigate issues around lack of expertise in using EO data and remote sensing technologies, supporting the development of a platform accessible to all users and leading them through areas requiring technical expertise they do not yet have.

What are the drivers of coproduction?

There are drivers from the EU in utilising coproduction and cocreation, for example through the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI), an initiative based on collaboration between groups such as farmers, advisors and researchers and identifying the needs of end-users to cocreate and disseminate solutions to agri-environmental issues (European Commission, 2019). Two examples of these projects are:

- EuroDairy - https://eurodairy.co.uk/
- Inno4Grass - https://www.inno4grass.eu/en/project

"*The cornerstone of both types of projects is the interactive innovation approach in which actors with complementary knowledge work together from the project conception to implementation and dissemination of results. Building blocks for innovation are expected to come from science as well as from practice and intermediaries. End-users and practitioners are to be involved, not as a "study-object", but in view of using their entrepreneurial skills for developing solutions and creating "co-ownership" of results. This speeds up the acceptance and dissemination of new approaches.*" (European Commission, 2019).

In the UK the Environmental Land Management scheme (ELMs), intended to replace the CAP following the UK leaving the EU, has used aspects of coproduction with farmers and land managers involved in designing and testing the systems put in place (see, for example, Peak District National Park Authority, 2020)

Benefits of coproduction

The process of coproduction, while supporting the "production" of knowledge / process / end point that can benefit stakeholders, can itself offer benefits.
- Knowledge of e.g. working with and between different communities and groups.
- Bringing together groups and stakeholders to work on an outcome can foster a sense of belonging, groups can remain together. This echoed in, for example, Communities of Practice, where groups of individuals interested in topic form a group to share and exchange knowledge.
- "Ownership" of outcomes.
- Peer groups and peer-to-peer learning and peer recommendations, stakeholders sharing knowledge, see (for example) Rose et al., 2018.
- End "product" more likely to be accepted and utilised.

- More rapid uptake / ease of use for end-users.

Where has coproduction been used?

Coproduction has been used in a range of settings to bring together groups of stakeholders to develop a range of outcomes.

- Healthcare – healthcare providers / professionals and patients (for example, Coalition for Personalised Care, 2023)
- Sustainability (Galende-Sanchez and Sorman, 2021)
- Public policy and administration (Alford, 2014)
- Education

A variety of EU funded projects have also used coproduction in a range of settings. Some examples are given in table 1:

Table 1: Example of coproduction projects

Project Title	Brief Description	URL
CONFER Coproduction of Climate Services for East Africa	"Focusing on climate adaptation through coproduction of Climate Services in East Africa. Our main objective is to codevelop dedicated climate services for the water, energy and food security sectors with stakeholders and end-users, to enhance their ability to plan for and adapt to seasonal climate fluctuations. With the help of statistical and machine learning tools, we want to improve the accuracy of weather forecasting in the region, in order to reduce impact associated with extreme weather."	https://confer-h2020.eu/
ENABLE	"... partners work together in a co-productive way to test and promote coproduction as a new participatory way to provide services for people with intellectual disability. The coproduction approach on which the ENABLE project has been developed is fundamentally rooted in addressing social injustice and inequity. Training and focus groups were approached from the standpoint of collaboration and partnerships that regard diversity and inclusion in training environments as vital assets that contribute to the richness, accessibility and effectiveness of learning and training activities."	https://coproduction.eu/project-3/

AGORA - A Gathering place to codesign and cocreate Adaptation	"The project will focus on the codesign and cocreation of innovative, problem-oriented climate-adaptation solutions. These cooperative processes will tap the insights of a wide variety of people: citizens, academics, experts, policymakers, entrepreneurs, representatives of civil society organizations, and other relevant actors. The aim is to generate solutions that can be widely adopted in Europe, and that can be tailored to specific contexts and needs to address ongoing socioeconomic change."	https://www.sei.org/projects-and-tools/projects/codesign-and-cocreate-adaptation/

Coproduction methodological frameworks

The process of coproduction may involve using a variety of research methods and approaches. Participatory Action Research (PAR) aims to bring together researchers and communities / groups in order to develop solutions and knowledge in response to community needs. Working on the principle that communities have the expertise and understanding of their "local" needs it aims to give control to those experiencing problems and engage them in finding solutions, leading to more relevant, sustainable solutions and solutions that are more often adopted and utilised (Institute of Development Studies, 2023).

Design Thinking originated within engineering and technical product design, and has now been adopted as a design process across various disciplines (Olsen, 2015). It has been defined as "*an analytic and creative process that engages a person in opportunities to experiment, create and prototype models, gather feedback, and redesign*" (Razzouk and Shute, 2012), and emphasises the need for engagement with the process of design (from both the designer and the people whose needs are being considered) through feedback and re-design processes. Design Thinking will also take into consideration technical feasibility and commercial viability.

Coproduction can utilise a range of methods and techniques, these could include interviews, workshops, focus groups and surveys. One example of the types of survey used is the Delphi style, where the systematic and interactive process fits with the "feedback loops" which support the process of coproduction. Himanen, (2016) describe the use of the Delphi system in codesigning resilient food systems, whereby the iterations and feedback within the Delphi process supported codesign "*Feedback and re-evaluation based on accumulating knowledge should be assistive in codesigning solutions toward developing food system resilience*."

Consideration also needs to be given to how these methods are used. For example, are workshops and interviews held in person, or online? Or is a combination of delivery modes used? Medema et al.

(2014) discuss the benefits of using Virtual Learning Platforms, whereby an online space "... *fosters equal access and a democratic environment for all actors carrying a diversity of views and opinions. It also provides a safer and more accessible environment to the wider public for more easer and open engagement and expressions of views and opinions.*"

Tools

Examples of specific software and tools used in ENVISION are described in section 4.

Coproduction stakeholders

Who are the specific stakeholders within the agri-food sector we need to consider within ENVISION? The stakeholders who need to be involved in a successful coproduction process will depend on the focus and endpoint.

Broad range of potential stakeholders:

- Farmers, landowners, agricultural workers
- PA's and CB's
- Retail sector
- Consumers

For each stakeholder, their role within sector needs to be identified, relationship dynamics need to be understood, and what influences stakeholders have on decision making and technologies.

Challenges of coproduction

Establishing and bringing together groups of stakeholders for coproduction can be challenging. Cultural differences can cause difficulties in discussions and enabling all stakeholders have the opportunity to both speak and be heard. Time constraints may also be an issue. The coproduction process can be time consuming; stakeholders may have limited time available to contribute to the process. Accessing a physical or online space in which stakeholders can meet may also be problematic. Physical meetings may require travel time and incur costs, online or virtual meetings (for example via Zoom or MSTeams) requires stakeholders to have access to technology and an internet connection that enables them to participate in full.

Ensuring all stakeholders can contribute is important. Communication needs to enable between all stakeholders. There could, for example be language constraints, both in terms of stakeholders having to communicate in their non-native language and the use of "discipline-based" or "expert" language. Hierarchies could also form, and it is important to emphasise that coproduction aims to give **all** those involved in the process a voice. Norstrom et al. (2020) highlight the need for frequent interactions between all participants in the coproduction process and the need to avoid token participation. Galende-Sanchez and Sorman (2021) undertook a review of sustainability policy focussed projects that used coproduction. They highlight that many of the projects (60%) although described as coproduction, did not go beyond a consultation model, and note that in these instances it is often experts that are the focus, not the diverse range of stakeholders. The roles and responsibilities of stakeholders should be clarified and communication between different groups enabled.

Principles and key considerations for effective coproduction

What needs to be considered when designing and implementing coproduction? Beier et al. (2016) developed a series of recommendations for coproduction which included a set of guiding principles and recommended practice. Emphasis was placed on sharing of both knowledge and the constraints faced by different groups of stakeholders, for example with scientists this could involve discussing uncertainty around research results. Flexibility also highlighted, flexibility to, for example, adapt the outcomes of the coproduction process to range of different scenarios or contexts. Using evaluation to feedback on the process of coproduction as well as the outcomes in order to improve following iterations was also highlighted as an important step in the process of coproduction.

This section will bring together a "checklist" of considerations towards a standardised framework for effective coproduction and will be reported on in D2.7.

Materials and Methods

In this section, we present the methodological framework that describes the ENVISION coproduction approach for the development of a platform, mobile application, and EO-based monitoring services to facilitate sustainable agriculture through compliance with the EU CAP. While ENVISION, as an EU H2020 Innovation project, primarily aims to the production of a commercially viable and desirable toolbox to address specific needs of the agri-food sector, we implemented a coproduction framework that considered the generation and advancement of knowledge overall, stakeholder experiences and networks, and future collaborations as equally important outputs / products. Through the specific activities described in the following sections, WP2 ultimately aimed to enhance our understanding of key coproduction challenges, raise awareness in stakeholders of the agri-food sector regarding their potential involvement and benefits of coproduction for digital innovation, maximise stakeholder active engagement, and share the lessons learnt with other large EU consortia that employ coproduction approaches.

ENVISION coproduction: Design Thinking into Extreme Programming (DT-XP)

To improve the quality and usability of the ENVISION software interface for customers and end users, Design Thinking (DT) practices were integrated into Extreme Programming (XP) development processes.

What is Extreme Programming

Extreme Programming (XP) is an agile software development methodology that focuses on user centricity. It improves software development in five ways; communication, simplicity, feedback, respect, and courage (Erikson et al., 2005). This methodology considers customer satisfaction at its core and aims to involve all partners in a collaborative team as equals and empowers developers to respond to changing customer requirements (Wells, 2013).

What is Design Thinking

Similar to XP, Design Thinking (DT) describes an iterative, interactive, human-centred development process that involves collaboration, and interactive visualisation and testing of prototypes and business plans (Lockwood, 2009). Further to EP, DT proposes 5 distinct phases in the innovation process through which users can define problems collaboratively, identify potential solutions, develop, and test those, and develop plans for their commercial implementation and viability. The implementation of these phases in the context of ENVISION is described in more detail in the section "The 5 phases of Design Thinking in ENVISION" below.

ENVISION coproduction stakeholders

Identifying and engaging with all potential stakeholders is among the most critical and challenging aspects of developing an effective coproduction approach, particularly when considering such complex concepts as *sustainable agriculture* and ambitious targets as the *commercial implementation* of innovative digital technologies, as ENVISION does. ENVISION identified the following main groups of stakeholders that would play a key role in the development of commercially

desirable and viable EO-based monitoring technologies addressing CAP requirements for sustainable agriculture:

- **Business cases** – here we identified members of the three *Paying Agencies* (CAPO, NPA, LV), one *Certification Body* (OCS), and one *Farm Assurance Scheme* (LEAF) pilots. This diverse group consisted of a range of experts including senior governmental officers, administrative officers, field inspectors, IT experts, and associated farmers.
- **Developers** – this group involved platform, service (i.e., model), and mobile application developers from AgroApps, DRAXIS, NOA, and EV ILVO, consisting primarily of IT experts and project managers.
- **Coproduction facilitators** – this group included academics (URDG) as the lead coproduction facilitators, and involves a collaboration with researchers and service developers (EV ILVO) for the monitoring of business case implementation, as well as with communications managers (ITC) and project managers (DRAXIS) to address specific coproduction challenges such as potential issues with dissemination of information and materials, lack of resources and time, etc.
- **Lighthouse customers, advisory board members, and other external stakeholders** – here we identified potential users of the ENVISION platform, services, and mobile application that were external to the project consortium, but expressed an interest to be actively involved in aspects of the coproduction process (e.g., design, testing). The group involved among others Paying Agencies, Certification Bodies, farmers, academics, and IT developers.

The DT-XP coproduction approach that describes the ENVISION product development journey, attempted to engage the groups of stakeholders described above in a continuous, active, and iterative collaboration through 5 phases, formulating specific objectives and using appropriate engagement methods as presented in the following section.

The 5 phases of Design Thinking in ENVISION

As in the more classic DT approaches, the ENVISION DT-XP began with the **"Empathise"** phase, which aimed to help developers better understand user requirements and concerns that need to be addressed by the end products (i.e., services, data products, knowledge, experience, networks). In this phase, the stakeholders explored also potential challenges that could have made development and adoption of the end products difficult, as well as opportunities and threats to their implementation and viability at large or commercial scale. This phase was facilitated through questionnaire-based surveys, semi-structured interviews, and workshops that involved all potential stakeholders (i.e. ENVISION coproduction facilitators, developers, business cases). The qualitative information was stored in the form of User Stories, as described in detail in Deliverable 2.2. "Report of customer requirements from ENVISION services", and analysed to identify common themes and patterns in stakeholder responses.

Next was the **"Define"** phase, where ENVISION business cases and developers reflected on previously identified User Stories (requirements, concerns, and challenges) in order to prioritise and redefine the most concerning issues that need to be addressed. ENVISION business cases used the *"importance of requirement/concern/challenge to stakeholder"* and *"urgency to address"* criteria to prioritise User Stories, while ENVISION developers considered the *"Effort to address"* and *"Data intensity"* criteria.

In the **"Ideate"** phase that followed, stakeholders used the prioritised User Stories to identify and design innovative solutions, as well as to adapt and improve existing ones. To facilitate this, we held technical workshops where ENVISION developers presented wireframes and mock-ups of the proposed platform, services, and mobile application, and business cases provided detailed feedback considering the previously established User Stories and the following characteristics / functionalities:

i. *Layer and data visualisation* – this explored what type of information that is relevant to the demographics of monitored parcels do business cases want to visualise (e.g., location, ID), which alerts and graphs from services relevant to the declaration (e.g., baseline NDVI values for crop growth monitoring), and at what temporal and spatial resolutions.

ii. *Data and information uploading* – this explored what purpose would service users want to be able to upload data and information for (e.g., training / improvement / updating of services), which specific file formats would they want to be able to upload, which potential users would need access to such features (e.g., inspectors, farmers, IT experts), and at what frequency.

iii. *Data requests and acquisition* – similar to above regarding requested file formats, frequency of data and information downloading, and users that would have access to this functionality, as well as issues of interoperability i.e., would service users need to transfer data and information from the ENVISION platform and services to their own existing systems.

iv. *Integration with existing systems of the business cases* – here we identified service users' existing systems and asked them to describe the systems' architecture, workflow, and uses to identify potential connection points, as well as to better understand how business cases envisioned the ENVISION platform and services working through their systems.

The identified solutions (i.e., ENVISION services) were then developed into artifacts (**"Prototyping"**) around the specific pilot cases through a coproduction phase that involved frequent (i.e., biweekly) bilateral technical meetings led by the ENVISION developers (i.e., developer – business case meetings). A detailed log of the development process (e.g., progress of specific tasks, issues that emerged and how they were overcome) was kept on the Trello platform (software development management platform), which was accessible for information purposes and for reflection on piloting progress by all ENVISION partners.

The final coproduction phase described by our DT approach, involved the **"Testing"** of services by all business cases regardless of whether they were involved actively in the development of a specific service, and potential customers, developers, and farmers external to the consortium (e.g., Lighthouse Customers). To facilitate this, we structured *coproduction workshops* for external stakeholders to test and reflect on the ENVISION platform, services, and mobile application, and engage in a *feedback and update / improve* iterative process with ENVISION developers. Within the context of this phase, such a coproduction workshop will be held for software developers external to ENVISION and with multidisciplinary backgrounds, in May 2023; specific emphasis will be given on the features and functionalities of the ENVISION Add-on Development Tools. As potential end users of the ENVISION mobile app, farmers will be consulted through another coproduction workshop in June 2023.

Monitoring and evaluation of business case implementation: Links with WP5

In the context of the DT-XP ENVISION coproduction approach described above, the *"business case implementation"* process largely involved activities that took place during the *"Prototyping"* and *"Testing"* phases. During these, WP5 led the monitoring and evaluation of relevant activities and progress made, specifically working through an *Operational* and an *Evaluation* period.

The *Operational* period, included three *"activity groups"*:

i. **Use and testing of the ENVISION products and services within the business case** – involving the development of the business flow (business logic) within the specific requirements of each business case, the testing of the products under different conditions and scenarios, and the integration of the products within the business case workflow and existing systems whenever necessary.

ii. **Communication and collaboration between the consumers, the providers, and the end users** – involving technical meetings, webinars, and workshops at business case and consortium levels to support the implementation phase (e.g., ensuring that the desired and correct data formats were accessible via the platform and services)

iii. **Gathering and reporting of feedback** – this was performed through frequent workshops, questionnaire-based surveys (e.g., regarding user-friendliness and user acceptance), and ENVISION product demonstration events (both internal and external to the business case)

The *Evaluation* period included a single *activity group "Evaluation of business cases and their added value in collaboration with WP2"*, which involved the definition first of evaluation criteria through consultations with stakeholders within the ENVISION consortium, identification of baseline standards and information (for benchmarking purposes), and finally the validation of ENVISION products and services.

As the *Evaluation* period and activities are still under way, the concluding outcomes from the feedback, progress, and identification of potential challenges during the implementation of business cases will be reported in D2.7 (M36), together with the WP2 feedback on User Stories, the ENVISION coproduction experience (i.e., stakeholder perspectives). Further joint WP5-WP2 workshops with the business cases will be conducted in early September 2023 for a final evaluation of the pilots and coproduction experiences.

Continuous feedback on coproduction

Similar to the business case monitoring and evaluation process led by WP5, the coproduction facilitators of WP2 structured a group of activities to gather continuous feedback on specific aspects of the coproduction framework, and reflect on coproduction stakeholders' perspectives, expectations, and experiences.

Progress and reflection on User Stories, the ENVISION product development process, and ENVISION coproduction framework

As explained in the DT-XP description above and in D2.2. in more detail, User Stories have been a core element of the ENVISION product development process and the overall DT-XP coproduction approach.

The software developers used the identified User Stories as a progress guide throughout the development and business case implementation phases to ensure that the ENVISION platform,

services, and mobile application would address the consumers and end users requirements adequately. A log of the specific tasks, progress, and challenges associated to the established User Stories were kept on the Trello management platform, in the deliverables D4.2 and D4.3, as well as through the detailed feedback and evaluation processes of WP5 (section 4.2. above).

The coproduction facilitators led a series of interactive, hybrid workshops during the first consortium meeting in Thessaloniki, Greece (May 2023) that aimed to collect feedback from ENVISION stakeholders regarding the progress made in relation to each individual User Story, and to update User Stories through a consensus approach whenever necessary. The workshops included a mixture of quantitative and qualitative data and feedback collection methods through the Mentimeter platform, which then informed group (i.e., group of developers, group of end users) and joint discussions. Some of the specific themes that were evaluated by the software developers, and consumers and end users in relation to User Stories and ENVISION product development were:

- *Considering each of the established User Stories, do ENVISION products and services meet my needs and expectations?* (scale from 1-Dissatisfied to 10-Very satisfied)
- *Are my concerns being addressed throughout the ENVISION product and services development process?* (scale from 1-Not at all to 10-Fully addressed)
- *Do I feel confident that the end product will fit my future strategic planning?* (scale from 1-Not at all to 10-Very confident)

The workshops also involved an exploration of ENVISION stakeholders perceptions and reflection on coproduction related concepts, including the following:

- *What does successful coproduction mean to me?* (Word-cloud exercise)
- *State your level of agreement regarding the following statements as requirements for a successful coproduction: frequent communications; active collaboration on every objective; active engagement with stakeholders from beginning to end; active and frequent engagement with farmers (end users); active and frequent engagement with developers*
- *I feel that communications in the first half of ENVISION coproduction were 1-Not effective to 10-Very effective*
- *We need to prioritise on improving our communications with: Lighthouse customers and advisory board members; Project management; Coproduction facilitators; Farmers; Developers* (Voting exercise)
- *The specific tasks of other ENVISION partners and stakeholders throughout and till the end of coproduction are clear to me* (1-Strongly disagree to 10-Strongly agree)
- *I understand how other partners' tasks relate to my work within the ENVISION coproduction* (1-Not at all to 10-Fully understand)
- *My worth within the ENVISION coproduction is dependent on other partners delivering objectives in a timely manner* (1-Not at all to 10-Absolutely dependent)
- *All ENVISION partners are equally represented in the ENVISION coproduction* (1-Strongly disagree to 10-Strongly agree)
- *All ENVISION stakeholders are equally represented in the ENVISION coproduction* (1-Strongly disagree to 10-Strongly agree)
- *I feel confident that ENVISION products and services will be delivered on time* (1-Strongly disagree to 10-Strongly agree)

- *I feel confident that ENVISION products and services will meet my needs adequately* (1-Strongly disagree to 10-Strongly agree)

The outcomes of these workshops were used to inform the next steps of the ENVISION product development and coproduction processes, specifically through updating the previously established User Stories and through developing solutions to identified challenges of coproduction (e.g., communication effectiveness, clarification of partner roles and responsibilities).

The workshop activities described above will be repeated in September 2023 through the collaborative evaluation of business case implementation with WP5, and the concluding outcomes of the analyses will be reported in D2.7.

Monthly feedback on coproduction survey

Further to the interactive workshops described above, the coproduction facilitators have structured and run a brief questionnaire-based survey to collect feedback on coproduction activities that the different ENVISION stakeholders undertake, on a monthly basis. The survey was initially developed around open-ended questions, with the aim to collect detailed information on success stories and challenges of coproduction as suggested by the progress made in the individual work packages. However, due to low completion rates during its piloting phase, it was then modified and structured around questions using Likert scales (e.g., disagreement – agreement statements) to maximise engagement. The specific themes the survey questions are (Strongly Disagree to Strongly Agree scales):

- *I have been able to express my needs, concerns, and opinions freely within the ENVISION coproduction framework*
- *The ENVISION coproduction framework has been key in keeping track and updating user requirements throughout the different stages of the ENVISION product development process*
- *Discussions, debates, and disagreements between partners have been amiable and respectful*
- *My opinions have been heard and valued equally as everyone else's*
- *Contributions of other partners have been useful, accurate, and without bias*
- *There have not been any conflicts of interest between partners, and if yes, they were addressed and resolved in a collegial and respectful manner*

The stakeholders were then asked about the level of priority they considered regarding aspects of coproduction that need to be improved before the next reporting period (i.e., monthly). Priority was defined as a consideration of the urgency and importance to work on the specific aspects.

- *Communications between partners and stakeholders*
- *Relationship dynamics between partners and stakeholders*
- *Allocation of tasks, action points, and duties*
- *Ways to follow-up and reflect on progress*
- *Expanding ENVISION's networks to achieve higher stakeholder diversity, knowledge exchange, and future collaborations*

The survey aims to collect relevant information over a 12-month period, from October 2022 to October 2023 (end of project). A link to the survey is distributed to the ENVISION partners in the beginning of every monthly project meeting (virtually). The survey remains open and accessible for completion throughout the 12-month reporting period, but reminders are sent to every partner for

timely completion to maintain a more accurate reflection on their monthly activities. The outcomes and conclusions of this survey will be reported in D2.7.

Awareness and involvement of stakeholders in the coproduction of EO-based monitoring technologies

In addition to our efforts within the ENVISION team of partners (consortium) for a deeper understanding of the potential factors that limit stakeholder engagement, we distributed an online questionnaire-based survey to farmers (potential end users) of several EU Member States (translated to their native language), investigating their level of awareness and involvement in coproduction processes for the development of EO-based monitoring technologies in sustainable agriculture.

The survey was developed and distributed via the Qualtrics XM platform and included questions along the following themes:

- *Demographics (e.g., type of production, size of farming business)*
- *Capacity of farm business to support the development and adoption of novel IT systems (e.g., personnel training, IT infrastructure)*
- *Current or past participation in coproduction efforts for digital innovation in agriculture*
- *Access to information regarding developments and innovations for sustainable agriculture*
- *Access to support or training that would enable them to unlock the potential benefits of novel IT systems for sustainable agriculture*
- *Impacts of Covid-19 pandemic on their farming operations and potential for novel IT systems to help overcome similar challenges in the future*

The survey will be open until the end of June 2023 and its results will be reported alongside the findings of the evaluation of potential challenges in coproduction, in D2.7. To date, we have received 118 survey responses from 5 different EU Member States.

A Delphi approach to determine factors for successful coproduction

A Delphi consensus approach is a research method used to help arrive at a decision regarding a complex issue under investigation, by consulting the opinions of stakeholders and experts through a series of survey and discussion rounds. In the context of the ENVISION coproduction approach, we structured a three-round Delphi consensus framework that consisted of two sequential online questionnaire-based surveys (i.e., one informed based on the outcomes of the other) and a concluding consensus hybrid workshop involving an open joint discussion. The surveys were distributed to all ENVISION partners and stakeholders within the ENVISION consortium boundaries. The follow-up, concluding, consensus hybrid workshop took place in November 2022 during the second formal consortium meeting in Athens, Greece.

The foundations for the construction of the first Delphi survey round, were laid through an extensive literature review we performed on the main challenges of coproduction in agri-environmental sciences and beyond (e.g., health sciences, education, business, and management). We supported and further supplemented the findings of the literature review with consultations with coproduction facilitators in other large EU consortia (e.g., eShape). In the end, we identified six main themes / aspects of coproduction and a list of potential challenges / barriers relevant to each of those that

could disrupt coproduction, and invited participants in a score allocation exercise to identify the most important coproduction challenges according to their opinion.

The six main coproduction themes / aspects we investigated were:

- **Communication and Dissemination** – which included communications between stakeholders, language barriers in information dissemination, format, and type of disseminated information, communication and dissemination strategies and channels, frequency of communication and dissemination activities, and identification of appropriate audiences.

- **Culture** – which included cultural differences regarding working hours, work ethos, gender equality, inclusivity, diversity, collaboration, and different priorities regarding sustainable development in the agri-food sector.

- **Project management** – which referred to potential issues related to the delegation of tasks, time management, deliverables, stakeholder roles and responsibilities, opportunities and mechanisms for feedback provision, and specific management styles.

- **Technology**- – which mainly considered issues related to stakeholder access to technologies used within the coproduction framework (e.g., online communication platforms), and accessibility issues.

- **Stakeholder relationships** – which included issues related to inequality, inconsistency, and limitations in stakeholder participation, stakeholder diversity, rotation in roles and responsibilities, understanding of partners and stakeholders' responsibilities and interests, and mechanisms for conflict resolution.

- **Knowledge and experience sharing** – which referred to issues regarding the understanding and appreciation of partners and stakeholders' knowledge and experiences, and engagement with stakeholders beyond ones immediate roles and responsibilities to generate broader knowledge and network opportunities for the consortium.

The stakeholder perspectives that we obtained from the Delphi survey on the themes above, were used to structure the second Delphi round. Specifically, we selected the overall Top 20 factors (based on allocated scores) that participants identified as potentially disruptive to coproduction. The second survey involved a scoring exercise (0 to 100) of *coproduction activities* as potential solutions to the disruptive factors they identified, based on how important they believed these would be in improving overall effectiveness and success rate of the coproduction process. The *coproduction activities* were:

- *Frequent progress meeting regardless of specific tasks / action points / KPIs.*
- *Frequent meetings for stakeholder network development and expansion.*
- *Agree on commonly understood and simplified terminology early-on in the project lifetime.*
- *Dissemination strategies should be audience-relevant and summarise information.*
- *Coordinate dissemination activities / channels in line with potential market audiences*
- *Each WP should have a dedicated communications manager that can summarise information and link with different WPs.*
- *Communication and Dissemination WP should frequently circulate simplified / filtered outputs from each WP to communications managers.*

- *User Stories should be derived from a consolidated list of sustainable development priorities for each stakeholder nation / region to account for potential cultural / geographical differences.*
- *Frequent consensus meetings to consolidate different perspectives on common action points.*
- *Collective framework for decision making within coproduction.*
- *Coordinate dissemination of outputs according to external decision-making mechanisms.*
- *Use various tools processes to allow for different voices to be heard.*
- *Inclusive coproduction framework.*
- *Early identification of different abilities and interests of stakeholders for better delegation of roles and tasks.*
- *Roles and responsibilities are revisited very frequently and rotated to avoid staleness and disengagement.*
- *Communication and task delegation / reporting tools are interactive and user friendly.*
- *Early agreement and provision of Information and Communications Technology (ICT) tools to all stakeholders, to facilitate coproduction throughout.*
- *Dedicated knowledge and experience exchange sessions, frequently and from early on.*
- *Multidisciplinary presentations to gain knowledge of different subjects involved in coproduction and exploring of how to best integrate this knowledge.*

The second Delphi survey was distributed to all ENVISION stakeholders attending the Athens consortium meeting (whether in-person or remotely). As soon as we had received a response from each attendee, we processed the findings (i.e., 0 to 100 scores) and identified a *Top 10 of coproduction activities* that future approaches should consider enhancing engagement coproduction, effectiveness of participation, and overall success rate.

These Top 10 activities formed the discussion points around which we structured the concluding, consensus workshop. In this final part of the Delphi approach, we held a group discussion for each of the individual *coproduction activities*; the workshop facilitator would move the discussion to the next point if and only when consensus was reached regarding the clarity of content, importance, and feasibility of the proposed *coproduction activity*. In the case participants would change their mind about a specific *coproduction activity* belonging in the Top 10 and this was validated through a group discussion (i.e., the majority would request a change), the *activity* with the immediately higher score would be selected to complete the Top 10 list.

 The outputs of the Delphi consensus approach will be analysed in conjunction with the outcomes of *"Continuous feedback on coproduction"* related activities. We aim to evaluate these findings also in the context of lessons learnt from other EU projects and consortia that operated within a coproduction framework (e.g., eShape, RECAP), to synthesise a set of *Guiding Principles* for the development and implementation of effective and successful, standardised coproduction frameworks in the agri-food sector. Ultimately, these principles could help guide the design and development of Innovation, Research, and Research & Innovation projects, highlighting critical differences in the way these different types of projects should be managed from beginning to end, to best address stakeholder representativeness and equality issues, the mitigation of funding and

management related impacts that large EU consortia often face, and the advancement of knowledge, experience, and stakeholder networks among others.

Results

Identification and engagement of coproduction stakeholders

The first phase involved identifying and engaging stakeholders in the coproduction process. The results table displaying the demographics of the stakeholders involved, as well as participation and completion rates throughout to the end of coproduction, will be included in Deliverable 2.7 once the coproduction process has been completed.

Table 2 below shows the number of stakeholders that engaged actively at the different phases of the ENVISION coproduction process. This table will be completed in Deliverable 2.7 to include all activities through to the end of the project and demonstrate how stakeholders were engaged at repeated points within the iterative design thinking phases of coproduction of the ENVISION platform and services.

Table 2: Numbers of stakeholders involved in the coproduction activities of ENVISION

Stakeholder group	Organisation	Phases of Design Thinking in ENVISION					Total number of stakeholders
		Empathise	Define	Ideate	Prototype	Test	
Business cases							
	CAPO	✓	✓	✓	✓	✓	12
	NPA	✓	✓	✓	✓	✓	8
	LV	✓	✓	✓	✓	✓	5
	OCS	✓	✓	✓	✓	✓	3
	LEAF		✓	✓			3
Developers							
	AgroApps	✓	✓	✓	✓	✓	3
	DRAXIS	✓	✓	✓	✓	✓	2
	NOA	✓	✓	✓	✓	✓	4
	EV ILVO	✓	✓	✓	✓	✓	3
	INOSENS				✓	✓	3
Coproduction facilitators							
	URDG	✓	✓	✓	✓	✓	5
	ITC	✓	✓	✓	✓	✓	2
	EV ILVO				✓	✓	2
	DRAXIS				✓	✓	2
Lighthouse customers							
	Other PAs				✓	✓	TBC
	Other CBs				✓	✓	TBC
	Farmers				✓		10
	Academics		✓	✓			TBC
	Other			✓	✓		5

	developers					

User Stories for problem definition and solution identification

Empathise & Define Phases

Phase 1 of the steps in the e-shape framework for codesign (Barbier et al., 2019, 2022) was implemented by working through the Empathise and Define phases. Thirty one User Requirements for ENVISION were identified at the end of the 'Empathise' phase and were prioritised and redefined in the 'Define' phase (reported on in Deliverable 2.2).

Ideate Phase

ENVISION then moved into Phase 2 of the e-shape framework (implementation of codesign actions) based on the outputs from the Phase 1 activities. As established in the e-shape framework (Barbier et al., 2019, 2022), the sustainability of the ENVISION services can be achieved by ensuring that the coproduction process delivers:

> (1) information which is "use-generative" (that is having the power of generating multiple usages),
> (2) data-information relationships that are able to adapt to future advances and
> (3) information-usage relationships that are able to cope with multiple usages.

The coproduction approach established repeated involvement of the same end users within the iterative 'Ideate' phase which allowed them to adapt and develop further solutions using these e-shape resilience principles including interoperability of data (LaScala-Gruenewald et al., 2023) and integration with existing systems.

Evaluation of business cases – progress and reflection on User Stories

As described in the Materials and Methods section, the Prototyping and Testing phases of the DT-XP coproduction framework will be completed in September 2023. Presenting intermediate outputs of the on-going implementation, monitoring, and evaluation processes, may misinform the reader regarding the effectiveness and value of DT-XP coproduction for commercially desirable and viable digital innovations. Therefore, we will be reporting our findings regarding the progress and reflection on User Stories and any challenges stakeholders have identified during these DT-XP phases, in D2.7 and alongside the relevant WP5 findings.

The following figures present snapshots of the coproduction activities performed for the evaluation of progress and reflection on User Stories and the results we have obtained thus far.
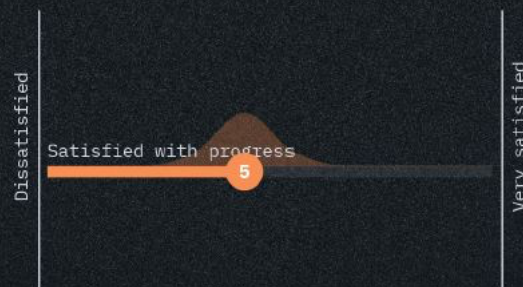
Figure 1: ENVISION end-user reflection on User Stories at an intermediate stage of ENVISION coproduction and product development
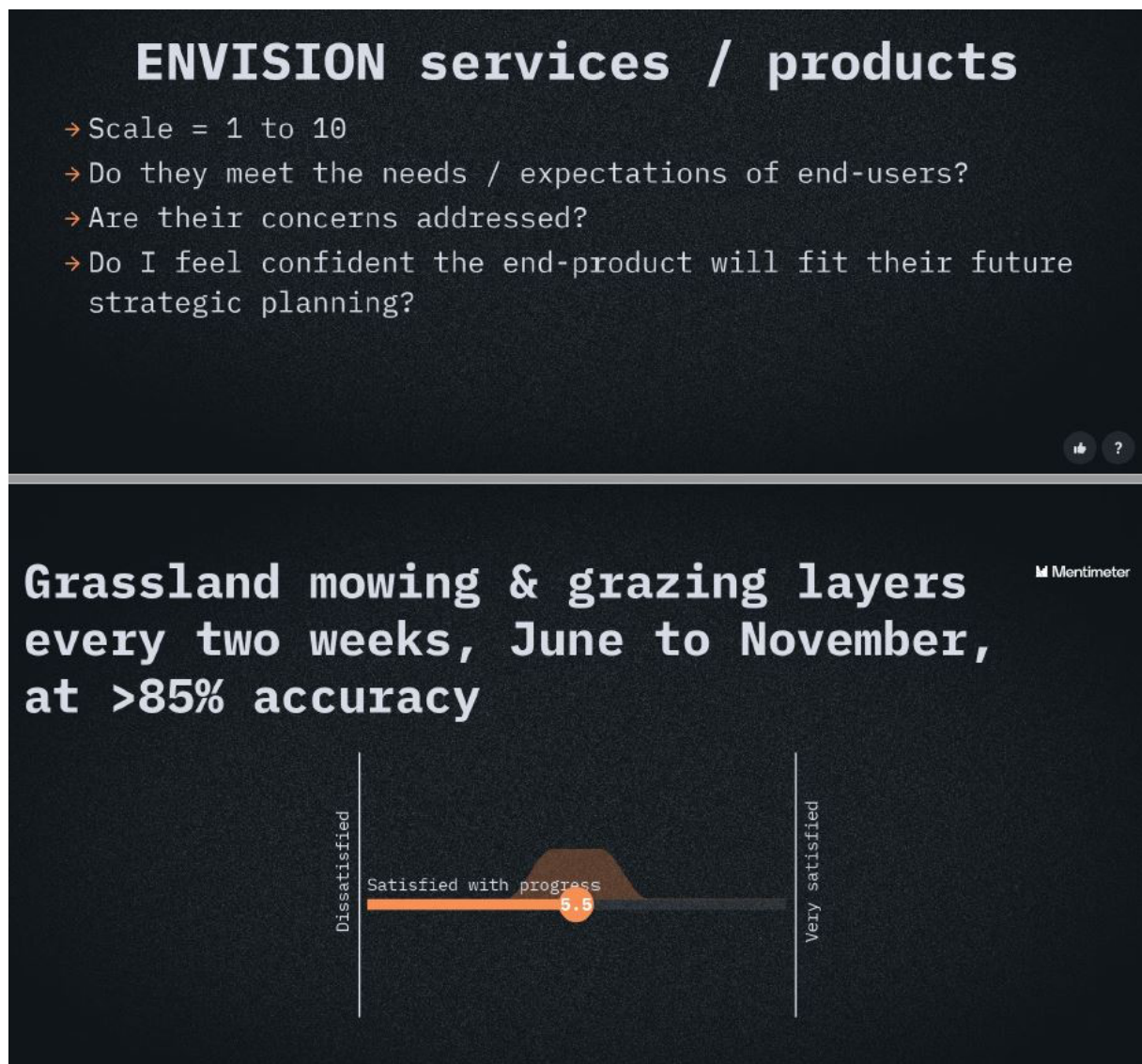
Figure 2: ENVISION developer reflection on User Stories at an intermediate stage of ENVISION coproduction and product development

Awareness and involvement of stakeholders in the coproduction of EO-based monitoring technologies

This section will present the findings of the online questionnaire-based survey we performed to explore farmer awareness and involvement in coproduction processes that aim to develop EO-based monitoring tools for sustainable agriculture, similar to the ENVISION project. Thus far, we have obtained approximately 118 completed responses from 7 countries: United Kingdom, Greece, Cyprus, Belgium, Lithuania, Serbia, and Bosnia and Herzegovina. It is important to note that at this stage, we have not received an equal number of responses from all these countries (unbalanced sample), and therefore we chose to keep the survey open until the end of June 2023 aiming to collect additional responses from lacking countries to facilitate a more meaningful assessment and conclusions, potentially including a cross-national comparison.

Continuous feedback on coproduction

As mentioned in previous sections, the results of our assessment, analysis, and reflection on ENVISION coproduction will be included in Deliverable 2.7 once the coproduction and development processes have been completed. The following figures present snapshots of results we have obtained thus far, relevant to feedback on ENVISION coproduction and stakeholder perspectives of critical issues of sustainable agriculture.
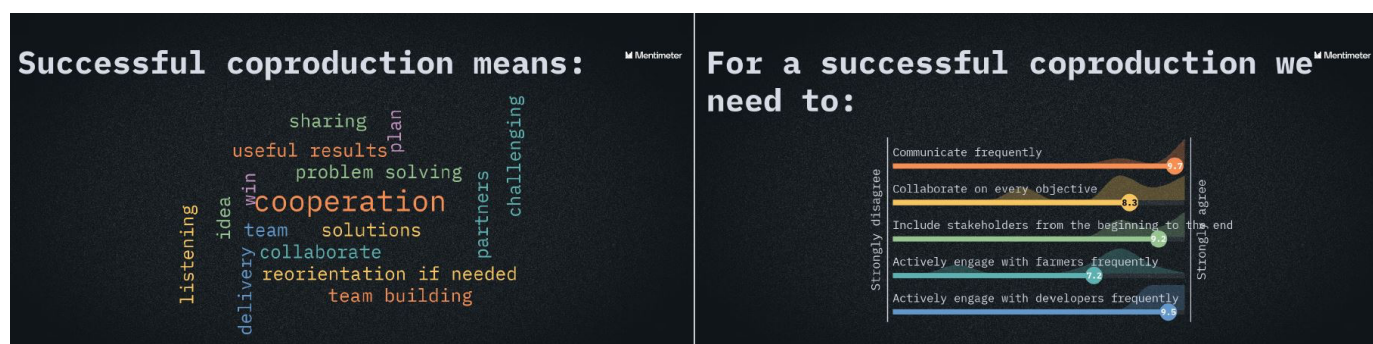

Figure 3: ENVISION end-user perspectives on coproduction and key concepts of sustainable agriculture at an intermediate stage of ENVISION coproduction and product development
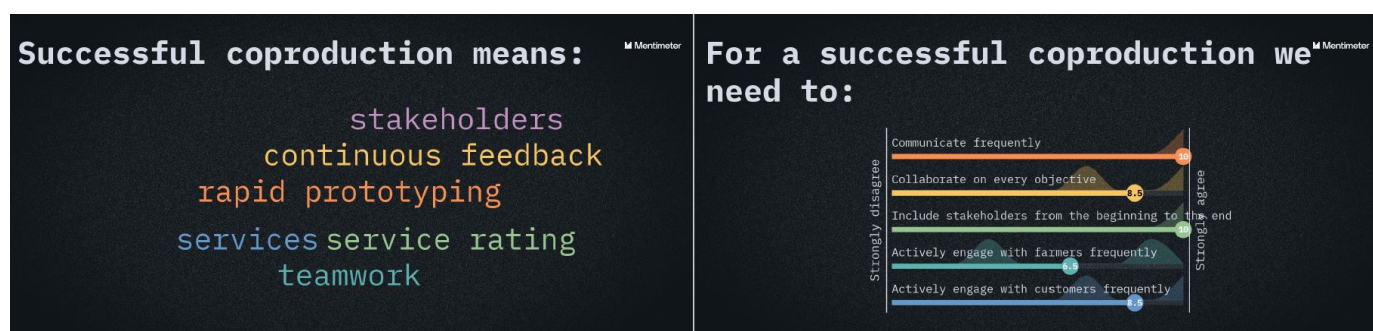

Figure 4: ENVISION developer perspectives on coproduction and key concepts of sustainable agriculture at an intermediate stage of ENVISION coproduction and product development

Delphi survey and workshop

The Delphi survey and workshop have been completed and all relevant data have been collected via Qualtrics and open-ended discussions. However, we will report those in Deliverable 2.7 upon completion of the ENVISION coproduction process, and alongside all other results on coproduction related feedback and the specific findings of WP5 on the evaluation of business case implementation to enable a more meaningful interpretation of stakeholder perspectives on coproduction, challenges identified, and a synthesis of Guiding Principles for effective and successful coproduction frameworks.

Discussion

This section discusses the process of codevelopment of the ENVISION commercial services with the end users (PAs and CBs) and how this process ensured quality in the innovative outputs while accounting for each user's different social structures, characteristics, and business needs. The results section of D2.6 is still in draft form, therefore the final analysis, discussion, and conclusions from this work will be reported on in the final deliverable D2.7. We therefore briefly reflect here on the importance and value of coproduction without reference to specific findings.

The work described in this Deliverable represents a considered, collaborative approach to innovation that embeds Extreme Programming into Design Thinking. XP was used as it is an agile software development framework that focuses on customer satisfaction (Erikson et al., 2005). Short development cycles have been employed with regular checkpoints for end users to provide inputs and for developers to respond to required changes. This constant, iterative communication process improves productivity but requires management to facilitate smooth communication and task focussed interactions. The framework of DT (Lindberg et al. 2011 and described in Deliverable 2.2) integrates human, business and technological factors into the problem solving and design parts of XP (Sohaib et al., 2019). The repeated exploration of the 'problem' space and 'solution' space with a team of facilitators has proven an effective way to manage the coproduction of ENVISION and has generated knowledge, experiences, networks, and collaborations beyond the specific project outputs.

The codevelopment approach within ENVISION project builds on the experiences from the RECAP project (Rousi et al., 2020) and the other recent EU projects that have utilised codevelopment approaches for the development of EO-based Software as a Service (SaaS). Examples include Sen4CAP (De Vroey et al., 2021), eShape (Barbier, 2022) and the DIONE project (Karagiannopoulou, et al., 2020) which adopted a stakeholder-driven, systems participatory design that analysed the specifications from the perspectives of seven defined user persona archetypes. The ENVISION project built and improved upon these past experiences and Deliverable 2.7 will include a reflection on the novel aspects and enhancements made.

This collaborative approach was important as over the past decade the EU has encouraged Responsible Research and Innovation (RRI) principles to be embedded in research projects to facilitate democratisation of science and connect with citizens through participatory process. There is the need now for a theoretical framework for methodological implementation of coproduction (Robinson et al., 2021) to ensure that this legacy continues to build and improve citizens' engagement with research and innovation. The coproduction of ENVISION provides the opportunity to construct a set of Guiding Principles for future projects (to be elaborated in D2.7). These principles will allow more effective implementation of coproduction processes, based on RRI principles, to support innovations within the agri-food sector and help guide the sector towards more sustainable agricultural practices (Velten et al., 2015).

These principles will also consider ways to address any barriers or challenges in the implementation of coproduction in innovation projects. Since successful coproduction requires substantial commitment to three key components; interdisciplinarity, stakeholder participation, and production of knowledge that is demonstrably usable (Lemos & Morehouse, 2005) the process necessitates stakeholders to provide a significant amount of time and effort. In addition to time requirements, there can also be some challenges in the successful implementation of coproduction (Popovici et al., 2020) which can include mismatched terminology and unrealistic expectations (Briley et al., 2015), power imbalances (Vincent et al., 2020), participation only in localised contexts (Galende-S´anchez & Sorman, 2021).

In D2.7 we will provide a holistic reflection on the ENVISION coproduction approach which will include consortia-level reflections on i) the development of ENVISION products and services, ii) the production of knowledge and experiences, iii) the advancement of relevant scientific fields, and iv) the development of stakeholder networks for future collaborations. A recent review by Sillak et al. (2021) provides three assessment criteria for successful coproduction namely; 1) the involvement of actors and their roles in different phases (initiation, design, and implementation) of cocreation; 2) the use of activities to foster transformative power; and 3) the outcomes of cocreation. We will also use these generic criteria to reflect on the coproduction process used during ENVISION in Deliverable 2.7 and we will report on the impact of such collaborative working in achieving the project aims.

Conclusions

This draft deliverable has presented the methodological steps taken (or planned) with the end users for the codevelopment process of the ENVISION commercial services, using the DT-XP framework. The main reasons for choosing this framework were to ensure customer satisfaction, productivity, and innovation through agile and participatory methods. The DT-XP framework is similar to other codevelopment approaches used in related EU projects, such as RECAP, Sen4CAP, and DIONE and will be compared and contrasted further in D2.7 along with a full discussion of the advantages and challenges of the DT-XP framework, lessons learned, and best practices for future codevelopment projects.

Although only preliminary results are included in this draft deliverable, our initial findings suggest that the coproduction approach was successful in achieving the project aims and advancing relevant scientific fields. We have demonstrated that coproduction enabled a collaborative and iterative development of ENVISION products and services that met the expectations and requirements of potential end users. We have also shown that coproduction facilitated the production of new knowledge and experiences among the project partners and stakeholders, as well as the development of stakeholder networks for future collaborations. Furthermore, we have contributed to the literature on coproduction by identifying key challenges and disruptive factors for cocreation in digital innovation projects for sustainable agriculture.

However, as with any such complex, multidimensional, and multistakeholder methodological approach, we acknowledge specific limitations and areas for improvement in the ENVISION coproduction process too. We propose a shift from a solely outcome-based evaluation system (e.g., in our case evaluating how desirable and commercially viable the ENVISION products and services will be), to a holistic system that evaluates equally i) the products of the collaborative effort, ii) the quality of relationships and collaborations between all stakeholders, iii) the advancement of scientific knowledge in the specific field, but also broader knowledge, and v) the creation, growth, and establishment of stakeholder networks for future engagement and collaborations. This ambitious systematic evaluation should run from the birth of an idea through to beyond the lifetime of the implemented project and should use both quantitative and qualitative evaluation methods.

Therefore, we suggest some recommendations for future work on coproduction in digital innovation projects for sustainable agriculture. First, we recommend conducting a stakeholder analysis before initiating cocreation to identify relevant actors and their roles, interests, and expectations. Second, we recommend designing and implementing a variety of activities that can stimulate creativity, learning, and empowerment among co-creators. Third, we recommend developing and applying a comprehensive framework for assessing the success and impact of cocreation on different levels: individual, organizational, societal, and environmental.

In conclusion, we have demonstrated that coproduction is a valuable approach for developing innovative products and services for sustainable agriculture that can address complex and wicked problems. We will synthesis and report the full findings in D2.7 were we will also highlighted some challenges and opportunities for improving coproduction practice and research. It is therefore our intention to produce generic *Guiding Principles* to inform other digital innovation projects that aim to foster sustainability through cocreation.

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