CODECS PLATFORM, FIRST RELEASE

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Executive summary

This document is the report for the Digital Platform of the CODECS project. It has been created to fulfil the needs of the project's Deliverable 7.1. It summarises the work conducted in the CODECS Digital Platform (Task 7.1).

The purpose of this document is to provide documentation of the methodology followed, and an overview of the Digital Platform. The document illustrates the activities performed to describe the scope of the platform, user needs, functional and non-functional requirements, description of design and deployment details, as well as future steps regarding the platform's development and legacy after the project's end.

The CODECS Digital Platform aims to provide an inventory of digital technologies built on achievements of existing platforms, an inventory of datasets created within the CODECS project, a multi-criteria assessment toolkit related to the various facets of sustainability of digital technologies and a toolkit for digital demonstrations of the assessment results.

The platform is currently being developed and managed by the Agricultural University of Athens.

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1. Introduction

The present report outlines the progress achieved in Task 7.1, which focuses on creating the "CODECS Digital Platform". This digital platform has the primary goal of facilitating as a single point of unrestricted access to components, including:

Objective 1 Digital Content Storage and Access - Dataset Inventory: Datasets and research outputs created during the digital ecosystem analysis and the cost-benefit analysis of the technologies, are stored and can be accessed by stakeholders in the online digital platform.

Objective 2 Meta-Inventory of Digital Technologies: The platform includes a comprehensive inventory of digital technologies, leveraging the successes of existing platforms as a foundation (FAIRshare, DESIRA, Smart-AKIS among others).

Objective 3 Multi-Criteria Assessment Toolkit: Within the platform, a sophisticated toolkit is integrated to assess various facets related to the sustainability performance of digital technologies.

Objective 4 Digital Sustainability Demonstration Toolkit: The platform incorporates a toolkit for digital sustainability demonstrations, enabling the presentation of technology assessment results through virtual demonstrations and interactive storybooks.

Objective 1 will be realized through the utilization of datasets sourced from WP3 (“Analysis of digital ecosystems”) and WP4 (Costs and benefits analysis – assessment of the potential of digital technologies in agriculture”), specifically pertaining to the digital ecosystem analysis and cost-benefit assessment data respectively. Objective 2 will be attained through web scraping tools that search reference inventories as outlined in Task 7.2. Meanwhile, Objective 3 will be accomplished by hosting the assessment toolkit developed as part of Task 7.4. Lastly, Objective 4 will come to fruition through the seamless integration of the outcomes from all objectives into suitable virtual and interactive demonstration tools. This comprehensive approach ensures that the CODECS digital platform is equipped to fulfil its core objectives effectively.

The primary audience for this document comprises associates engaged in Research and Innovation (R&I) projects, actively participating in endeavors aimed at advancing scientific research and conducting tests on innovative technologies across Europe and Associated Countries. This audience encompasses the project's consortium, which includes various stakeholders such as agricultural advisors, farmers, researchers, and policymakers. The overarching goal is to achieve this by implementing novel methods designed to generate open, reproducible, and scalable digital content and tools, with a focus on conducting multi-objective assessments of digital technologies within the agricultural domain. Furthermore, additional stakeholder groups with interest in the content presented in this report, encompass project managers, software developers, architects, and product developers who seek insights into the platform's implementation efforts, in addition to gaining a comprehensive understanding of the digital platform's scope and content.

Based on the context outlined above and to efficiently illustrate all the activities executed towards the development of the CODECS digital platform, the report begins with a brief outline of the common terms used throughout this document, followed by Section 3 and a description of the overarching aim of the CODECS digital platform and the objectives aimed for each stakeholder separately. Section 4 includes an overview of the digital platform and Section 5 is an outline of the methodology followed in the development. User needs and platform requirements (functional and non-functional) are detailed in **Section 6**. The design of the prototype version of the platform’s architecture and features is documented in **Section 7**. Information on the front- and back-end development of the platform is available in **Section 8**. Finally, **Section 9** describes the steps to be taken next regarding the platform’s development, as well as the CODECS digital platform’s longevity and exploitation after the project’s end.

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2. Terminology

Table 1: Terms used across the deliverable with a short description.

Term	Description
AKIS	Agricultural Knowledge and Innovation Systems
WP	Work package
API	Application Programming Interface
Metadata	Information about the characteristics, attributes, and context of a particular piece of data or content, making it easier to organize, search, and understand.
Application Scenario	A field of application of digital technologies in given contexts (example irrigation in arid contexts)
Dataset Inventory	A comprehensive meta-inventory of digital technologies, offering a centralized, tailored to the user needs overview of technologies, across various domains, supporting understanding of the dynamic technological landscape and the emerging trends, for better-informed decisions in technology adoption and innovation
Meta- Inventory of Digital Technologies	The meta-inventory of digital technologies will be built on achievements of existing platforms. A structured digital repository for CODECS datasets will be created based on datasets created by the project itself. The data-inventory aims at offering storing abilities to authorized users and centralized access for all its users to harness the potential of data sources and empower objective decision-making and conflict resolution related to various facets of digitalization

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3. Aim and objectives of the CODECS digital platform

The CODECS platform serves as a dynamic hub for showcasing cutting-edge digital tools and research outputs, with the overarching goal of enhancing awareness and driving the adoption of technologies that align with a sustainable digital vision. This digital platform boasts an umbrella infrastructure, signifying its role as an integrated framework that offers an array of services and tools within a centralized control panel. This design empowers users and stakeholders to conveniently access and oversee the available resources through a unified interface.

The CODECS digital platform hosts a diverse spectrum of digital technologies, available in a meta-inventory tailored to the user's needs. It also provides data storage and access capabilities for information collected from the CODECS's Demo Farms. Additionally, the platform features tools that facilitate comprehension and multi-criteria evaluation of the costs and benefits associated with farm digitalization, taking into account economic, environmental, and social considerations.

The datasets accessible on the platform, play a pivotal role in promoting objective decision-making and fostering conflict resolution related to various facets of digitalization. Building on the achievements of existing platforms, the meta-inventory of the available digital technologies not only enhances the ability to establish and deploy these technologies but also facilitates the collection of agricultural data. This, in turn, can strengthen further policy interfaces in the domain of digitalization and innovation.

Following a user-centric and agile approach, the CODECS platform focuses on discerning user preferences and requirements to enhance engagement. Designed with a strategic focus, the online digital knowledge platform primarily caters to AKIS actors, farmers, policymakers, and researchers. The platform design promotes engagement, fostered by the transparency and openness of the research outputs it presents. Complementing this, the platform incorporates virtual demonstration tools with interactive methodology handbooks and engaging storybooks. The resources synergistically enhance the effectiveness of the platform in promoting societal engagement and adopting sustainable digital principles.

Table 2 outlines the identified target groups along with the corresponding objectives that the CODECS digital platform is intended to fulfill for each group independently. Even though there might be different or divergent motivations in the objectives of the diverse members and stakeholders, the overarching objective is to cultivate a dynamic point of reference for digital tools, data, and technologies that accommodate the interests of all stakeholders.

Table 2: Objectives that the CODECS digital platforms will serve for its stakeholders.

Stakeholder	Platform's objective for target group
Researchers	Provide open access to CODECS database and meta-inventory of available digital tools, FAIR in design, as material to build upon and achieve cutting-edge research.
Policymakers	Provide a multi-criteria assessment toolkit for of digital technologies and datasets from Demo Farms to support evidence-based decisions that could drive better-informed sustainable digital policies.
Advisors	Provide easy access to data and demonstration tools/material for making data-informed guidance and support of their community; Empower proactive involvement for the adoption and implementation of digital applications.
Farmers/foresters	Provide access to data and insights with respect to the performance, readiness of the farms and of the digital ecosystems accounting multi-criteria for the evaluation for evidence-based decision-making.

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Stakeholder	Platform's objective for target group
Producers of technology	Provide access to data and digital technologies to stay up-to-date and competitive in the tech landscape, create products, services and formulate long-term strategies that align with industry trends.

The current release of the CODECS digital platform marks the accomplishment of an initial milestone in the pursuit of the overarching objectives of the platform and its specific objectives tailored to each of the stakeholders. Feedback and insights expected to be gathered from future evaluation surveys and workshops with stakeholders of the platform will play in the future, a pivotal role in the enhancement of the platform in catering effectively to the unique needs of the diverse user groups.

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4. Overview of the CODECS digital platform

In the context of the project's WP7 - CODECS platform, a digital platform will be developed by the AUA, which will be accessible through a www link from any browser. This repository will be released by the 30th of September 2023 (with annual updates) and will host search, demonstration, and evaluation tools. The CODECS digital platform delivers a meta-inventory of available digital technologies, an inventory of datasets generated within the project, a multi-criteria assessment toolkit for digital technologies and a toolkit for digital sustainability demonstrations. This aim of this section is to provide a walkthrough of the CODECS Digital Platform by focusing on the information and content delivered to its users, as well as key capabilities. The CODECS meta-inventory of digital technologies and inventory of datasets are pivotal components of the platform. Access to these two modules is enabled by specific items in the digital platform's menu a shown in Figure 1.

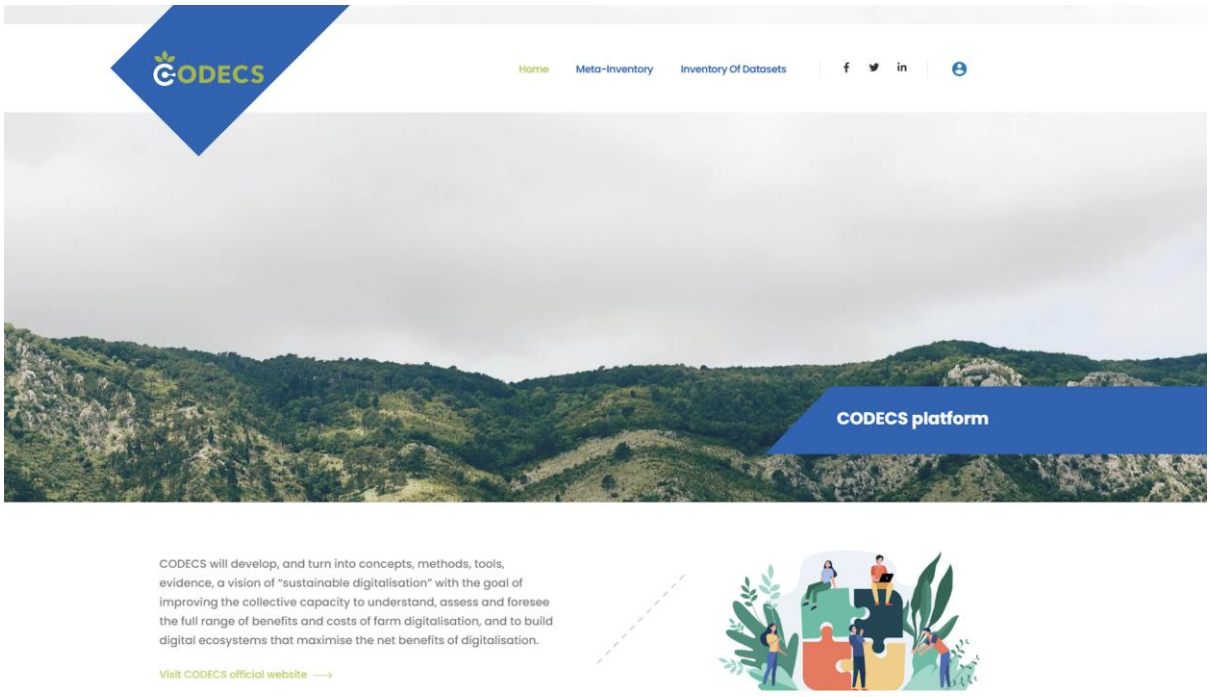

Figure 1: CODECS platform home page.

Visual and textual prompts available on the platform's landing page facilitate access to the two modules. Figure 2 illustrates the sections of the digital platform indicating the exact number of datasets and technologies available on the respective modules, with a short description of the said modules:

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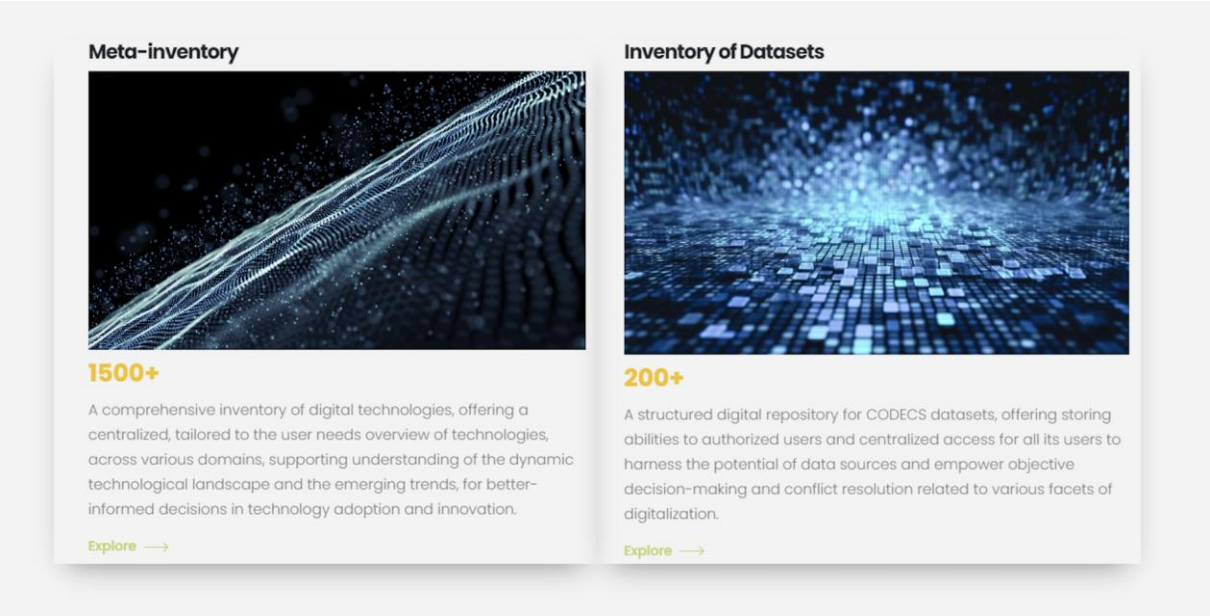

Figure 2: CODECS platform, "Meta-inventory" & Inventory of Datasets.

Figure 3 presents the footer of the homepage, with an overview of the menu with active buttons (Home, Meta-Inventory, Inventory of Datasets) that lead to the corresponding pages. Additionally, project information is available, along with options for contacting the coordinators via email. There are also links to the platform's social media accounts.

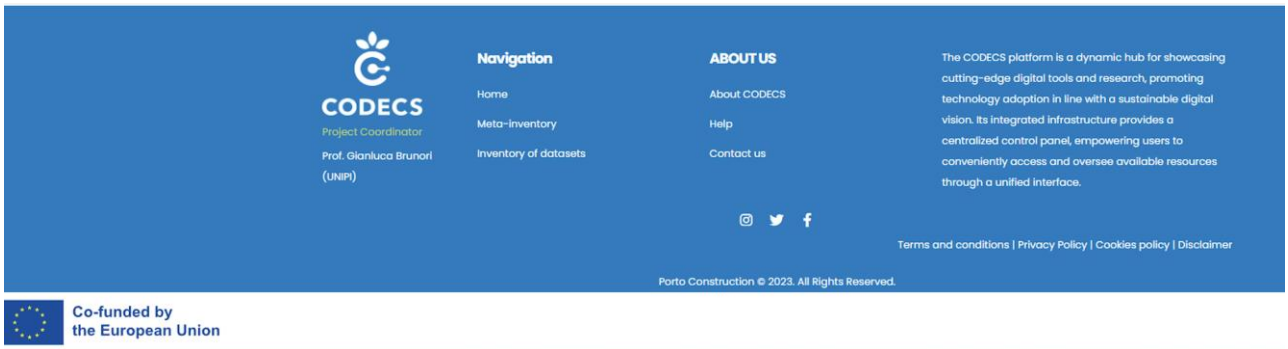

Figure 3: Footer screenshot on the landing page of CODECS platform.

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In the meta-inventory module, applications of digital technologies belonging to the context of a predefined field are displayed. Figure 4 shows the outlining of the application scenarios into which the technologies are clustered.

Figure 4: Application scenarios in Meta-inventory module.

Users can select an application scenario and access a summary of the associated digital technologies, as illustrated in Figure 5 below. The available technologies can then be viewed by navigating across the page or using the filter options on the left-hand side of the screen.

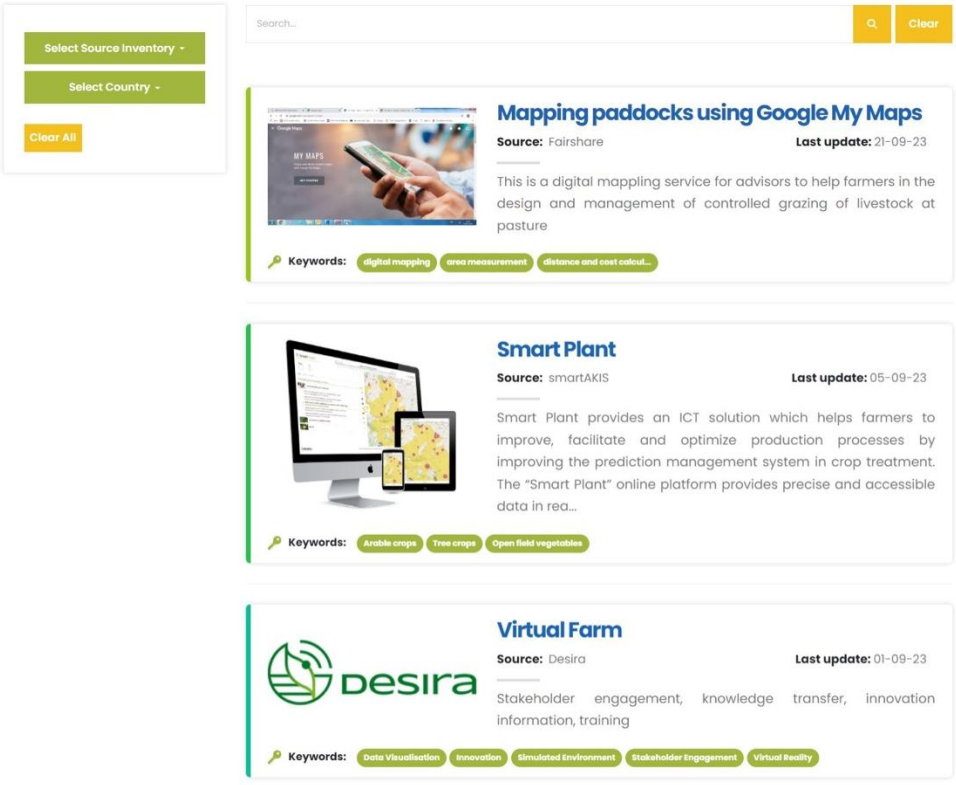

Figure 5: Screenshot of Meta-inventory module.

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In Figure 6 below, the 'Dataset Inventory' module is presented, which shows the datasets that have been generated by CODECS itself. These datasets are then displayed in an inventory with technology filters.

Figure 6: Screenshot of Inventory of datasets module.

5. Methodology

This section provides an overview of the **CODECS digital platform's design** and **development methodology**. Our methodology follows the **agile development approach**, which is characterized as dynamic and responsive (see Figure 7). Unlike traditional heavyweight linear and sequential methods, agile embraces an iterative and adaptive cycle to address complexities and uncertainties inherent to the development and maintenance of digital tools (Javanmard & Alian, 2015).

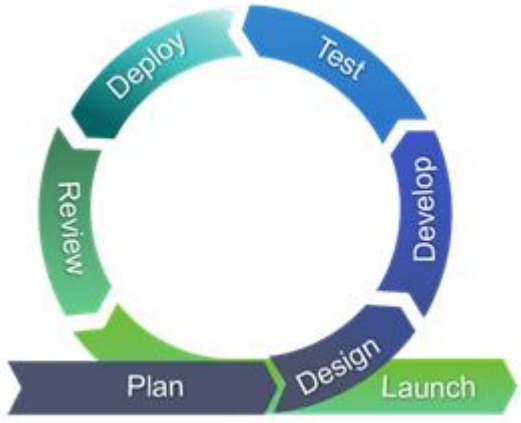

Figure 7: Schematic representation of agile methodology.

Iterative user feedback guides allow a breakdown of the design processes into chunks of requirements and features to produce functional increments of the platform. Communication and commitment to refinements derived from timely collected feedback allow prioritization of the adaptations and alignment with the evolving user needs and preferences. Maintenance of a backlog of features, enhancements, and fixes worked at each iteration, is of utmost importance to ensure that the platform evolves towards its said objectives.

The creation of an MVP product creates a foundational version of the platform that allows quick deployment and testing to ensure frequent product releases that are highly adaptable and resilient to evolving preferences and new insights.

Figure 8 in the following page illustrates the iterative process followed for implementing the agile methodology in the CODECS digital platform's design and development.

Below, a brief explanation of the **phases** involved is provided.

- **Phase 1: Scoping**

Examination of the scope of the digital platform to gain an in-depth understanding of what the digital platform is meant to achieve.

- **Phase 2: User needs identification**

Activities performed to acquire input to identify user needs, including surveys and user-driven sessions to collect feedback.

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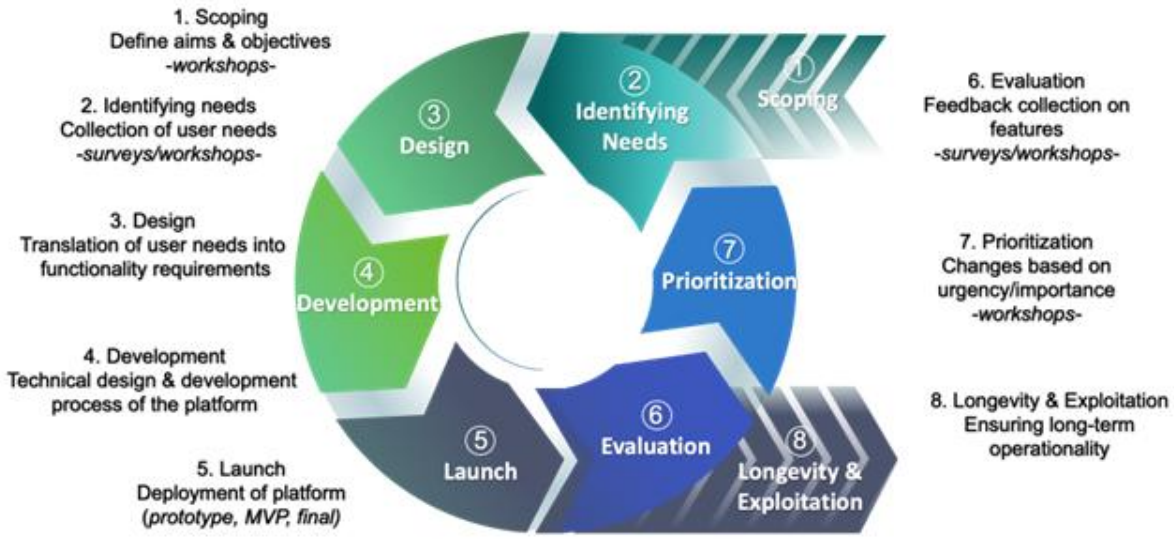

Figure 8: Methodology of the CODECS platform.

- **Phase 3: Design**

The design of the CODECS digital platform involves the process of "translating" the acquired user needs into functionalities for the platform.

- **Phase 4: Development**

The process of implementing the functionalities and creating the features of the CODECS digital platform.

- **Phase 5: Deployment**

Release and deployment of the platform in its existing form (currently the MVP version).

- **Phase 6: Evaluation and feedback collection**

The process of collecting input from users on the already established features of the platform, through surveys and user-driven sessions.

- **Phase 7: Prioritization of changes and adaptations planning**

Identification of changes and adaptations to be made to the CODECS digital platform, as well as their urgency and implementation importance, following a process of internal feedback assessment (the internal review of the obtained feedback from the platform's development team).

- **Phase 8: Longevity and exploitation**

The actions to be taken to ensure the platform stays operational even after the project's end.

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6. User needs collection and definition

6.1. User needs collection

6.1.1. Survey design

A survey was held by the AUA in collaboration with CZU and BIOS, with both organizations acting as task leaders of WP7. The survey items aimed to provide insights into user needs for designing and developing the MVP version of the CODECS digital platform. The online survey was distributed to the project's consortium, resulting in 37 responses. The survey consisted of four parts, each consisting of questions with pre-defined multiple or single-choice answers, items to be rated on a five-point scale ranging from 'not at all important' to 'very important' and from 'not at all likely' to 'very likely', and open-ended questions. The survey included the following four sections:

Section 1: 'Background Information on Respondents' Expertise and the Use of Digital Technologies', which aimed to collect data on respondents' work-related technology use patterns, attitudes towards technology use, and background information on their expertise.

Section 2: "Investigation of user needs for the Data Entry Tool", which included items essential for designing the data entry tool of the CODECS digital platform (i.e., the platform's capacity to support dataset upload).

Section 3: 'Investigation of user needs for accessing datasets'. This section covered information relevant to the design and development of accessing datasets via the platform.

Section 4: 'Investigation of needs for the CODECS meta-inventory for digital technologies for agriculture'. The final survey section contained items to provide important information for the design of the CODECS meta-inventory of digital technologies in agriculture available through the digital platform.

6.1.2. Survey results

Following the collection of survey responses, the AUA team produced a report on the results that are presented in the Annex. The major points raised were valuable in prioritising some features for the development of the MVP version of the CODECS platform and avoiding the use or development of some others, in order to meet user requirements. These key points of the user need survey are presented as follows:

Section 1 'Background information on the expertise of respondents and the use of digital technologies

A summary of the main findings of the survey section can be found below:

- The majority of respondents are members of project partner organisations who primarily use digital devices in their daily work.
- The most frequently used devices are personal computers and smartphones.
- The most common professional activities are communication and collaboration over distance.
- The respondents are adept in technology, enjoying the use of digital devices and feeling at ease with software applications.
- There is a belief that digital technologies increase productivity and facilitate communication with colleagues.
- The preferred method of learning software applications is through video tutorials, rather than relying on text-based manuals.

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- Respondents regularly encounter and overcome issues related to digital technology and appreciate online comments that relate to digital resources. However, posting comments on the internet is not a prevalent practice among respondents.

Section 2- "Investigation of user needs for the Data Entry Tool"

The main points of the results of this section of the survey are as follows:

- Respondents express willingness to submit a dataset or other digital object to a digital platform using an upload form, and most have already done so.
- A common issue encountered during the uploading process is the time-consuming nature of it.
- Nearly half of the participants report the quantity of information required as an added difficulty.
- A considerable proportion of respondents identify issues with the instructions for uploading being unclear and the absence of a feature to save progress.
- A large number of participants indicate their readiness to use an application programming interface (API) to transfer digital materials or files to a digital platform.
- In the context of using an API for data uploads, the difficulty of the user authentication process surface as a significant issue.

In terms of what information should be included per dataset, more than half of the respondents agree on the following:

- A summary,
- The name and agricultural sector of the dataset,
- The date of its release,
- The terms and conditions for using or reusing the dataset,
- The method used to collect the data,
- The licence specifying permitted usage,
- The creator or provider of the dataset.

Regarding the upload form, it seems that most participants attach importance to the following aspects:

- The uploading process being conducted in stages,
- Clear instructions on the information required in each field of the upload form,
- An option to 'save progress' and resume the upload at a later time,
- The ability to preview and make adjustments to the user's input before the final submission/upload,
- Provision of a text-based upload guide.

A relatively high response rate suggests that the multilingual upload has some degree of significance but is not crucial.

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Section 3: 'Investigation of user needs for accessing datasets

Key takeaway from the responses in this section is that participants exhibit a strong grasp of digital platforms that facilitate access to agricultural data. Moreover, a substantial portion of survey respondents, nearly half of them, report having actively utilized these digital platforms to access agricultural data. Furthermore, these participants have gone a step further by sharing specific platform names that they have engaged with.

An important issue addressed in this section concerns the challenges faced by the respondents when interacting with digital platforms for agricultural data. The most commonly reported issues are:

- The user-unfriendly interface and poor user experience,
- The large amount of information that is usually presented to the user through the different screens of the digital platform.

The survey participants were asked to provide examples of digital platform functionalities that they found useful. The features can be grouped into the following groups:

i. Search function
ii. User experience
iii. Availability of information/metadata
iv. Information architecture
v. Navigation
vi. Multilingualism

Regarding the metadata that survey participants consider important to be available in a digital platform, users identify as significant information to have:

- A brief textual description of the dataset
- The agricultural sector related to the dataset,
- The dataset's name,
- Terms and conditions for dataset use.

Regarding the rating and comments the results are as follows:

- It appears that free-text comments are more likely to be considered as a piece of information that drives decisions about whether or not to access and use a dataset, compared to dataset ratings.
- The majority of survey participants gives positive feedback when asked to rate and comment on a dataset on the CODECS digital platform, a minority returns negative feedback while some indicate that they would only do so anonymously.

Some statements were given to the participants regarding the probability of them using particular search methods. Such statements are found to be enabled by:

- Using predefined keywords,
- Full-text search (i.e., the use of free-form text for your search),
- Scenario-based search (e.g., as a cattle breeder, I wish to access information on digital technologies related to...),
- Search by offered filters (e.g., agricultural sector, farm size, cost), and these methods were reported as being utilised by the survey participants.

The filter-based search method appears to be the most popular.

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Section 4: 'Investigation of needs for the CODECS meta-inventory for digital technologies for agriculture'.

Section 4 of the survey aims to offer insights to inform the development of the CODECS digital platform's meta-inventory of digital agricultural technologies. The primary discoveries from this section are outlined below:

About six out of ten respondents are aware of such inventories. In addition, respondents report that they have never used inventories of digital technologies for agriculture.

Regarding the features that respondents consider useful, examples include:

- Filtering by agricultural sector and by theme, filters such as type of technology/application/target, free-text search (search-related features),
- Intuitive navigation, nice layout, simple interface, user-friendly display of information (UX); and
- Classification based on application scenarios, platform of digital innovation based on geographical information, digital innovation catalogue (delivery of information).

In terms of the difficulties that the respondents face when using digital agricultural inventories, they highlight:

- Poor user experience,
- The large amount of information made available through the inventory interfaces,
- Difficulty in using the inventories,
- Difficulties in navigation.

In regard to the information deemed crucial for inclusion in an inventory of digital technologies, the majority of respondents emphasized the significance of specifying the intended agricultural sector for each respective technology. Regarding the rating and comments of digital technologies:

- The majority of respondents consider the ratings of digital technologies for agriculture to be valuable information, with a similar pattern observed when asked about the availability of comments on these technologies.
- The survey shows that almost half of the participants would rate a digital technology for agriculture, with a significant number of respondents responding positively and some anonymously. The majority will also read comments about such technology.

The survey participants assessed statements on their probability of using certain search methods when searching for digital technologies for agriculture in relevant inventories, and search methods seem to be either likely or very likely to be used by the survey participants.

Concerning the filters that respondents consider most important, the agricultural sector in which the technology is intended to be used seems to be the most popular response.

6.2. Definition of user needs

The requirements of users associated with the CODECS digital platform have been established by leveraging the insights and conclusions derived from the "User Need Survey". The presentation of user requirements adheres to a standardized format, featuring a unique identifier in the format UN## and an accompanying description. The user needs are presented clustered into four categories; user needs pertaining to the CODECS Platform [Pltf], user needs of the Meta-Inventory [MetIn] of digital technologies, user needs of the Data-Entry Tool [DatEn], and user needs of the Dataset-Inventory [DatIn]. Detailed user needs descriptions can be found in

Table 3 provided below.

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Table 3: User Needs as defined by the "User Need Survey".

Category	User Needs
CODECS Platform [Pltf]	**UN01:** Access to information on the scope of each of the modules of the platform, so as to know what each platform module is about.
	UN02: Access to information without needing to authenticate myself, so as to not spend time on log-in each time I access it.
	UN03: Access to textual and visual cues informing me about how to access the meta-inventory of digital technologies, so as to be able to easily access it.
	UN04: Access to textual and visual cues informing me about how to access the dataset inventory, so as to be able to easily access it.
	UN05: Use an upload form, so as to be able to upload a dataset to the CODECS platform.
	UN06: Easily navigate through the platform, so as to be able to find pages and information of interest without spending much time.
	UN07: Access to an API, so as to be able to provide datasets.
	UN08: Access to textual and visual cues informing me about how to access the upload form, so as to be able to easily access it.
	UN09: Access to textual and visual cues informing me about how to access the CODECS API, so as to be able to easily access it.
	UN10: Access to information in my mother tongue, so as to be able to comprehend the information delivered to me.
CODECS Meta-Inventory [MetIn]	**UN11:** Access to information about each of the delivered technologies, so as to be able to conclude about the relevance of the technology to my needs and interests.
	UN12: Easily navigate through it, so as to be able to find pages and information of interest without spending much time.
	UN13: Customize the amount of information delivered to me, so as to neither being overwhelmed with unnecessary information nor be delivered with little information.
	UN14: Access to digital technologies clustered in groups, so as to be able to know about similarities of the technologies provided.
	UN15: Search for technologies using pre-defined filters, so as to be guided in the identification of technologies of interest and relevance to my needs.
	UN16: Search for technologies using pre-defined keywords, so as to be guided in the

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Category	User Needs
	identification of technologies of interest and relevance to my needs.
	UN17: Search for technologies using free-text keywords, so as to be able to explore what technologies are available.
	UN18: Search for technologies using pre-defined scenarios, so as to be informed about the use of technologies in a real-world context.
	UN19: Access to advanced search capabilities, so as to be able to customize my search.
	UN20: Access to information in my mother tongue, so as to be able to comprehend the information delivered to me
	UN21: Access to ratings of the digital technologies, so as to know how other users value the digital technologies presented in the meta-inventory.
	UN23: Rate digital technologies, so as to let other users know how I value the digital technologies in the meta-inventory
	UN24: Read comments about the digital technologies, so as to know how other users value the digital technologies presented in the meta-inventory.
	UN25: Post free-text comments about digital technologies, so as to let other users know how I value the digital technologies in the meta-inventory.
CODECS Data-Entry Tool [DatEn]	**UN26:** Have clear instructions about how to use the upload form, so as to know what information I need to provide and how.
	UN27: Save progress and resume later, so as to not have to execute the upload all at once.
	UN28: Preview and edit my input before the upload, so as to be able to do a final check to my input and any corrections that may be needed.
	UN29: Return to previous steps of the upload process, so as to be able to do a check to my input and any corrections that may be needed.
	UN30: Upload in a stepwise manner, so as to be able to easily execute it.
	UN31: Access to it in my mother tongue, so as to be able to execute the upload.
	UN32: Easily get authentication credentials, so as to be able to use the API.
	UN33: Upload large-sized datasets, so as to not encounter limitations in the size of the datasets I want to provide.

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Category	User Needs
	UN34: Access to documentation, so as to know what operations I can perform and how.
CODECS Dataset Inventory [DatIn]	**UN35:** Access information about each of the delivered datasets, so as to be able to conclude about the relevance of the dataset to my needs and interests.
	UN36: Search for datasets using pre-defined filters, so as to be guided in the be guided in the identification of datasets of interest and relevance to my needs.
	UN37: Search for datasets using pre-defined keywords, so as to be guided in the identification of datasets of interest and relevance to my needs.
	UN38: Search for datasets using free-text keywords, so as to be able to explore what datasets are available.
	UN39: Read comments about datasets, so as to know how other users value the datasets in the inventory.
	UN40: Search for datasets using pre-defined scenarios, so as to be informed about potential use of datasets in a real-world context.
	UN41: Access to ratings of datasets, so as to know how other users value the datasets available in the inventory.
	UN42: Rate datasets, so as to let other users know how I value the datasets in the inventory.
	UN43: Post free-text comments about datasets, so as to let other users know how I value the datasets in the inventory.

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7. CODECS platform requirements

7.1. Functional requirements

The functional requirements of the CODECS platform, defined for its MVP version, are presented in this section. Functional requirements are presented using an identifier of the form FR##, a title, and the user need(s) associated with them. They are grouped into categories (general platform requirements, meta inventory, data entry tool, dataset inventory, and user profile) for clearer organization and delivery of the intended information. Furthermore, the priority of each requirement is stated, with Priority 1 indicating that the specified requirement will be considered for the MVP version of the platform, whereas Priority 2 indicates that the specified requirement is designated for the second version of the platform.

Table 4: Functional requirements of the CODECS digital platform.

Category	Functional Requirement	Associated User Need(s)	Priority
CODECS Platform [Pltf]	**FR01:** Access to information about the scope of each module	UN01	1
	FR02: Access to information without user authentication	UN02	1
	FR03: Navigation System	UN03, UN04, UN06, UN08, UN09	1
	FR04: Upload form	UN05	1
	FR05: View digital technology and dataset count from homepage.	UN01	1
	FR06: CODECS API	UN07	2
	FR07: Multilingual support	UN10	2
Meta-Inventory [MetIn]	**FR08:** Access to information about meta-inventory technologies.	UN11	1
	FR09: Navigation System	UN12	1
	FR10: Selection of the amount of the delivered technology information (metadata).	UN13	1
	FR11: Grouping of technologies into clusters using the application scenarios.	UN14	1
	FR12: Search technologies through filters	UN15	1

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Category	Functional Requirement	Associated User Need(s)	Priority
	FR13: Search technologies through pre-defined keywords.	UN16	2
	FR14: Search technologies through free text keywords.	UN17	1
	FR15: Search technologies through predefined scenarios.	UN18	2
	FR16: Search technologies through advanced search capabilities.	UN19	2
	FR17: Multilingual support	UN20	2
Data Entry Tool [DatEn]	**FR18:** Availability of visual and textual clues, providing indications for the information to be entered in the data entry tool.	UN26	1
	FR19: Progress saving capabilities.	UN27	1
	FR20: Preview and edit input before upload.	UN28	1
	FR21: Return to previous steps of the upload process.	UN29	1
	FR22: Progression of upload process in steps.	UN30	1
	FR23: Multilingual support.	UN31	2
	FR24: API Registration Key Authentication.	UN32	2
	FR25: API documentation.	UN34	2
Dataset Inventory [DatIn]	**FR26:** Access information about datasets.	UN01, UN35	1
	FR27: Search datasets through predefined filters.	UN36	1
	FR28: Search datasets through predefined keywords.	UN37	1
	FR29: Search datasets through free-text keywords.	UN38	1

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Category	Functional Requirement	Associated User Need(s)	Priority
	FR30: Search datasets through predefined scenarios.	UN40	2
User Profile	**FR31:** Register profile	None	1
	FR32: Log in to profile	None	1
	FR33: Access favorites list from user profile.	None	1
	FR34: Edit user profile.	None	1
	FR35: Delete user profile.	None	1
	FR36: View and edit uploads. (Authorised Users Only)	None	1
	FR37: Apply for authorization privileges.	None	1
	FR38: Create Application Scenarios (Authorised Users Only)	None	1

7.2. Non-functional requirements

Within this section, we catalog and elucidate all the non-functional requirements that encompass the background operations and conditions crucial for the CODECS platform to operate seamlessly and deliver an optimal user experience.

In alignment with the insights from Karl Wiegers and Joy Beatty's book "Software Requirements", non-functional requirements delineate the attributes and limitations a system must exhibit to its users. They set boundaries on the evolving product, encompassing aspects such as performance, usability, reliability, security, and supportability. In essence, non-functional requirements are the criteria that describe the qualities, characteristics, and constraints of a software system or product, rather than its specific behaviours or functions. These requirements specify how the system should perform, rather than what it should do. Within the realm of the CODECS platform, this document delves into the non-functional requirements, particularly emphasizing performance and security considerations.

7.2.1. Performance Requirements

Performance requirements relate to the criteria under which the platform should operate. These criteria focus on the ability of the platform to perform its operations, within a specific operational environment, in an efficient and effective way.

Response time

Response time refers to the maximum allowable duration for the platform to react to a user's action or request. The CODECS digital platform is expected to function as a progressive web application, ensuring swift response times for various user interactions and tasks, including page loading, transaction processing, executing search queries, and more.

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- **Requirement**: The platform should have a maximum response time of 2 seconds and normal response time of 1 second.
- **Validation**: The response time of the platform can be validated through real-time monitoring of the requests on the production server.

Throughput

Throughput can be defined as the number of concurrent users requests the platform should be able to handle within a specified timeframe.

- **Requirement**: The platform should be able to process a minimum throughput of 1,000 user requests per second.
- **Validation**: Load testing can be used to validate the throughput of the platform in the production server.

Resource Utilisation

Resource utilisation can be defined as the maximum allowed consumption of system resources in terms of CPU, memory, disk usage, and network bandwidth.

- **Requirement**: The CODECS digital platform should ensure that utilisation of CPU will remain below 70%, memory utilisation below 80% and disk usage below 70% within normal operations.
- **Validation**: Resource utilisation can be validated via real-time system monitoring and performance testing.

Availability

Availability can be defined as the desired uptime percentage that indicates the amount of time the system should be accessible and operational for the end users.

- **Requirement**: The web platform should have a minimum availability of 99.9% during a calendar month
- **Validation**: Availability can be validated via monitoring tools that record uptime and downtime events. Analysing these events can produce the actual availability percentage and compare it with the target requirement.

7.2.2. Security Requirements

Security requirements specify how the protection of the system, its data, and its users from unauthorised access, data breaches, and other security threats is achieved., A concise overview of the precise security protocols to be considered during the design and implementation phases of the software development process is provided. These protocols center on safeguarding the system, its data, and its users against unauthorized access, data breaches, and various security threats.

Authorisation and Access Control

Authorisation and access control mechanisms allow for systems to restrict access to specific sets of functionalities/ operations, data and or resources based on a set of rules and policies set by the system owner.

- **Requirement**: The platform should enforce appropriate authorisation and access control policies to restrict user access to specific functionalities, data, or resources based on their roles and privileges.
- **Validation**: Testing and security assessment procedures can be used to validate this requirement.

Data Confidentiality

The platform should protect sensitive data by implementing appropriate encryption mechanisms, both during transit and storage. This includes using secure protocols (e.g., HTTPS) for data transmission and encryption algorithms (e.g., AES) for data at rest to prevent unauthorised access and data breaches.

- **Requirement**: Implement security protocols

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- **Validation**: Security assessments and audits (i.e., penetration testing) can be used to validate this requirement.

Data integrity

The CODECS digital platform should ensure data integrity by implementing mechanisms to detect and prevent unauthorised or unintended modifications to data, ensuring its accuracy and reliability.

- **Requirement**: Implement data integrity mechanisms.
- **Validation**: Data integrity can be validated via testing and audits during data input, validation processes, backup, and recovery tests.

Secure coding practices

The source code of the platform should follow secure and best coding practices to avoid or at least mitigate common vulnerabilities (i.e., SQL injection, cross-site scripting etc) and ensure the overall security of the system.

- **Requirement**: Implement best coding practices
- **Validation**: The effectiveness of secure coding practices can be validated through code reviews, static code analysis, security testing, and vulnerability scanning.

Access Logs

The platform should maintain extensive audit logs of user activities and events in a secure location. These logs should be monitored to detect and respond to security (or any other) incidents or suspicious activities.

- **Requirement**: Log user activities and monitor.
- **Validation**: The effectiveness of audit logging and monitoring can be validated through periodic reviews of log entries, incident response drills, and audits of security controls.

Security Updates

The platform should regularly receive and apply security updates to address known vulnerabilities, software bugs, and emerging security threats. The updates should be obtained from reliable sources and applied in a timely manner to ensure the platform's security remains up to date.

- **Requirement**: Perform security updates on software and database.
- **Validation**: Security updates can be validated through vulnerability scanning, penetration testing, and security assessments.

Cookies and Analytics

The platform is expected to efficiently handle cookies and analytics to improve user experience, privacy, and overall performance.

- **Requirement**: Manage cookies and analytics to ensure user privacy and optimize the application's performance. Cookies and analytics will only be tracked after the user has agreed to provide permission.
- **Validation**: Cookies and analytics are effectively managed in accordance with privacy regulations (including the General Data Protection Regulation), user preferences are always respected, and performance remains optimal. Regular auditing should confirm compliance and adherence to best practices. In the scope of the CODECS platform, analytics are used to track and analyse the user experience and navigation in the platform.

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8. Design

8.1. CODECS platform architecture

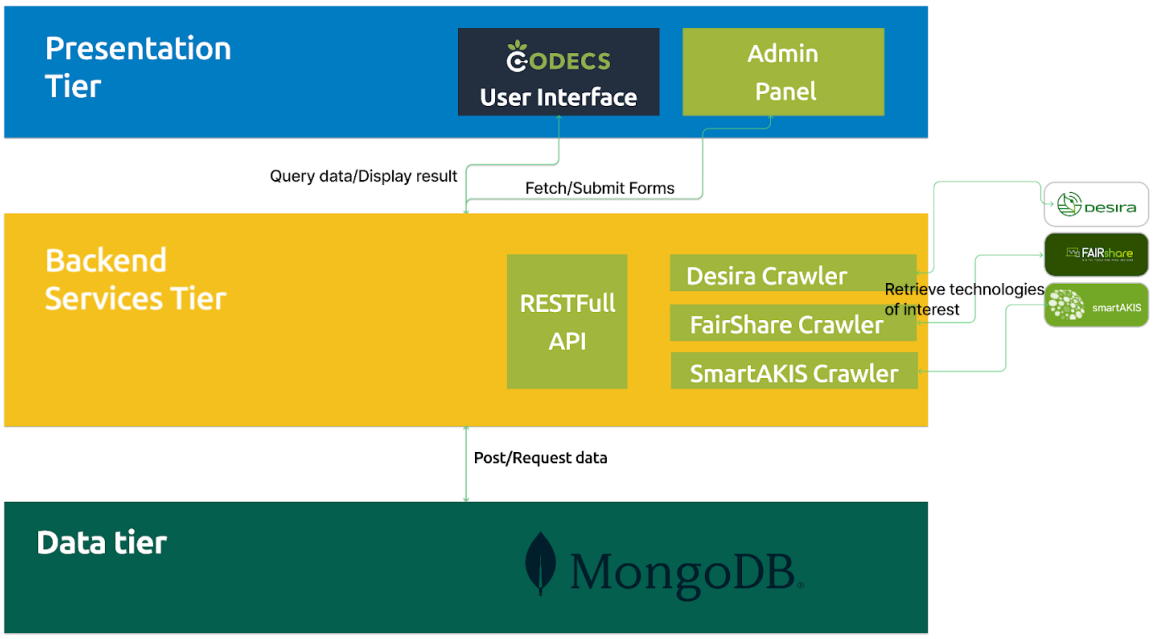

Figure 9: Diagrammatic representation of the CODECS platform's architecture based on the tier approach.

Figure 9 illustrates the architecture of the CODECS platform, organized based on the tier approach. These tiers encompass the components of **Data Tier**, **Backend Services Tier**, and **Presentation Tier** which are described below:

- The Data Tier primarily focuses on data storage and management, encompassing databases and data storage systems integral to the platform's development. This tier is responsible for the storage, retrieval, and manipulation of data. For CODECS, we have chosen MongoDB, an open-source NoSQL database management system renowned for its ability to create document-oriented databases capable of accommodating diverse data structures.
- The Backend Services Tier, also known as the application or logic tier, houses the platform's core business logic and processing capabilities. It handles user requests, manages data processing, and orchestrates application functionalities. This tier incorporates essential components such as application servers, microservices, and APIs. Additionally, we have developed crawlers, as part of Task 7.2 (Meta-inventory of digital technologies), to extract technologies of interest from existing repositories. In the initial platform version, we utilized the DESIRA, FAIRshare, and Smart-AKIS inventories.
- Lastly, the Presentation Tier represents the user interface, serving as the front-end of the platform and is where user interactions occur. It also includes an Admin panel designed to grant specific authorized users access to functionalities like dataset uploading, retrieval, and editing.

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8.2. CODECS platform features

The MVP version of the CODECS Digital Platform is set to be released by the end of September 2023. The first version of the platform shall provide access to the Dataset Inventory, the Meta-Inventory, and the Data Entry tool.

The platform's features are described in detail below. The name of the feature is presented, alongside its associated functional requirements (Section 7.1) and a description of the feature's implementation and application.

Feature 01: Access Meta-Inventory, Dataset Inventory and Data Entry Tool.

Associated Functional Requirement(s): FR03, FR04

Description: The users of the CODECS Digital Platform are able to access the different modules available through the header menu of the platform.

Figure 10: The CODECS header menu.

Feature 02: Access Project Information.

Associated Functional Requirement(s): FR01

Description: The users of the CODECS Digital Platform are able to access information regarding the project by clicking on the appropriate link on the home page.

Figure 11: CODECS project information.

Feature 03: View Number of datasets and description of Meta-Inventory and Dataset Inventory from home page.

Associated Functional Requirement(s): FR01, FR05

Description: The users of the CODECS Digital Platform are able to view the exact number of datasets and technologies available on the platform's respective modules, as well as view descriptions of the said modules.

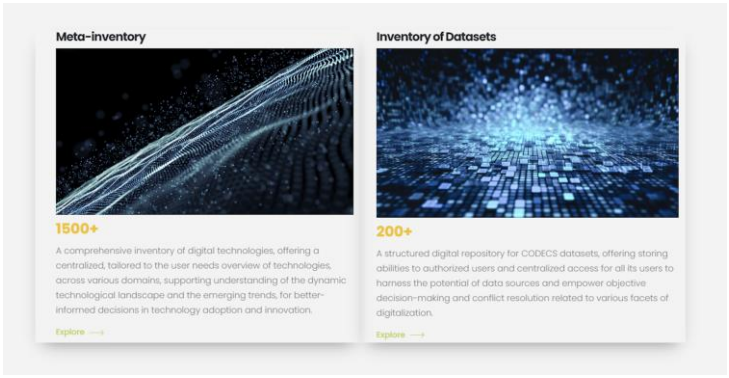

Figure 12: The CODECS module description and dataset count.

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Feature 04: View Technologies available on the meta inventory.

Associated Functional Requirement(s): FR09

Description: When accessing the Meta-Inventory, users are able to view the available technologies, including their title, creator, upload date, a short description, and all related tags.

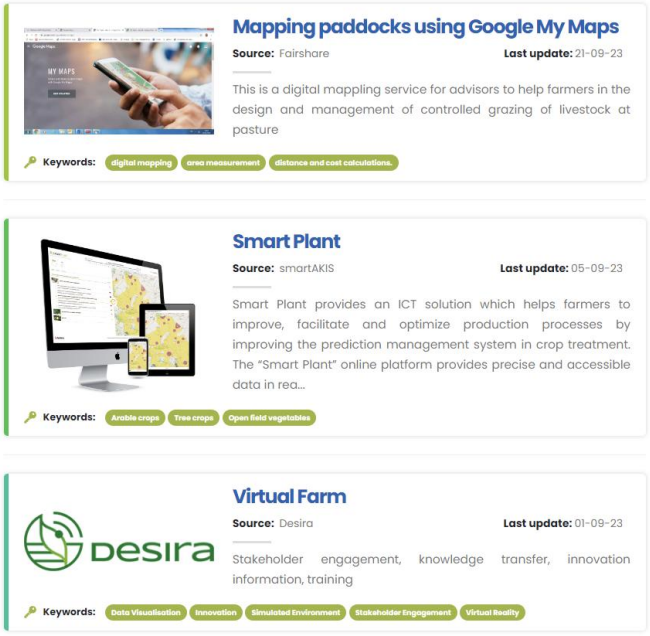

Figure 13:The CODECS meta-inventory technology list.

Feature 05: Filter Technologies of the Meta-Inventory

Associated Functional Requirement(s): FR09, FR10, FR12

Description: The users of the CODECS Digital Platform are able to select from a list of available filters, to narrow down the returned results from the list of technologies.

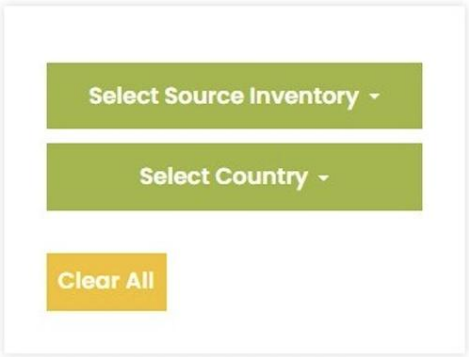

Figure 14: The CODECS Meta-Inventory filter.

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Feature 06: View Technology description and metadata.

Associated Functional Requirement(s):FR08, FR09

Description: By accessing the Technology overview page, users are able to view information regarding the creator, upload date and description of the dataset. Furthermore, a list of available metadata regarding the chosen technology may be viewed. The metadata made available may be customised by the user.

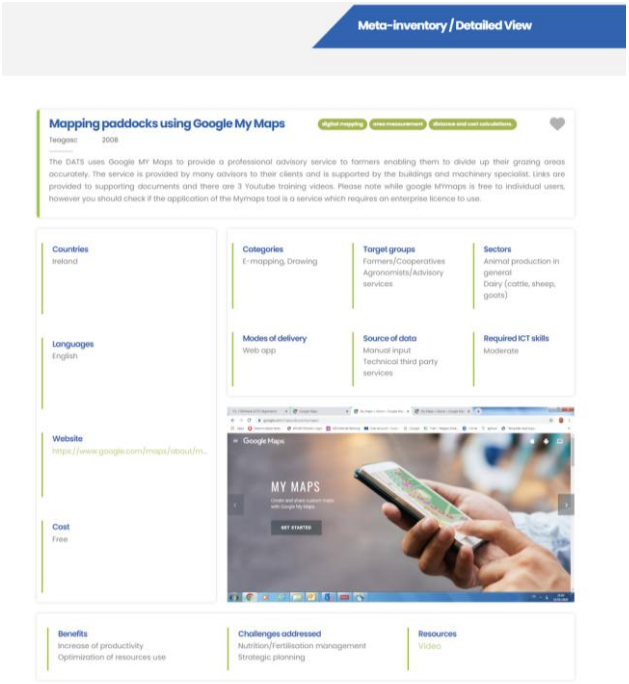

Figure 15: The CODECS technology overview page.

Feature 07: Grouping in Application scenarios.

Associated Functional Requirement(s): FR11

Description: The user can select an application scenario and access a summary of the associated technologies that have been grouped to match the content of the more generic cluster.

Figure 16: The CODECS technology overview page.

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Feature 08: View Technology page.

Associated Functional Requirement(s): FR09

Description: By accessing the Technology overview page, users are able to visit the chosen technology's page by clicking on the appropriate link, which will redirect them to the technology's website.

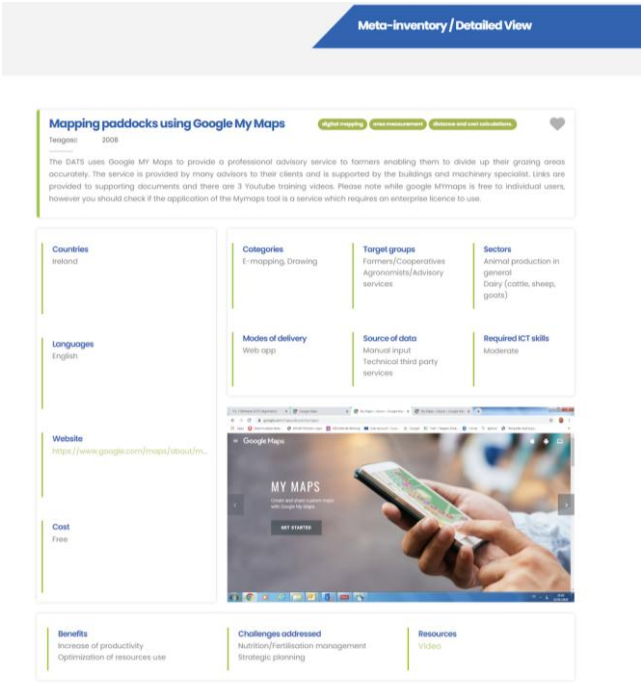

Figure 17: The technology's website, situated under the clickable link.

Feature 09: Access Upload Form on the Dataset Inventory

Associated Functional Requirement(s): FR18

Description: The users of the CODECS Dataset Inventory are able to access the upload form from the Dataset inventory page, by clicking on the "Create" button.

Figure 18: The CODECS dataset inventory granting entry to the Upload Form.

Feature 10: View Dataset list available on the inventory.

Associated Functional Requirement(s): FR26

Description: When accessing the Dataset-Inventory, users are able to view the available datasets, including their title, creator, upload date, a short description, and all related tags.

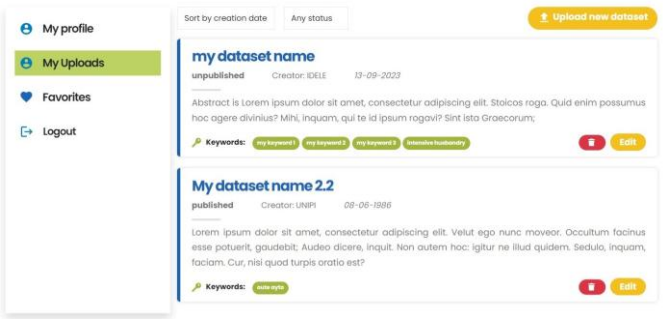

Figure 19: The CODECS dataset list.

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Feature 11: Filter Datasets of the Inventory

Associated Functional Requirement(s): FR27

Description: The users of the CODECS Digital Platform are able to select from a list of available filters, in order to narrow down the returned results from the list of datasets.

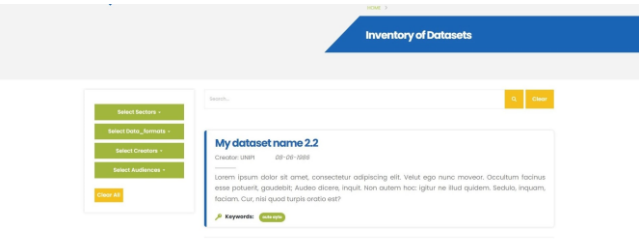

Figure 20: The CODECS Dataset inventory filters.

Feature 12: Search through keywords Datasets of the Inventory.

Associated Functional Requirement(s): FR28

Description: The users of the CODECS Digital Platform are able to search datasets from a list of predefined keywords, in order to narrow down the returned results.

Figure 21: The CODECS Dataset inventory filters.

Feature 13: View dataset description and metadata.

Associated Functional Requirement(s): FR26

Description: By accessing the dataset overview page, users are able to view information regarding the creator, upload date and description of the dataset. Furthermore, a list of available metadata regarding the chosen dataset may be viewed. The metadata made available may be customised by the user.

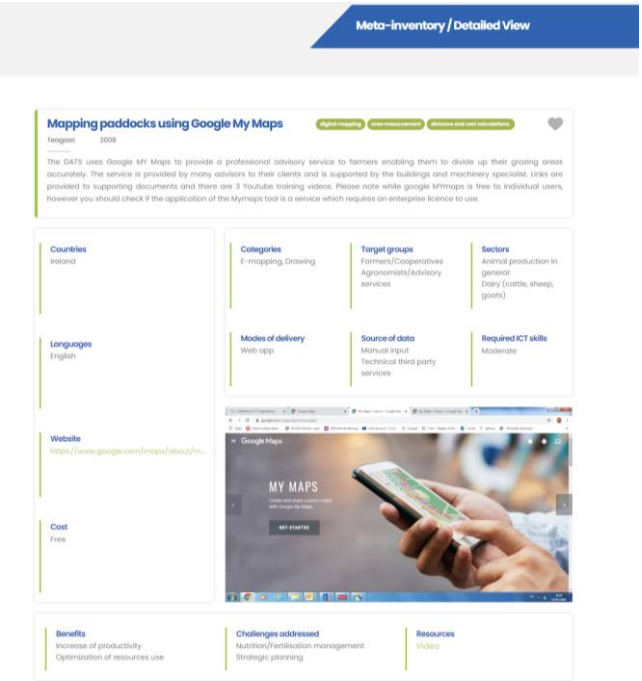

Figure 22: The CODECS dataset overview.

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Feature 14: View Dataset page.

Associated Functional Requirement(s): FR26

Description: By accessing the dataset overview page, users are able to visit the chosen dataset's page by clicking on the visit page button.

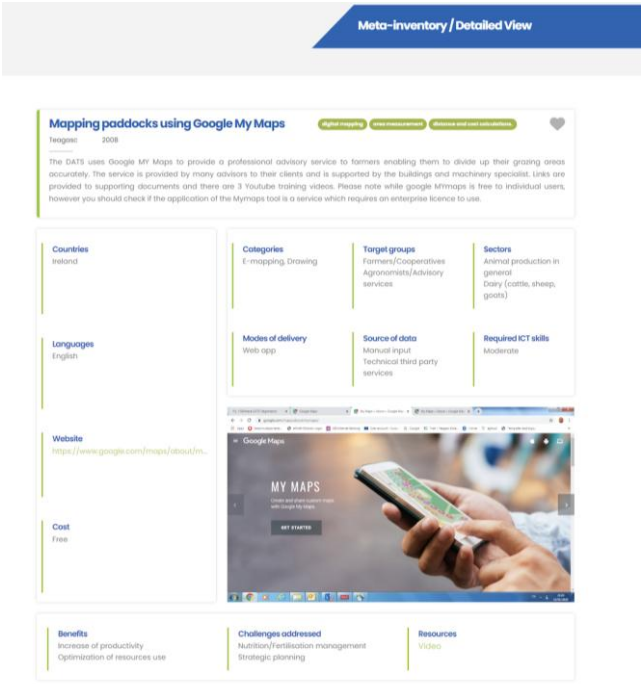

Figure 23: The technology's website, situated under the clickable link.

Feature 15: Upload Form

Associated Functional Requirement(s): FR18, FR19,FR20, FR21

Description: Authorised users are able to upload appropriate datasets through the CODECS platform's upload form in progressive steps. The upload form provides users with the necessary information to fill out the appropriate metadata fields and allows them to save, preview or edit their progress and return previous steps of their upload.

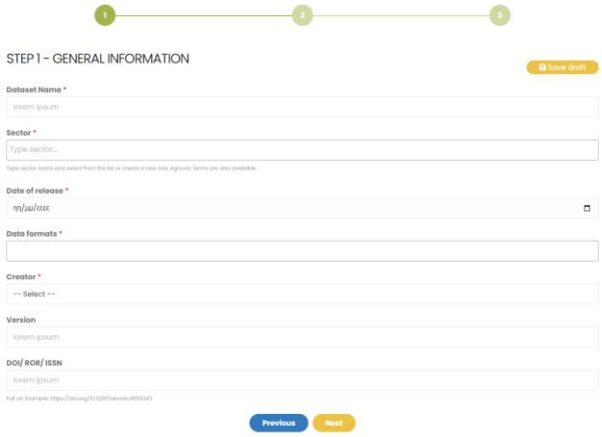

Figure 24: The CODECS Platform's Upload Form.

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Feature 16: Upload Overview page

Associated Functional Requirement(s): FR19, FR20, FR21

Description: After completing the upload form, the user will be presented with the Upload Overview page, which will act as a preview of the dataset before the finalisation of the upload. The user may then choose to save the upload or return to a previous step of the upload process.

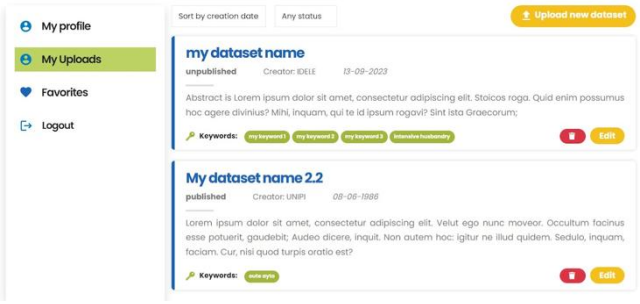

Figure 25: The Upload Overview page.

Feature 17: Register and Log in to profile.

Associated Functional Requirement(s): FR31, FR32, FR37

Description: Authorised users may sign in the CODECS platform using their appropriate credentials. Users have also authorisation privileges in editing user permissions.

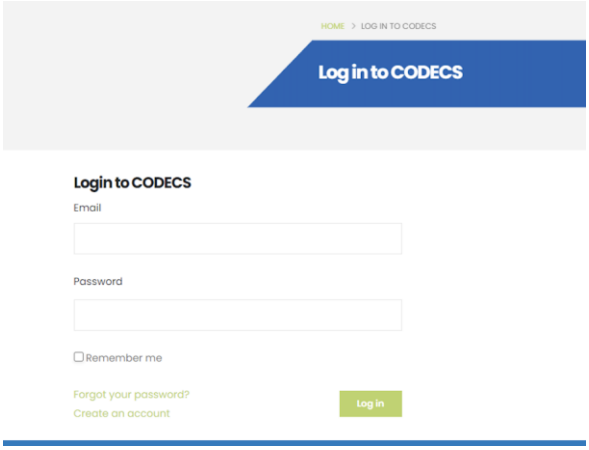

Figure 26: The sign in/sign up page.

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Feature 18: Edit User Profile.

Associated Functional Requirement(s): FR34, FR35

Description: Users can edit their profile on the “My Profile” page, where they will be able to add or update their personal information and settings, as well as delete their profile.

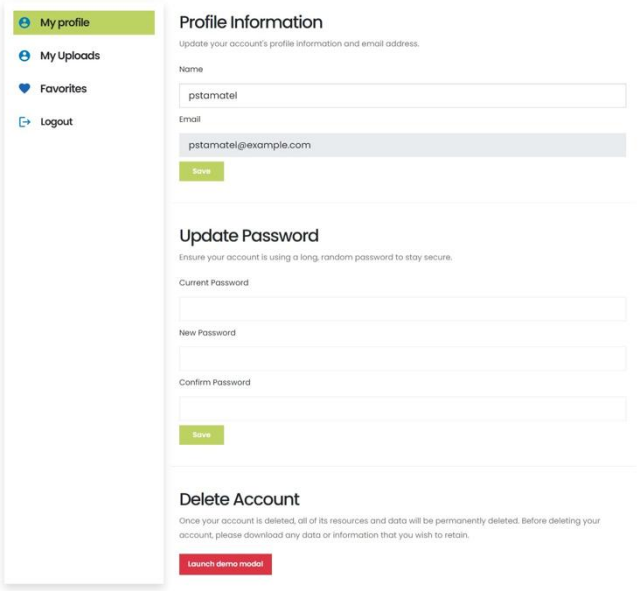

Figure 27: “My Profile” page of the User Profile.

Feature 19: View Uploads on User Profile.

Associated Functional Requirement(s): FR20, FR36

Description: Authorized users can access the entire list of their uploads, both completed and in progress. Moreover, they may upload a new dataset. They may also edit their existing uploads or finalise the ones that are not completed.

Figure 28: “My Upload” page of the User Profile.

Feature 20: View Favorites on User Profile.

Associated Functional Requirement(s): FR33

Description: Users can access the entire list of their favorite datasets and technologies from their user profile. Users may edit and remove items from their favorite list.

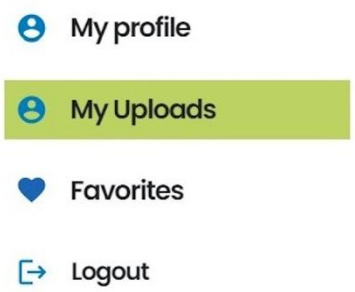

Figure 29: “Favorites” page of the User Profile.

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Feature 21: Create application scenarios.

Associated Functional Requirement(s): FR38

Description: Authorised users can create their own application scenarios.

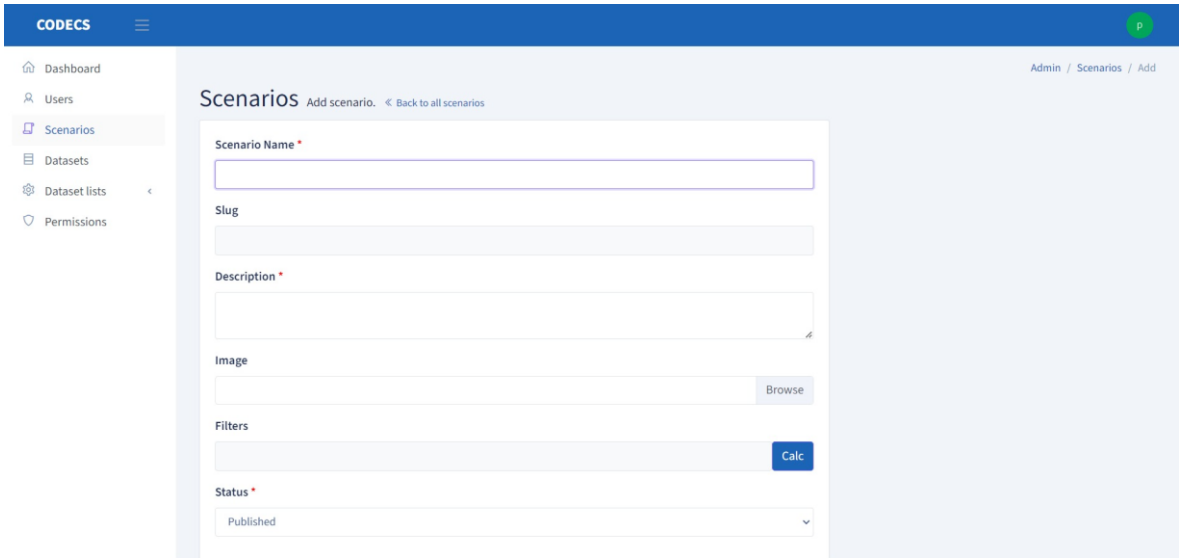

Figure 30: Interface for creating application scenarios.

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9. Development

9.1. Backend development

The backend section of the platform was created using Laravel, MongoDB and crawlers for data retrieval.

- Laravel is a PHP web application framework and serves as the cornerstone of the CODECS platform's backend. It was used for routing and middleware, database management as well as authentication and security.
- For data storage and management, MongoDB was used, an open-source NoSQL database management system. MongoDB's document-oriented database structure aligns seamlessly with the platform's need for flexible and scalable data storage.
- Lastly, as part of the Task 7.2 (Meta-inventory of digital technologies), Laravel commands were created to carry out operations related to data retrieval, processing and management of technologies from other public repositories (Smart-AKIS, FAIRshare, DESIRA). Laravel commands are defined within Laravel Artisan, which is the command-line tool included with the Laravel framework and provides a convenient and efficient way to interact with the platform's backend functionality.

9.2. Frontend development

The front-end development of the CODECS platform has been created using Laravel, Blade templates, Bootstrap, and React:

- Laravel offers a robust and elegant toolkit for building web applications, providing features such as routing, authentication, and database management that streamline development. It features elegant syntax, extensive documentation, and a very active community.
- Blade is a powerful and intuitive template engine used in Laravel. Blade templates provide a clean, expressive syntax for creating dynamic and reusable views in web applications allowing the inclusion of variables, conditional statements, loops, and more, enabling the creation of dynamic web pages efficiently and enhancing code organisation and maintainability.
- On the other hand, Bootstrap is a responsive, CSS-based framework that simplifies the creation of visually appealing and user-friendly interfaces. Its pre-designed components, responsive grid system, and extensive library of CSS and JavaScript components accelerate front-end development while ensuring compatibility across various devices and screen sizes.
- React, is an open-source JavaScript library for building user interfaces and features a component-based architecture, which allows developers to create reusable UI components that update efficiently as data changes.

The template used for the design of the CODECS digital platform was Porto. Porto is a versatile, well documented, and highly regarded multipurpose website template offering a comprehensive set of features and customizable elements. Porto is also known for its responsiveness, ensuring seamless functionality on various devices and screen sizes. Moreover, it comes with robust performance optimization features, ensuring fast loading times and an excellent user experience.

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10. Continuous Platform Development

10.1. Next Steps

In accordance with the methodology outlined in Section 5, the CODECS digital platform will undergo continuous enhancements and refinements, guided by the valuable feedback gathered from its user community throughout the project's lifetime. The development trajectory of the digital platform will prioritize the incorporation of new features and functionalities derived from the ongoing feedback collection processes. This commitment to evolution will persist, ensuring that the platform remains dynamic and responsive to the evolving needs of its users. Regular updates will be executed, and additional features will be seamlessly integrated into the platform's ecosystem, all the way up to the conclusion of the project.

As mentioned in Section 7.1, some functionalities of the CODECS Digital Platform and its modules are currently being developed for the platform's next iteration. Namely, the features of interest are the following:

- **Comments and Ratings**: Participants of the user needs survey almost unanimously stated that they enjoyed viewing ratings and comments on the information provided; despite that, they also stated that they prefer not to participate in rating and commenting on materials online. As it stands, the AUA development team is exploring alternative means of assessing objects among various dimensions, always conferring with the project's Steering Committee and Coordination team, in order to help crystallize these decisions.
- **Search through alternative means** (predefined keywords, predefined scenarios): Searching the inventories of the CODECS platform via predefined keywords and scenarios is an endeavour that requires close collaboration with and input from various partners of the Steering Committee. This shall be explored at a later stage and implemented in the next iterations of the platform, after close liaisons with all appropriate partners.
- **Advanced search capabilities**: Advanced search performed by utilising logical queries may be added to the platform's inventories. It is, however, necessary to consider interactions and patterns when utilising the search functions from users, as well as feedback from the partners, to optimise the parameters under which these capabilities may be implemented.

10.2. CODECS platform longevity and sustainability

This section within the deliverable, serves as an initial exploration of concepts, with the primary goal of establishing a foundational framework for defining and addressing the sustainability and long-term viability of digital platforms. It delineates an initial plan that lays the groundwork for forthcoming discussions, more comprehensive analyses, and the formulation of strategies essential for ensuring the enduring success of the CODECS platform within a sustainable plan.

The concepts of longevity and sustainability encompass multifaceted dimensions, often introducing complexity and ambiguity. Sustainability is a multidimensional notion its definition evolving over time to often emphasize "long-term viability" and the "continuity of an activity." Given the intricacies of this definition, it is imperative, especially in the context of platform development, to establish a clear foundation that encourages responsible, forward-thinking development practices.

CODECS will progressively enrich a meta-inventory of digital technologies built on achievements of existing platforms (FAIRshare, DESIRA, Smart-AKIS among others) which will be kept alive after the end of the project comprising new methodologies into the platform.

Throughout the ongoing evolution and expansion of the CODECS meta-inventory, a sustainability plan will be meticulously crafted to adeptly navigate the intricate interplay of **environmental**, **legal**, **social**, **economic,** and **technical** factors, ensuring the enduring continuity of the digital platform in the long term.

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The **environmental aspect** of digital platform sustainability is an increasingly critical consideration. As technology evolves, minimizing the platform's environmental footprint becomes imperative. Sustainable practices encompass hot-cold storage solutions and cloud servers as greener alternatives to conventional practice. In particular, hot storage refers to high-performance storage solutions, optimized for quick access and data retrieval. Such storage systems require more energy for their constant operation. On the other hand, cold storage is designed for long-term archiving and retrieval with an emphasis on energy efficiency. Transitioning less frequently accessed data to cold storage can lower energy consumption. In combination with migration to cloud servers which in lieu of conventional on-premises hosting models are often operated by renewable energy sources, and are known for better data and lifecycle management, can lead to substantial reduction of the environmental footprint.

The **technical aspect** in the context of digital platform longevity pertains to the platform's ability to adapt, evolve, and remain functional and efficient over an extended period. It encompasses the underlying infrastructure, software architecture, security measures, and technologies used to maintain and enhance the platform's performance, security, and user experience. A sustainable technological foundation allows the platform to remain resilient in the face of changing user demands, emerging threats, and technological advancements. Practices that lead to work reproducibility, as described by (Ziemann et. al., 2023) include the use of:

- Code version control (Subversion, git) for systematic tracking of changes in code over time allowing for a detailed history of modifications. It ensures that the entire codebase, including its evolution, is well documented and can be rolled back or forward, which is crucial in reproducing results. For software long-term archiving purposes, the registration of codes in repositories such as Zenodo or Software Heritage is strongly recommended.

- Computer environment control ensures that others can recreate the same environment to reproduce results and minimize discrepancies due to software setup variations. Virtual Machines or Containers (such as docker) can guarantee the computing environment's full reproducibility, despite of global computing environment evolution.

- Literate programming where code and documentation are intertwined to facilitate transparency of the approach followed in a narrative form alongside executable code. Jupyter Notebook, or R markdown enables the creation of such documents that combine narrative explanations, visualizations, and code snippets, thus making easier the reproducibility of the work done.

The **legal dimension** of digital platform sustainability is a fundamental pillar in ensuring its longevity. Compliance with evolving data privacy regulations and intellectual property laws is vital. Legal frameworks surrounding user data protection, content rights, and cybersecurity must be continuously adhered to and updated. A proactive approach to legal compliance plays a pivotal role in maintaining trust and credibility among users and stakeholders underpinning the platform’s operational continuity and sustained success. The CODECS digital platform is a non-commercial platform with an open character in the access of its digital content. The expansion of the meta-inventory after the project’s completion will remain to be supported by the CODECS web scraping tools in extracting technologies of interest from existing repositories. Legal aspects and specifying terms and conditions for the access, distribution, and reuse of newly sourced technologies will become available in their metadata (Licensing schemes).

In the **social dimension**, sustainability involves fostering a positive and inclusive user community. Digital platforms must prioritize user safety, well-being, and equitable access. Engaging with diverse user perspectives through feedback channels ensures continuous improvement and user satisfaction. Cultivating a sense of belonging and shared values within the platform's community fosters loyalty and user retention, contributing to its long-term viability and relevance in an ever-changing digital landscape.

The **economic aspect** of digital platform sustainability hinges on a viable business model that supports financial resilience. The CODECS digital platform needs to rely on sufficient funding sources to guarantee the preservation and effective delivery of its services. In a well-structured strategy, it is imperative to incorporate an exhaustive cost analysis that encompasses the resources necessary for the upkeep of the technological infrastructure, software maintenance, content updates, and human resources for the seamless, long-term operation of the web application. To accomplish this objective, securing structural funding becomes essential to cover the cost components for:

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- Human Resource Allocation

Allocating financial resources to ensure the continued provision of services and the availability of skilled personnel for equipment, infrastructure, content maintenance, and updates. Identifying key personnel essential for platform operation and maintenance (such as software developers, system administrators, content creators, database administrators, and help desk technicians) is necessary, accompanied by well-defined roles and responsibilities to estimate corresponding salaries or hourly rates. Lastly, evaluating the potential need for outsourcing tasks should be part of the associated cost considerations.

- Hardware and Software Maintenance

Creating a list of essential hardware components required for hosting the platform (including servers, data storage, and networking equipment) is essential for estimating their associated costs. Ensuring the financial resources cover hardware upgrades for energy-efficient and reliable operations is also crucial given the consideration with respect to the reduction of the environmental footprint.

- Web Application Operational Costs

Evaluating costs related to web hosting services and domain registration is essential, taking into account data security measures and compliance with data protection regulations. It is also important to consider redundancy and disaster recovery measures to maintain high availability and minimize potential downtime costs. Striking the right balance and avoiding overestimation of storage resources is important, not only for environmental sustainability but also for managing overall expenses effectively.

- Digital Content Review and Updates

Web scraping tools developed within CODECS will systematically browse and gather digital content repositories and relevant content and will regularly update the platform with new information, ensuring that users have access to the latest resources. However, to ensure the sharing of trustworthy digital content, digital technologies may need to undergo validation before becoming public on a given evaluation frequency. This validation can involve dedicated human experts for reviewing the content and providing documentation whenever needed.

- Comprehensive Cost Assessment

This entails computing both direct and indirect expenses associated with the operation and maintenance of the digital platform over a specified number of years. It is essential to conduct a sensitivity analysis to gauge how specific cost factors or assumptions impact the platform's overall sustainability.

Sustainable practices will be strongly encouraged in the CODECS digital platform deployment itself. It is imperative to remain mindful that substantial allocation of technical and human resources is required to pursue the implementation of such practices, which might not be always accessible. The anticipated return on investment is vital for the planning of this initial endeavour of the digital platform longevity, it needs to be addressed with practical constraints inherent to each aspect.

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Wiegers, K. E., & Beatty, J. (2013). Software requirements 3. Microsoft Press, U.S.

Ziemann, M., Poulain, P., & Bora, A. (2023). The five pillars of computational reproducibility: Bioinformatics and beyond.

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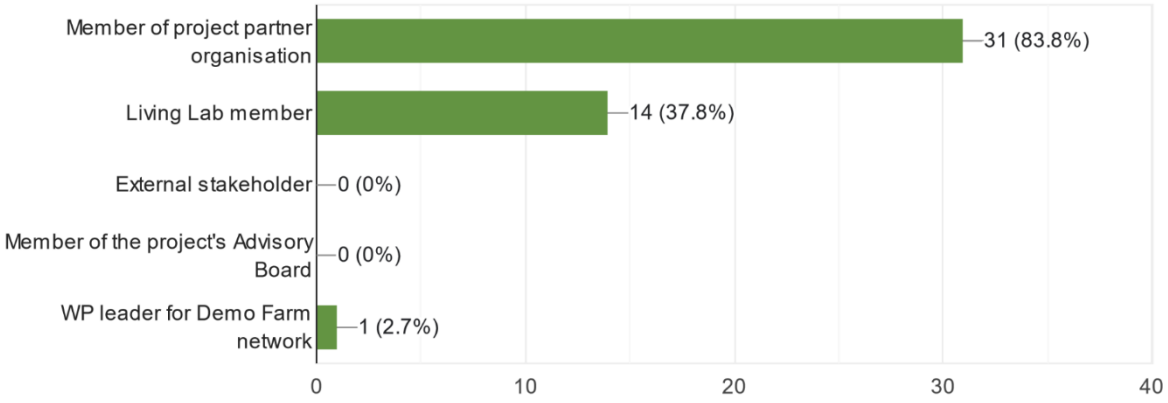
Annex

This Annex contains the questions and the answers provided in the User needs collection and insight acquisition survey.

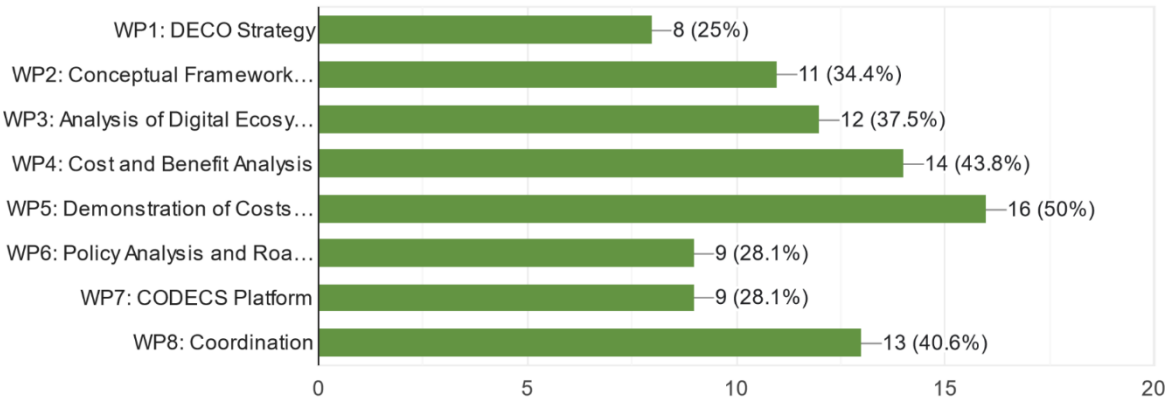
1. Which of the roles listed below describes best your involvement in the CODECS project? You may choose more than one options.

37 responses



2. In case you are a member of a partner organisation, in which project WPs are you associated with?

32 responses



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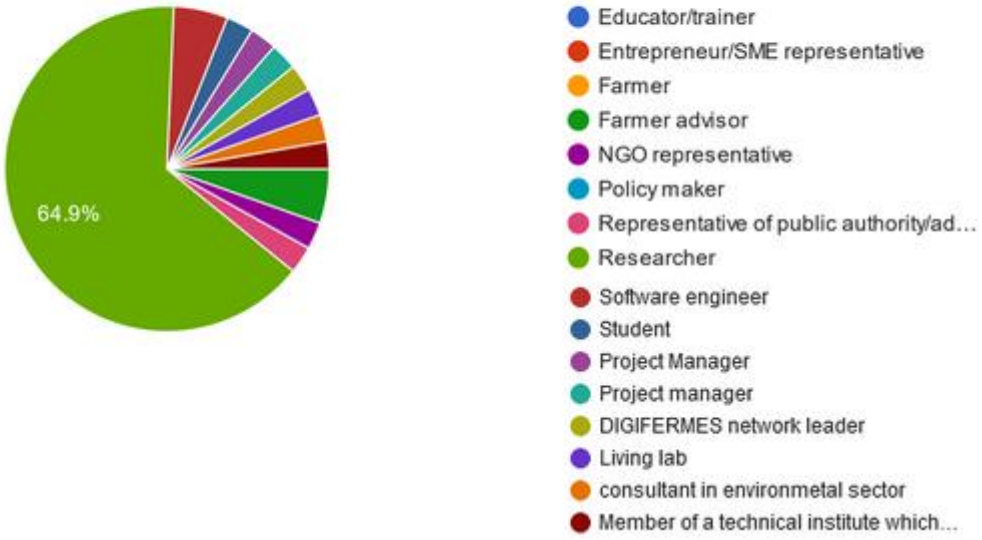
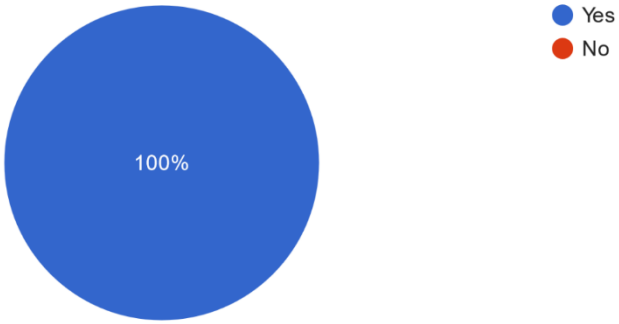
3. What is your background/expertise?

37 responses



4. Do you use any digital devices (personal computer, smartphone, tablet) for your everyday work-related activities?

37 responses



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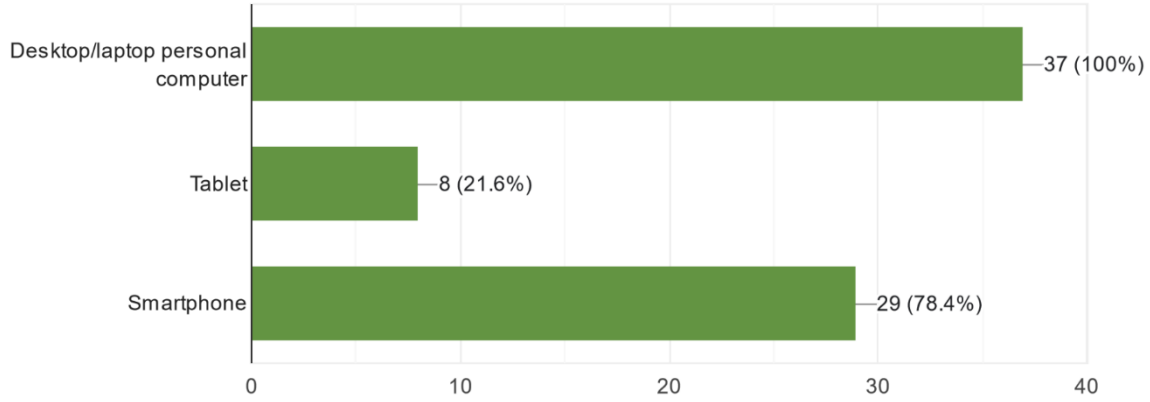
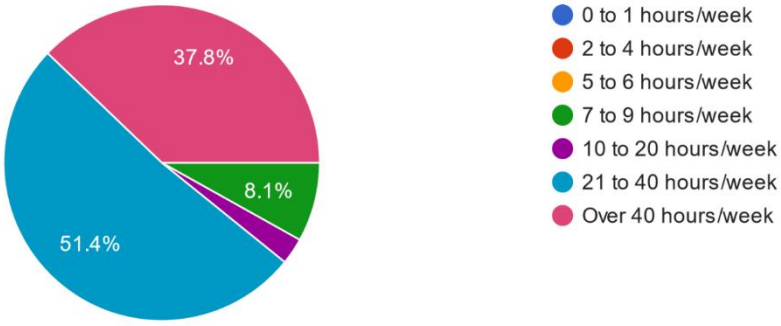
5. In the case that you make use of digital devices as part of your everyday work activities, could you indicate which of the following devices you most frequently use?

37 responses



6. Approximately, how many hours per week do you use digital devices for work-related purposes?

37 responses



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7. Which of the following activities do you usually use digital technologies for?

Category	Participants	Percentage
Communication and collaboration over a distance (e.g., via the use of emails, online collaboration applications, virtual meeting tools)	36	97.3%
Information search	33	89.2%
Document/spreadsheet/presentation creation and editing	32	86.5%
Search for project results or any kind of digital documents of usefulness to my work	32	86.5%
Search for scientific literature	31	83.8%
Data analysis	32	62.2%
Contact management	21	56.8%
Event monitoring and management	21	56.8%
Note keeping/keeping of digital archives and records	18	48.6%
Expense and revenue monitoring	17	45.9%
Coding/software development	5	13.5%
Development of Machine Learning models	2	5.4%
Keeping of digital logs for crop farming-/livestock-related activities	2	5.4%
Modeling, Automatic Controls and Robotics	1	2.7%
Writing	1	2.7%

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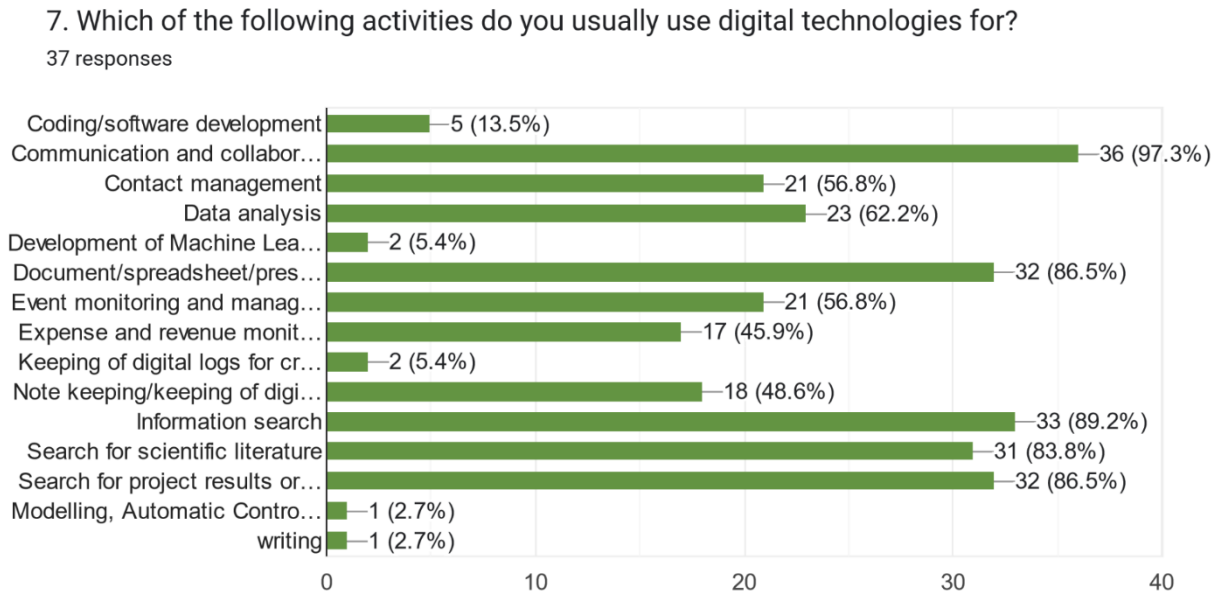

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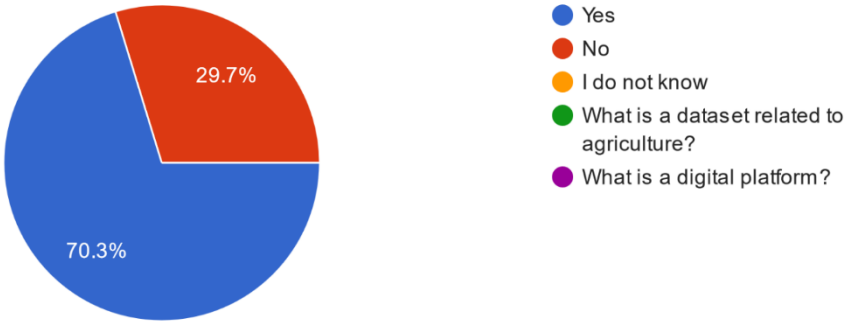
8. For each of the statements listed below, select the point of the rating scale that best denotes the extent of your agreement or disagreement.

	Strongly disagree	Disagree	Neither agree, nor disagree	Agree	Strongly agree
I like using digital devices.	0	1	1	18	17
I feel comfortable using software applications.	0	0	1	18	18
The use of digital devices and software applications allow me to be more productive.	0	0	3	12	22
The use of digital devices and software applications allow me to better communicate and collaborate with colleagues.	0	1	2	9	25
I will spend time going through manuals to better understand how I can use a software application.	5	11	15	2	4
A video tutorial is better for learning how a software application works compared to a text-based manual.	1	2	5	19	10
When I have a problem related to the use of a software application, I will solve it myself.	2	2	13	17	3
Comments about digital resources found on the Internet are useful.	2	3	5	21	6
I read comments related to digital resources available on the Internet.	3	7	2	19	6
I would post a comment for a digital resource I found on the Internet.	9	13	10	3	2

1. Have you ever uploaded a dataset related to agriculture (e.g., set of documents, imagery datasets, datasets containing measurements collected in the field, etc.) to a digital platform?

37 responses



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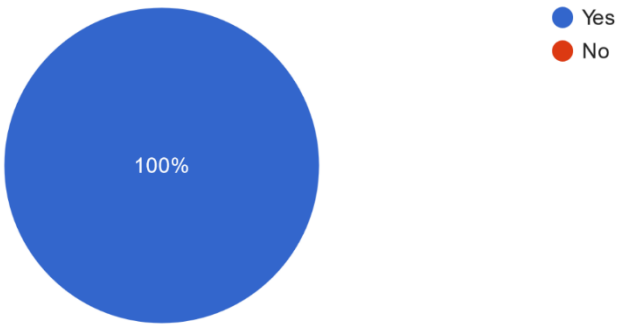
2. Would you be willing to use an upload form to submit a dataset or any other kind of digital object to a digital platform?

37 responses



3. In your opinion, what are the difficulties one may encounter when using an upload form for the upload of a dataset or any other kind of digital object to a digital platform? (You may choose **more than one** of the options available.)

Category	Participants	Percentage
Long process that usually requires much time to be completed.	19	51.4%
There is too much information that needs to be provided before making the upload.	18	48.6%
The instructions about how to do the upload (via the use of an upload form) are not always clear.	15	40.5%
There is no option to save progress and resume the upload process at a later time point.	15	40.5%
There is no preview and final editing option before clicking the "Submit" button.	14	37.8%
The upload form to be used is not user friendly.	13	35.1%
There is no option to return to a previous step and correct a field that has been already filled out.	9	24.3%
There is no split into steps that might make the process easier.	5	13.5%
It is not easy to find out how the upload form can be accessed in the digital platform.	4	10.8%
The upload form is only available in English.	3	8.1%
No particular difficulty, but I rarely upload large datasets, often it is just texts or similar.	1	2.7%

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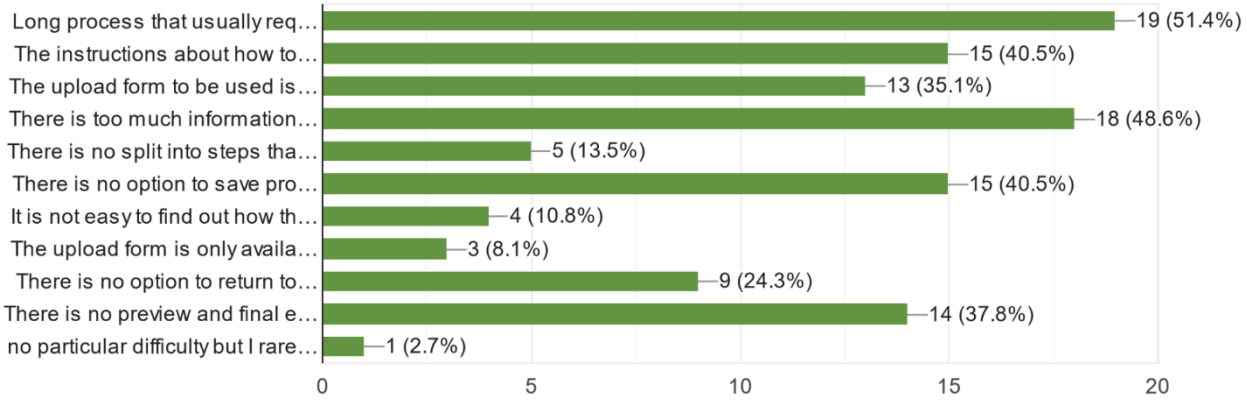
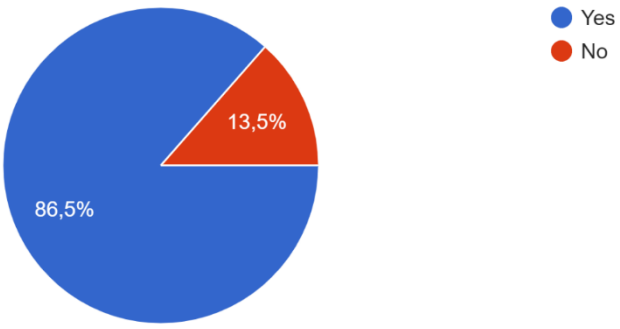
37 responses



4. Would you be willing to use an API (Application Programming Interface) to submit a dataset or any other kind of a digital object/file to a digital platform?

37 απαντήσεις



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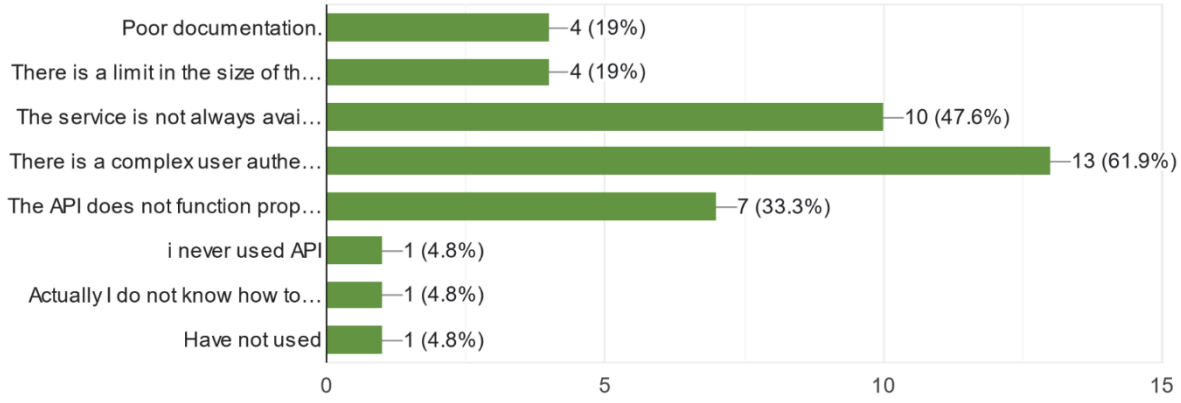
5. In case you have used an API before, what are the difficulties one may encounter when using an API for the upload of a dataset or any other kind of digital object to a digital platform? (You may choose **more than one** of the options available.)

Category	Participants	Percentage
There is a complex user authentication process.	13	61.9%
The service is not always available.	10	47.6%
The API does not function properly.	7	33.3%
Poor documentation.	4	19.0%
There is a limit in the size of the dataset/digital object to be uploaded.	4	19.0%
I've never used an API	1	4.8%
Actually, I do not know how to use an API to do this	1	4.8%
Have not used	1	4.8%

5. In case you have used an API before, what are the difficulties one may encounter when using an API for the upload of a dataset or any other kind o...ay choose more than one of the options available.)

21 responses



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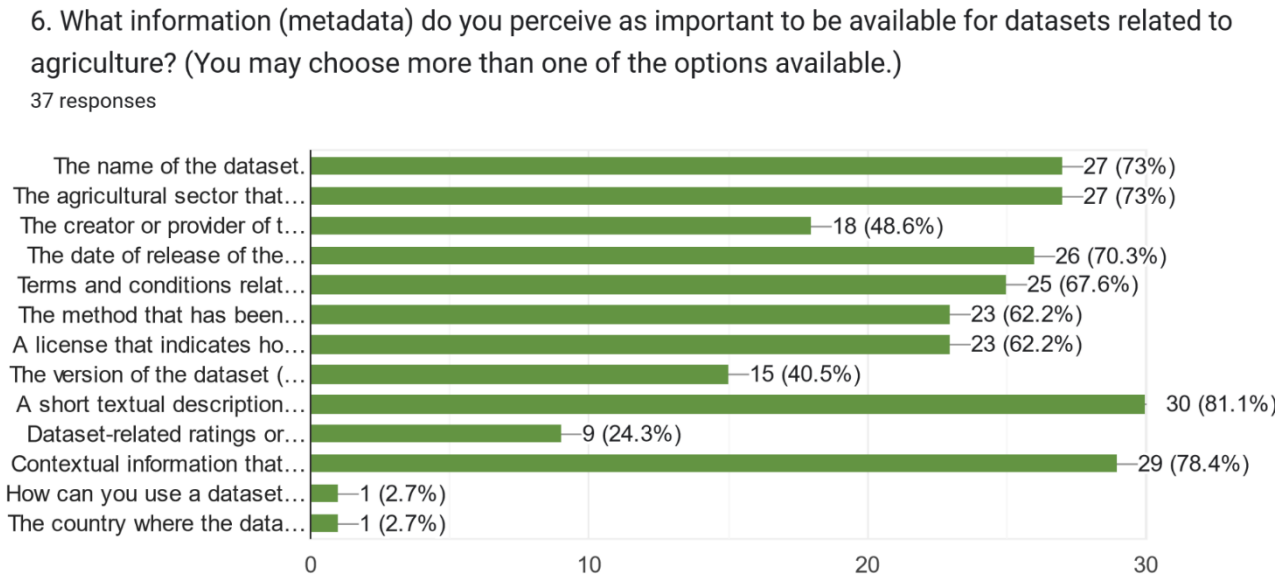
6. What information (metadata) do you perceive as important to be available for datasets related to agriculture? (You may choose **more than one** of the options available.)

Category	Participants	Percentage
A short textual description of the dataset.	30	81.1%
Contextual information that may facilitate decisions on how the dataset can be used (e.g., the geographic context to which the dataset relates, climatic conditions, cropping system, etc.).	29	78.4%
The name of the dataset.	27	73.0%
The agricultural sector that the dataset relates to.	27	73.0%
The date of release of the dataset.	26	70.3%
Terms and conditions related to the (re-)use of the dataset.	25	67.6%
The method that has been applied for the collection of the dataset.	23	62.2%
A license that indicates how the dataset could be potentially (re-)used.	23	62.2%
The creator or provider of the dataset.	18	48.6%
The version of the dataset (in case that there are other versions of the dataset available).	15	40.5%
Dataset-related ratings or comments posted by dataset users.	9	24.3%
How can you use a dataset without all this information? To me it's not relevant to ask the farmers about this.	1	2.7%
The country where the dataset has been created	1	2.7%



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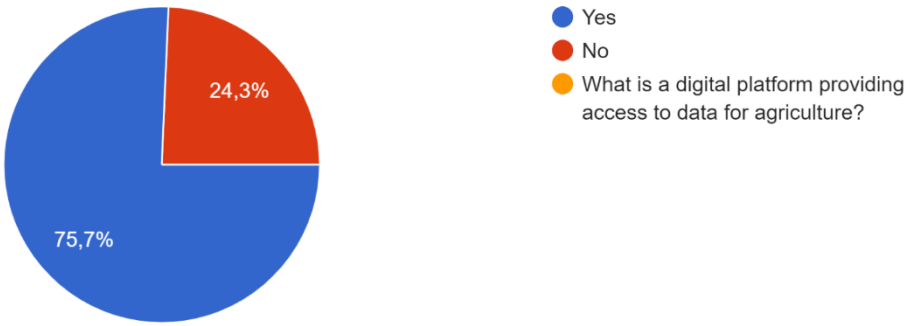
7. For each of the statements listed below, select the point of the rating scale that denotes the extent to which you perceive each of them as being important (or not).

	Not important at all	Not important	Neither important, nor unimportant	Important	Very important
The process of uploading a dataset in the CODECS platform, via the use of an upload form, should be split into steps.	0	4	10	18	5
There need to be clear indications and explanations of the fields needed to be completed in a form used for the upload of a dataset in the CODECS platform.	0	0	5	17	15
A "save progress" option should be available in the form used for the upload of datasets in the CODECS platform.	0	0	1	18	18
The upload form should be accessible in languages other than English.	1	3	21	5	7
The form for the upload of datasets in the CODECS platform should allow for returning back to a previous step to make changes/corrections.	0	0	3	22	12
The form for the upload of datasets in the CODECS platform should provide preview and editing capabilities before the final submission.	0	0	5	19	13
A text-based manual explaining the upload process using the upload form should be available.	1	4	13	15	4
A video tutorial explaining the upload process using the upload form should be available.	0	2	7	14	14
The upload of datasets in the CODECS platform should be enabled by an API (apart from the upload form).	0	1	18	15	3

1. Are you aware of any digital platforms providing access to data for agriculture?

37 απαντήσεις



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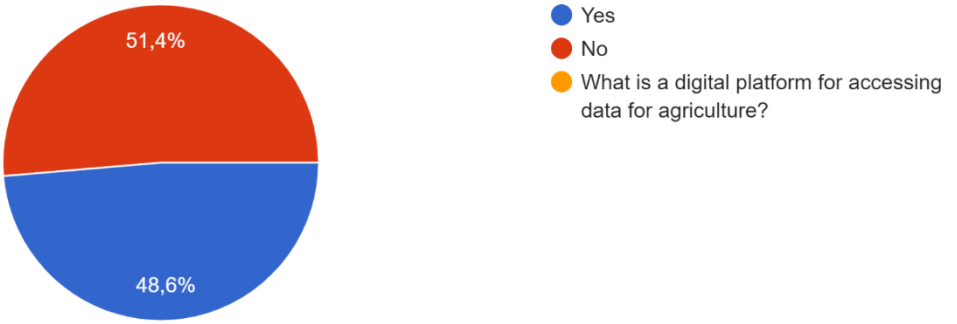
2. Have you ever used any digital platform for accessing data for agriculture?

37 απαντήσεις



3. In case you have used any digital platform for agriculture-related data in the past, could you let us know which they are? Provide up to five examples. Use commas to separate one example from the other.

faostat, istat.it, eurostat, ourworldindata

Smart AKIS, Fair Share

EPICURE/DEPHY/VITISEXPLORER

FAO, OECD, SmartAgriHubs Innovation Portal, AgroPortal

https://dati.toscana.it

https://sigpac.mapa.es/fega/visor/, http://sig.mapama.es/siga/

Libellium, Campbell SCI, Bosh, Metos

Eurostat; FADN; European Environmental Agency

ministerial dataset for fertilizers, ministerial dataset for plant protection product, national agency for payments, scientific platform for articles, European commission ECAS portal.

Satellite monitoring, weather monitoring, weather forecasting, decision-support models

FAO, NBS, World bank, IFAD

https://www.ksh.hu/agrarcenzusok_agrarium_2020, https://agriculture.ec.europa.eu/index_hu, https://www.nak.hu/hatosagi-szakmai-ugyek/ostermelo

EU Farmbook, Organic Farm Knowledge, ICT AGRIFOOD Knowledge Incubator,

SmartAgriHubs

ISTAT databases (https://www.istat.it/)

Climatic data, agriculture trends, agriculture export and import data

Ikostech, VegSyst-DSS, Iveg, Fiware

Agrosens

https://platform.innoseta.eu/, https://fairshare-pnf.eu/

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4. In your opinion, what are the major difficulties in using digital platforms for agriculture-related data? (You may choose more than one of the options available.)

Category	Participants	Percentage
The platform interfaces are full of information that is not easy to comprehend.	18	48.60%
User unfriendly interfaces/poor user experience.	18	48.60%
You need to create an account to get access to datasets.	16	43.20%
It is not easy to spot and access a dataset (or other kind of digital object) of interest.	15	40.50%
It is not easy to find datasets (or any other kind of digital objects) of interest and relevance to my needs.	14	37.80%
The navigation in the digital platform is difficult.	12	32.40%
There is no advanced search option.	10	27.00%
The information provided as a description for a dataset (or any other kind of digital object) is not enough.	9	24.30%
The search results that are being returned are not relevant.	7	18.90%
There is no manual (or any other kind of platform use instructions) available.	4	10.80%
Access to information is not available in the language(s) I speak.	3	8.10%
This is yet an example of questions assuming the respondent has a lot of experiences they will not have. The repsondents are interested in questions about: How can I solve my problems with digitalisation? How can I save time and money by digitalisation? How can I imporve qualities by means of diffitalisation?	1	2.70%
Need to be technologically savvy to use such platforms	1	2.70%

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5. In case you have used any digital platform for agriculture-related data in the past, could you name any features that appeared to be useful to you (e.g., access of a dataset in a few clicks, supply of enough information for the dataset)? Provide up to five examples. Use commas to separate one example from the other.

FAOSTAT

filters, keyword search, comparable data

None

access to the raw dataset, sufficient context information (metadata), relevant data

clear dataset name, proper formatted metadata, clear licence

API

Easy research tool, complexity fo the dataset, aggregate numbers for crop and/or surface, number of animals, regional importance of the data

search engine, sorting of types of files for better visibility, preview panel.

FAO

the ease to navigate in the platform, friendly interface, data arranged in Domains, Information available in the language I speak, enough information, the year the data was collected.

1) easy search; 2) information not to deep hiden; 3) actual information

actually, the platform is not so easy to use, only veruy poor metadata available

The search facility and advanced search facility, be able to filter the data, beable to download data in a useable format

easy to use search and filter function, good ux

6. What information (metadata) would you like to be provided with for datasets related to agriculture? (You may choose **more than one** the options available.)

Category	Participants	Percentage
A short textual description of the dataset.	32	86.50%
The agricultural sector that the dataset relates to.	30	81.10%
The date of release of the dataset.	27	73.00%
The name of the dataset.	26	70.30%
Contextual information that may facilitate decisions on how the dataset can be used (e.g., the geographic context to which the dataset relates, climatic conditions, cropping system, etc.).	23	62.20%
Terms and conditions related to the (re-)use of the dataset.	51	56.80%
The creator or provider of the dataset.	19	51.40%
The version of the dataset (in case that there are other versions of the dataset available).	19	51.40%
A license that indicates how the dataset could be potentially (re-)used.	17	45.90%
Dataset-related ratings or comments posted by dataset users.	9	24.30%
At WUR we have access to a datset with licence, but I have leanit it is limited and not as much to gther as I had hoped for. We use the Eurostat.	1	2.70%
The country from where the dataset comes from.	1	2.70%
looks like a previous question?	1	2.70%

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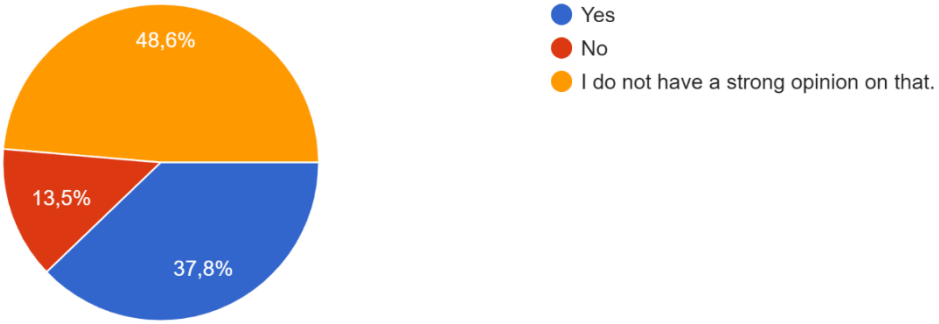
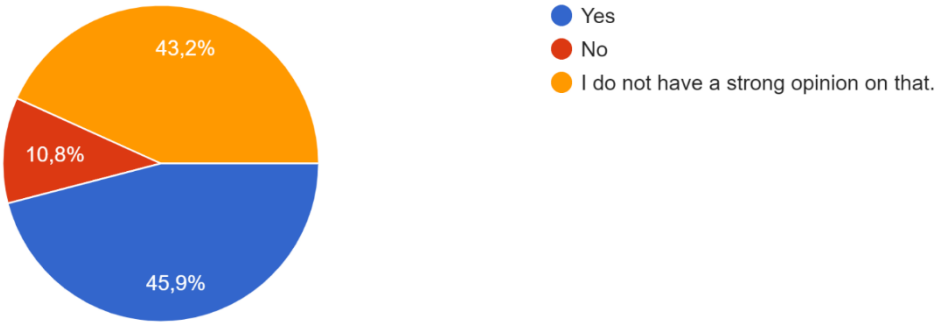
7. Do you consider the ratings of a dataset (e.g., by using a five-point rating scale) as a useful piece of information to you?

37 απαντήσεις



8. Do you consider the availability of comments on datasets (available in free-text form) as a useful piece of information to you?

37 απαντήσεις



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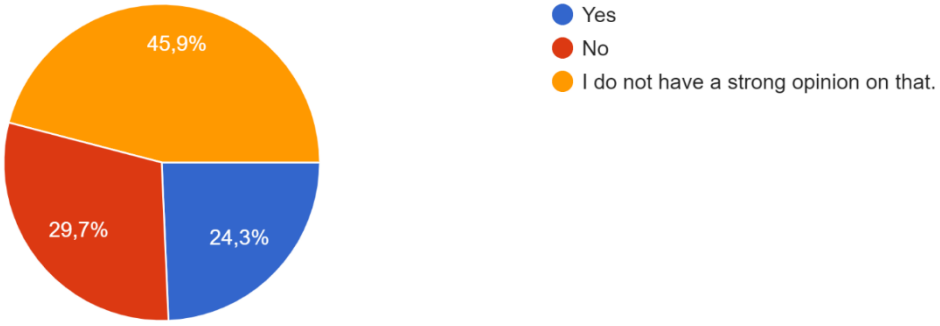
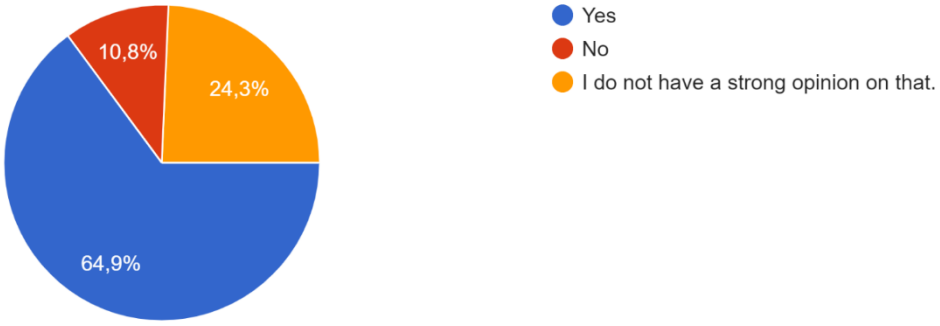
9. Would you make a decision about whether to access a dataset (or any other kind of digital object) based on the dataset's average rating?

37 απαντήσεις



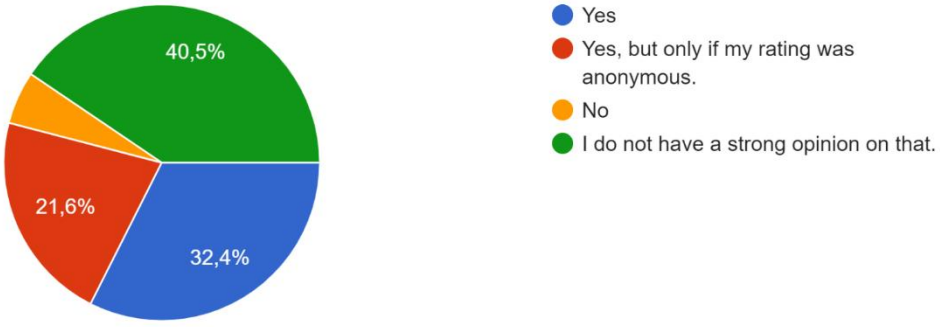
10. Would you read comments for a dataset (or any other kind of digital object) made by other users before accessing or downloading it?

37 απαντήσεις



11. Would rate a dataset available in the CODECS digital platform?

37 απαντήσεις



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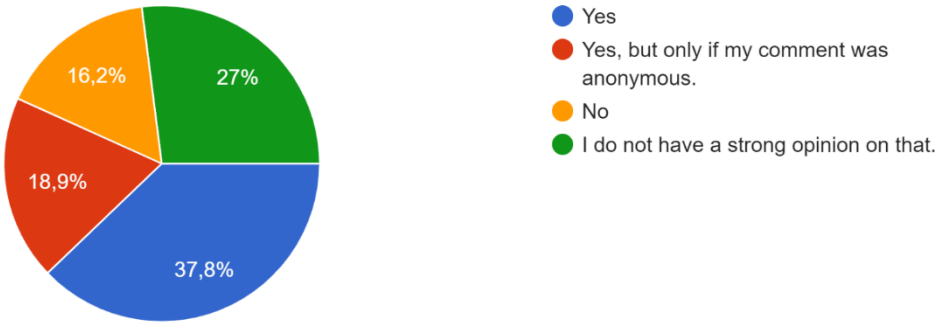
12. Would you post a comment for a dataset available in the CODECS digital platform?

37 απαντήσεις



13. Which of the following search methods would you most likely use?

	Not likely at all	Not likely	Neither likely, nor unlikely	Likely	Very likely
Search enabled by using predefined keywords	1	1	5	12	18
Full-text search (i.e., use of free-form text for your search)	1	4	3	14	15
Scenario-based search (e.g., as a cattle breeder, I want to access information on digital technologies related to ...)	2	2	8	19	6
Search by offered filters (e.g., agricultural sector, farm size, cost)	0	1	3	14	19

14. What filters do you perceive as important for narrowing down the results returned by a search engine? (You may choose **more than one** of the options available.)

Category	Participants	Percentage
The agricultural sector that the dataset relates to.	31	83.8%
The year of release of the dataset.	30	81.1%
Contextual information that may facilitate decisions on how the dataset can be used (e.g., the geographic context to which the dataset relates, climatic conditions, cropping system, etc.).	24	64.9%
The method that has been applied for the collection of the dataset.	15	40.5%
A license that indicates how the dataset could be potentially (re-)used.	9	24.3%
Terms and conditions related to the (re-)use of the dataset.	8	21.6%
Dataset-related ratings or comments posted by dataset users.	7	18.9%

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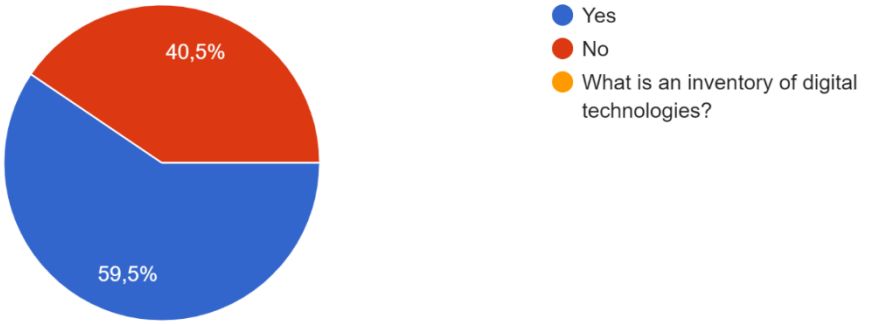
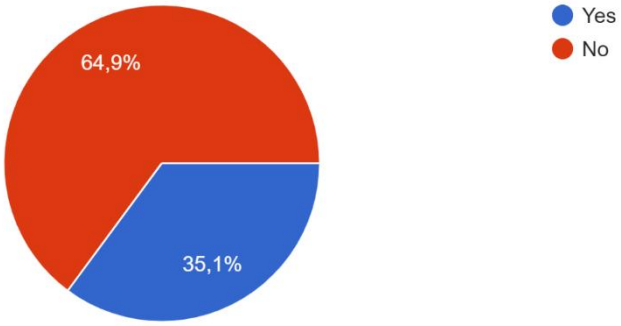
1. Are you aware of any inventories of digital technologies related to agriculture? (Such an inventory of digital technologies for agriculture has been developed and released by the SmartAKIS project.)

37 απαντήσεις



2. Have you ever used any inventory of digital technologies related to agriculture?

37 απαντήσεις



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3. In case you have used any inventories for agriculture-related digital technologies in the past, could you name a few of them? Provide up to three examples. Use commas to separate one example from the other.

gnomee

Gnomee, SmartAKIS

I have used it for research purposes (a list of different ones)

https://www.lesoutilsnumeriquesdesagriculteurs.com/magasin/outils/aspexit/

na

https://www.gnomee.eu/kbt

https://www.gnomee.eu/kbt/

SmartAgriHubs, IoTCatalogue

Iof2020 catalogue of digital innovations; Nefertiti project database; Smartagrihubs innovation portal.

gnomee, ict agri food knowledge incubator, EU farmbook

SmartAgrihub, IoTcatalogue,SmartAkis, Fairshare

https://fairshare-pnf.eu/

https://www.lesoutilsnumeriquesdesagriculteurs.com

https://www.lesoutilsnumeriquesdesagriculteurs.com/; https://agtechfinder.com/; http://agrotic.org/observatoire/

5. In your opinion, what are the major difficulties in using inventories of digital technologies for agriculture? (You may choose **more than one** of the options available.)

Category	Participants	Percentage
Poor user experience.	16	43.2%
The inventory interfaces are full of information that is not easy to comprehend.	14	37.8%
The navigation in the inventory is difficult.	13	35.1%
It is not easy to spot and access a digital technology of interest.	11	29.7%
The information provided as a description for a digital technology is not enough.	11	29.7%
There is no grouping of digital technologies in categories that could allow an easier access to them.	11	29.7%
There is no advanced search option.	10	27.0%
You need to create an account to get access to the inventory.	9	24.3%
It is not easy to find digital technologies of interest and relevance to my needs.	9	24.3%
The search results that are being returned are not relevant.	9	24.3%
Access to information about digital technologies is not available in the language(s) I speak.	4	10.8%
This section of questions are very relevant. Very often the digitalisation tools are failing making it very complicated for users with low experience to use it. E.g. error messages when everything is filled in according to the instructions...	1	2.7%
na	1	2.7%
I have never used one of these	1	2.7%

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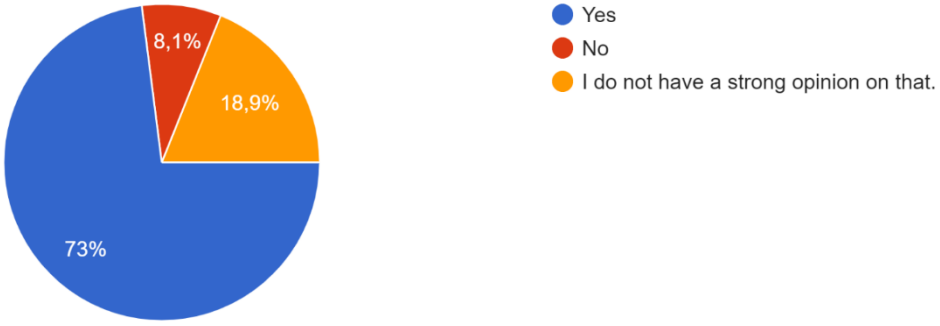
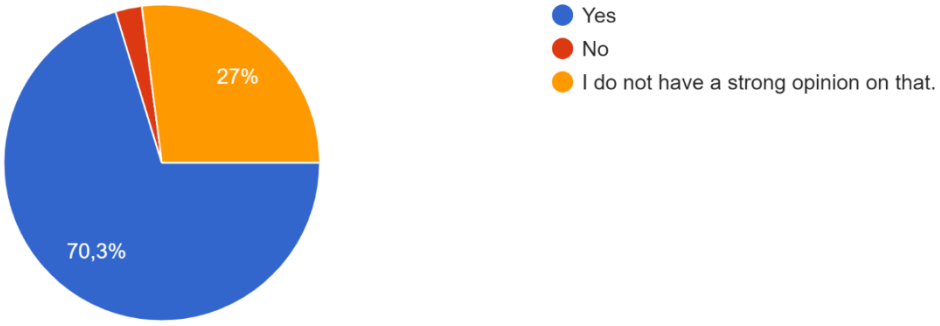
7. Do you consider the ratings of digital technologies for agriculture as a useful piece of information?

37 απαντήσεις



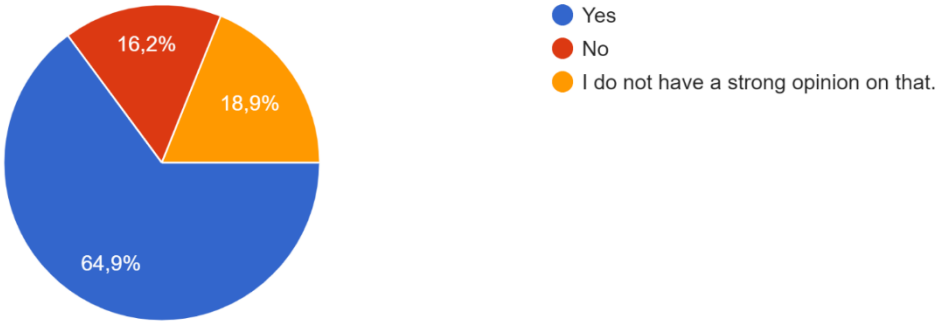
8. Do you consider the availability of comments on digital technologies for agriculture (available in a free-text form) as a useful piece of information?

37 απαντήσεις



9. Would you take the rating of a digital technology for agriculture into consideration?

37 απαντήσεις



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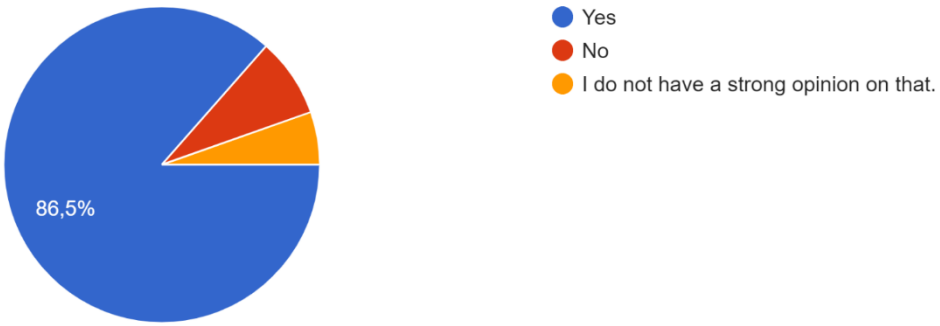
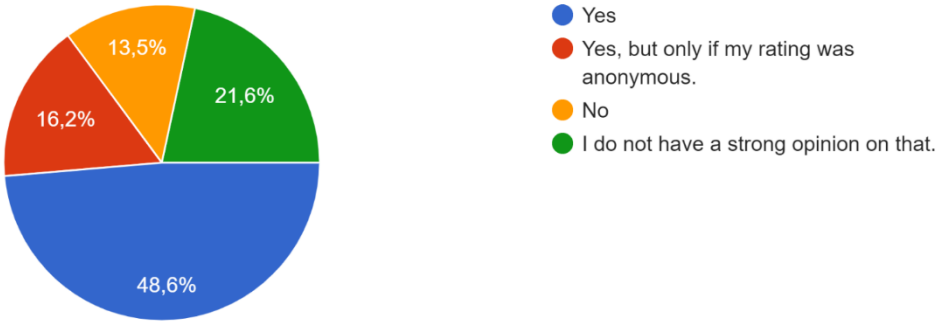
10. Would you read comments on digital technologies for agriculture made by other users?

37 απαντήσεις



11. Would you rate a digital technology for agriculture?

37 απαντήσεις



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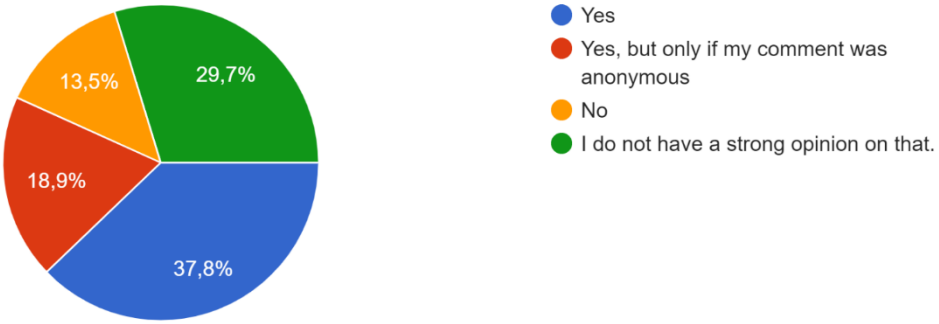
12. Would you post a comment for a digital technology for agriculture?

37 απαντήσεις



13. Which of the following methods to search for information on digital technologies for agriculture would you most likely use?

	Not likely at all	Not likely	Neither likely, nor unlikely	Likely	Very likely
Search enabled by using pre-defined keywords	3	3	2	11	18
Full-text search (i.e., use of free-form text for your search)	1	3	4	12	17
Scenario-based search (e.g., as a cattle breeder, I want to access information on digital technologies related to ...)	2	3	5	15	12
Search by offered filters (e.g., agricultural sector, farm size, cost)	2	2	2	14	17

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