



DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

D5.3 VIRTUAL RESEARCH ENVIRONMENT OPERATION REPORT YEARS 3-4

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D5.2 VIRTUAL RESEARCH ENVIRONMENT OPERATION REPORT YEARS 3-4

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Table of contents

Executive Summary	1
Introduction and Objectives	2
VREs Procedures	4
VREs Creation, Deployment and Operation	5
DESIRA Project VREs	10
DESIRA Project VRE	10
DESIRA Coordination Management VRE	12
Rural Digitization Forum	12
DESIRA Living Lab VREs	13
Biolaakso	13
Digitalais Marketings Latvia (Digital Marketing Latvia VRE)	13
Digitalisierter Obstanbau Bodenseeregion (Digitized fruit cultivation Lake Constance region VRE)	14
Oosterwold	14
Timber Regulation - Wood Traceability Italy	15
Toscana Nord	15
Vlaanderen	16
DESIRA Rural Digitalisation Forum (RDF)	16
RDF Agriculture	17
RDF Forestry	17
RDF Rural	17
DESIRA supported initiatives	18
RuralCluster	18
Concluding Remarks	19
References	20

Executive Summary

This deliverable D5.3 “Virtual Research Environment Operation Report years 3-4” is the revised and updated version of deliverable D5.2 “Virtual Research Environment Operation Report years 1-2”. It describes the activities carried out during the DESIRA project within Work Package 5. Specifically, in Task 5.1 “Knowledge Infrastructure: the DESIRA Virtual Research Environment” and Task 5.2 “Integration of Services and Tools and Use Reporting”. It reports the procedures governing the operation of the VREs as well as the status of the aggregated resources at the end of the project in the DESIRA infrastructure.

Virtual Research Environments (VREs) are “systems” specifically conceived to provide their users with a web-based set of facilities (including services, data and computational facilities) to accomplish a set of tasks by dynamically relying on the underlying infrastructure. VREs are among the key products to be developed and delivered by the DESIRA project to support Project coordination, Living Labs activities and Rural Digitization Forums activities.

The development of VREs is based on three main activities: (i) the development of software artefacts that realise a set of functions (including those needed for accessing specific datasets), (ii) the deployment of these artefacts in an operational infrastructure following the release procedures and tools, and (iii) the final deployment and operation of well-defined Virtual Research Environments by exploiting the facilities offered by the underlying D4Science infrastructure and its services [1, 2].

This report documents the last of the above three activities – i.e. the exploitation of the services and technologies offered by the underlying infrastructure to serve the needs of defined scenarios – as implemented in the context of the DESIRA project.

The DESIRA Infrastructure Gateway offers end-user access to 14 VREs. As of May 2023, 14 VREs were created and operated. Specifically, the DESIRA Project VRE (cf. Sec 3.1.1) was created before the project kick-off. These VREs have served the needs of more than 390 users and more than 10.200 user sessions. This required dealing with 185 tickets (121 related to the project management, 43 requests for tasks, support and enhancements; 7 requests for incidents and bugs; 14 requests for VRE creations).

1. Introduction and Objectives

Virtual Research Environments (VREs) are “systems” aiming at providing their users with web-based working environments offering the entire spectrum of facilities (including services, data, and computational facilities) needed to accomplish a given task by dynamically relying on the underlying infrastructure. VREs are key products to be delivered by the DESIRA project to meet the needs of its target community and scenarios. They are dedicated to discussing and developing various approaches and solutions to be applied to concrete cases, scenarios and also devised to serve specific communities and practitioners confronting a given research question.

The end-user accesses the VREs by exploiting a web component providing access to the DESIRA infrastructure, namely the DESIRA Infrastructure Gateway. This gateway is accessible via the URL <https://desira.d4science.org/>, and it is expected to be the end-user access point to the DESIRA Virtual Research Environments.

This deliverable – D5.3 ‘Virtual Research Environment Operation Report years 3-4’ – details the activity leading to the deployment and operation of a series of Virtual Research Environments addressing the needs for the DESIRA consortium.

This activity led to the deployment and operation of 14 VREs in the period from June 2019 to May 2023. At the end of Year 4, these VREs have served the needs of more than 390 users and more than 10.200 user sessions (see Figure 1). Figure 2 shows the average session duration in Europe, and Figure 3a shows the top 10 countries sorted by number of sessions, while Figure 3b shows top 10 countries sorted by average number of applications per sessions.

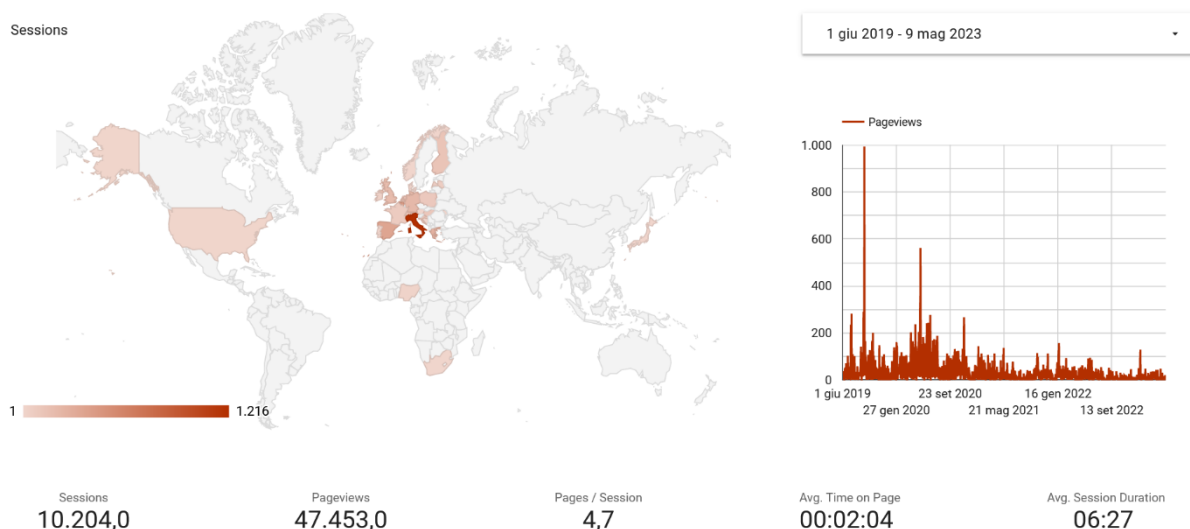


Figure 1: Geo-distribution of user sessions on the DESIRA Infrastructure Gateway.

The remainder of this report is organised as follows: Section 2 describes the policies and procedures governing the planning and deployment of Virtual Research Environments. Section 3 describes the Virtual Research Environments that have been deployed and operated during the period. For each Virtual Research Environment, the deliverable describes the goal and the main facilities offered to their users. Section 4 reports conclusions.

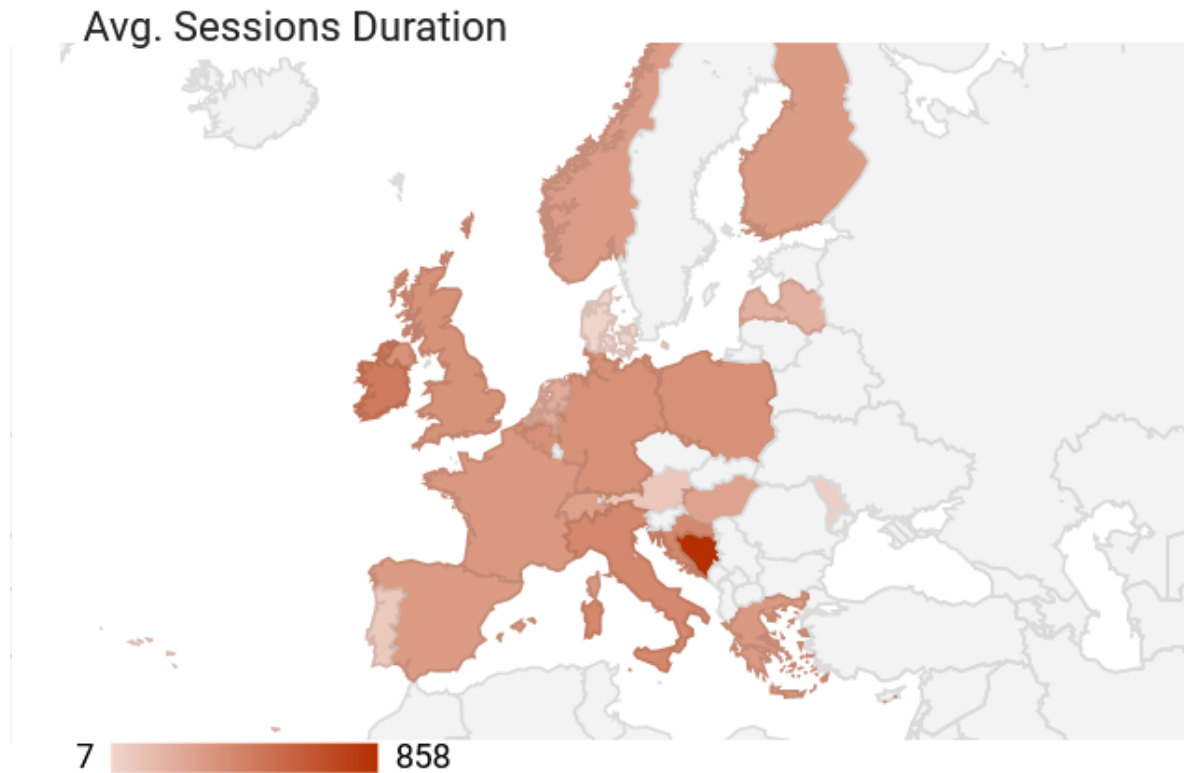
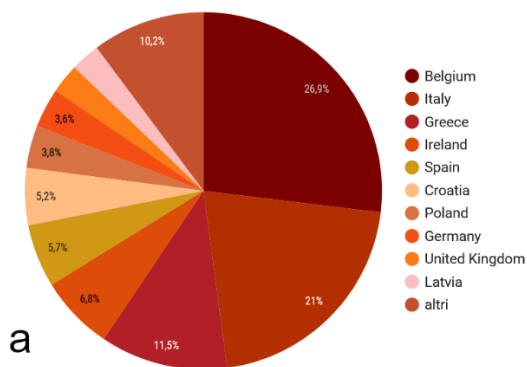


Figure 2: Average sessions duration.

Top 10 countries sorted by number of sessions



Top 10 countries sessions sorted by average number of applications per session

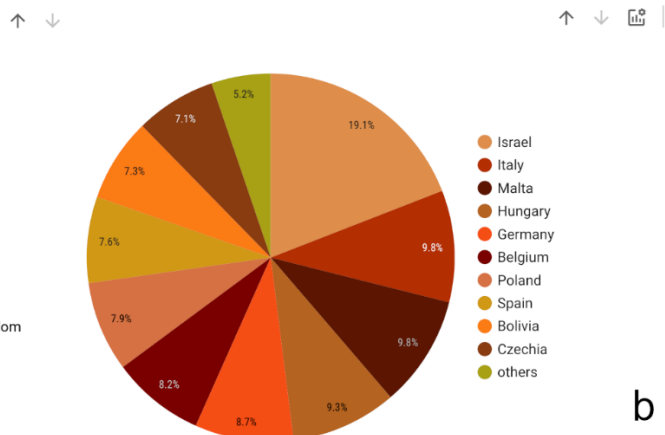


Figure 3a: Top 10 countries sorted by number of sessions. Figure 3b: Top 10 countries sorted by average number of applications per sessions

2. VREs Procedures

Deployment and operation of VREs is a collaborative effort involving the WP5 team called to deploy and configure the technology to create VREs expected by the work packages working to develop the enabling technology.

The procedure leading to VRE deployment is a consolidated one, i.e. it is the procedure inherited from the D4Science infrastructure and described in the D4Science Wiki:

[https://wiki.d4science.org/index.php?title=Virtual Research Environments Deployment and Operation](https://wiki.d4science.org/index.php?title=Virtual_Research_Environments_Deployment_and_Operation)

For the needs of DESIRA, this activity is supported by the project activity tracker. A specific VRE tracker has been created to capture the entire process from specification to operation. The VRE designer/requester produces the VRE specification. This specification must contain:

- VRE name and abstract;
- VRE Logo, The DESIRA pictogram is used as default when no specific logo is provided;
- VRE belonging group, i.e., DESIRA Project VREs, DESIRA Living Lab VREs, DESIRA Rural Digitalisation Forum (RDF), DESIRA supported initiatives.
- Membership policy, i.e., whether the VRE is open or restricted, who is allowed to invite members;
- VRE expected functionalities.
- VRE due date.

The following statuses are supported:

- **Planned:** the WP5 team approves the specification, i.e. the specification contains enough details to proceed with the creation, and acknowledges that the creation of the VRE is feasible by the due date initially requested (or liaise with the designer/requester to find a mutually suitable date);
- **Available:** the VRE is up and running and ready to be validated by the VRE designer/requester;
- **Released:** the VRE has been validated, and the target community can start using it;
- **Removed:** the VRE has been disposed of for the request of its manager;
- **Rejected:** the requested VRE cannot be created as the requirements outlined cannot be satisfied.

3. VREs Creation, Deployment and Operation

This section briefly describes the facilities used by VRE creators for the actual deployment of VREs, reports the complete list of deployed and operated VREs, and offers a characterisation of each available VRE.

A wizard supports the act of definition and deployment of a new VRE (see Figure 4). The wizard enables authorised users to transform the opened requests according to the procedure described in Sec. 2 into an actual specification and then, automatically, into a working VRE made available by the DESIRA gateway.

Through the wizard, the user must specify: (i) the descriptive information characterising the expected VRE (i.e. name, description, duration), and (ii) the functionalities to be made available in the specific VRE by selecting among the available ones. The resulting list of functionalities is derived from the feasible functionalities created thanks to the software version and services hosted by the underlying D4Science infrastructure.

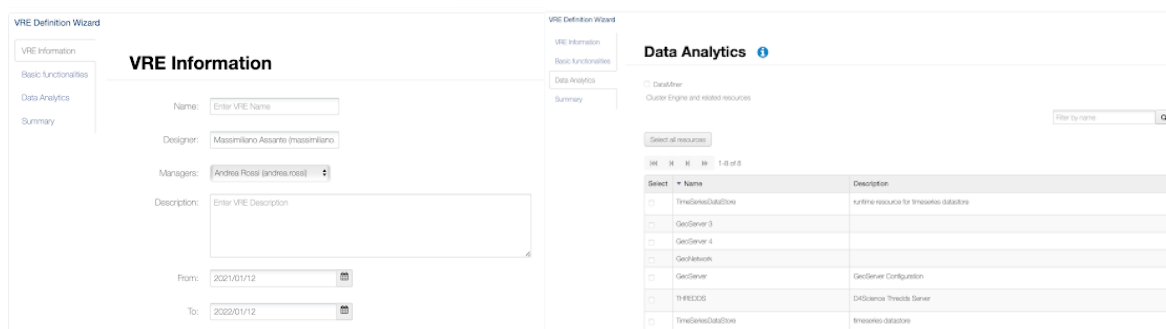


Figure 4: VRE Creation Wizard Screenshots

From June 2019 to May 2023, 14 VREs were created and operated to serve the needs arising in the context of the DESIRA project:

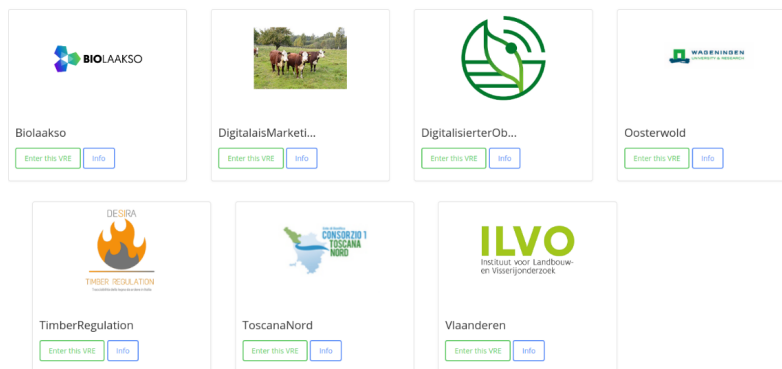
- 3 VREs to support the project management, coordination and file exchange (cf. Sec 3.1);
- 7 VREs to support national Living Labs (cf. Sec 3.2);
- 3 VREs to support Rural Digitization Forum (cf. Sec 3.3);
- 1 VRE to support initiatives, communities of practice and projects.

Figure 5 shows the list of VREs as presented in the DESIRA gateway.

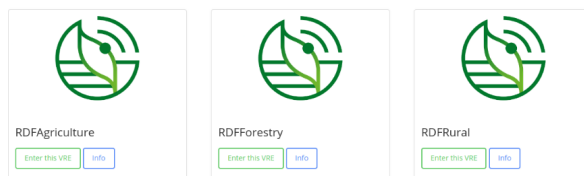
DESIRA Project VREs a series of services to manage, coordinate and enable collaboration among the DESIRA Consortium members.



DESIRA Living Lab VREs user-centered, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings.



DESIRA Rural Digitalisation Forum (RDF) It is composed of four multi-actor Working Groups that provide space for rural stakeholders and experts to exchange and share knowledge about digitalisation in Agriculture, Forestry, Rural Life and on rural Digital Policies.



DESIRA supported initiatives services and working environments conceived to support Initiatives, Communities of Practice and Projects.

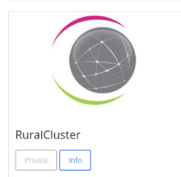


Figure 5: VREs operated by the DESIRA Gateway.

Figure 6 reports the number of users per VRE per month in the whole project duration. Figure 7 complements figure 6 by reporting the number of VRE user accesses per month in the 48 months of the project, hence by showing how often the DESIRA Project members have accessed and exploited these VREs. This chart shows peaks up to 1300 access per month.

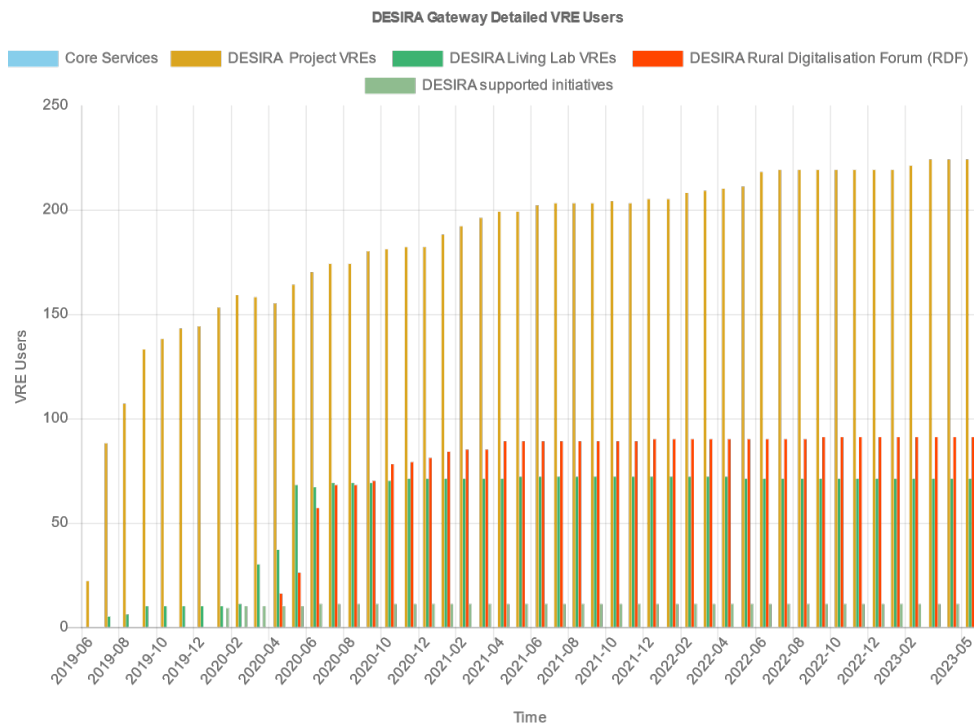


Figure 6: Number of users per VRE per month.

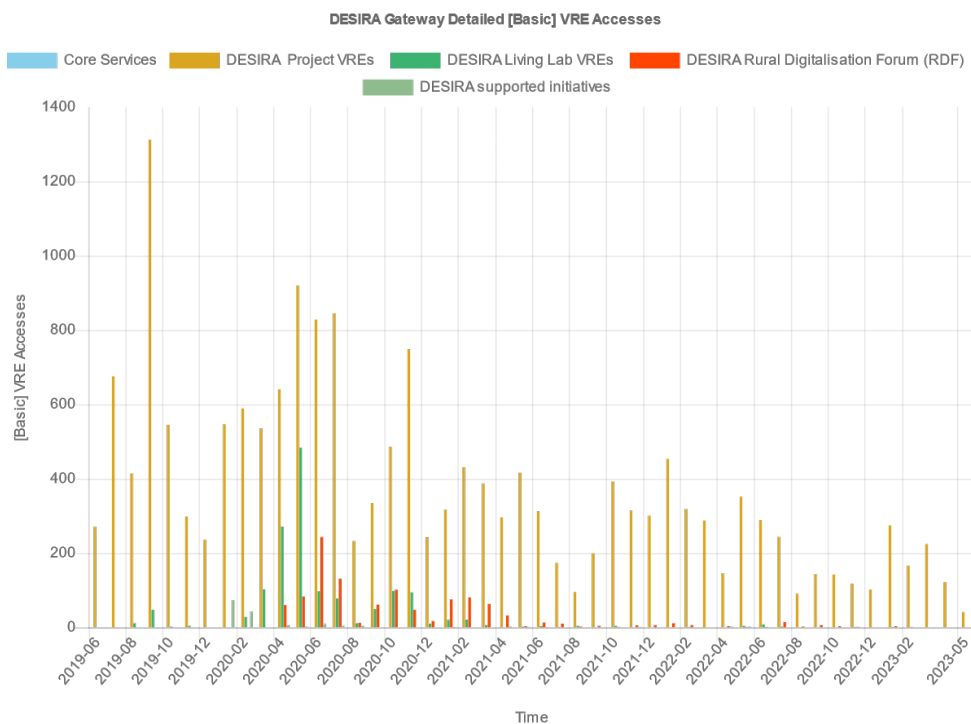


Figure 7: Number of VRE User Accesses per month.

The operation of VREs requires the management of requests for support, issues and malfunctions. Operating a VRE also deals with adding functionalities available in underlying D4Science infrastructure

not initially requested at VRE creation time. Figure 8 shows a screenshot of the issue tracker reporting the tickets for these typologies of tickets. During the reporting period, a total of 64 tickets have been resolved (43 requests for tasks, support and enhancements; 7 requests for incidents and bugs; 14 requests for VRE creations).

#	Tracker	Status	Priority	Subject	Assignee	% Done	Target version
> Support 20							
> Bug 6							
22219	Bug	Closed	High	Catalogue	Francesco Mangiacrapa	<div style="width: 100%; height: 10px; background-color: green;"></div>	DESIRA Project - WP1
20929	Bug	Closed	High	Featured Content on this VRE	Massimiliano Assante	<div style="width: 100%; height: 10px; background-color: green;"></div>	DESIRA Coordination & Management - DESIRA Gateway Issues
20813	Bug	Closed	High	Messages in VRE not delivered	Massimiliano Assante	<div style="width: 100%; height: 10px; background-color: green;"></div>	DESIRA Project - WP1
17467	Bug	Closed	Low	Unsharing a folder generates an error	Lucio Lelli	<div style="width: 100%; height: 10px; background-color: green;"></div>	DESIRA Project - WP1
17459	Bug	Rejected	Normal	Permission rights	Luca Frosini	<div style="width: 100%; height: 10px; background-color: green;"></div>	DESIRA Project - WP6
17181	Bug	Closed	Normal	post editing leads to losing both formatting and mentions	Massimiliano Assante	<div style="width: 100%; height: 10px; background-color: green;"></div>	DESIRA Project - WP1
> Request 22							
> Incident 1							
> Task 1							
> WP 8							
> WP Task 31							
> WP Activity 13							

Figure 8: A Screenshot of the DESIRA issue tracker used for the management of requests.

A brief description of each available VRE is reported in the following sections. All the VREs provide the following functionalities:

- **A private cloud storage area** is an easy-to-use workspace application designed for use by a wide set of different actors. The workspace provides the capability to store either private or shared data. It enables every user to store and organise the information objects interested in working with. In addition to that, the user can collaborate with other users by sharing objects and messages. Figure 9 shows the aggregated cloud storage area accesses (i.e. workspace accesses) per month;
- **Social networking application**, where each project member will have the possibility to share posts (text, images, and files annotated with hashtags) with VRE members and to collect them in a dedicated News Feed (as in Twitter and Facebook). These applications are conceptually close to the common ones promoted by social networks – e.g., posting news, commenting on posted news – yet adapted to promote large scale collaboration and cooperation on comprehensive scientific products, data sets, theories and tools. It has been adapted to the settings of working environments like those characterising DESIRA. Users can post news as well as applications;
- **Private messaging applications** integrated with the cloud storage to provide users with a familiar email environment as-a-Service. The distinguishing feature is represented by its integration with the rest of the functionalities. For example, it is possible to send any information object residing in the workspace (regardless of how “big” and “complex” it may be) as an attachment without consuming bandwidth;

- A **VRE Management facility** enables authorised users (i.e. VRE Managers) to manage other users using or wanting to access the VRE. VRE Managers can: (i) authorise users for access to the VRE; (ii) assign or withdraw roles to users; (iii) remove users; and (iv) send communications to the current users;
- A **notification facility** to alert users on relevant activities as they happen. These notifications offer a sense of anticipation and create a productivity boost. Users receive an alert (through a priori selected channels, e.g., email, web portal, Twitter) notifying them when something of interest has happened in their VRE(s);
- A **member’s facility** the list of VRE co-workers, i.e. the list of members partaking in the VRE and contributing to it.

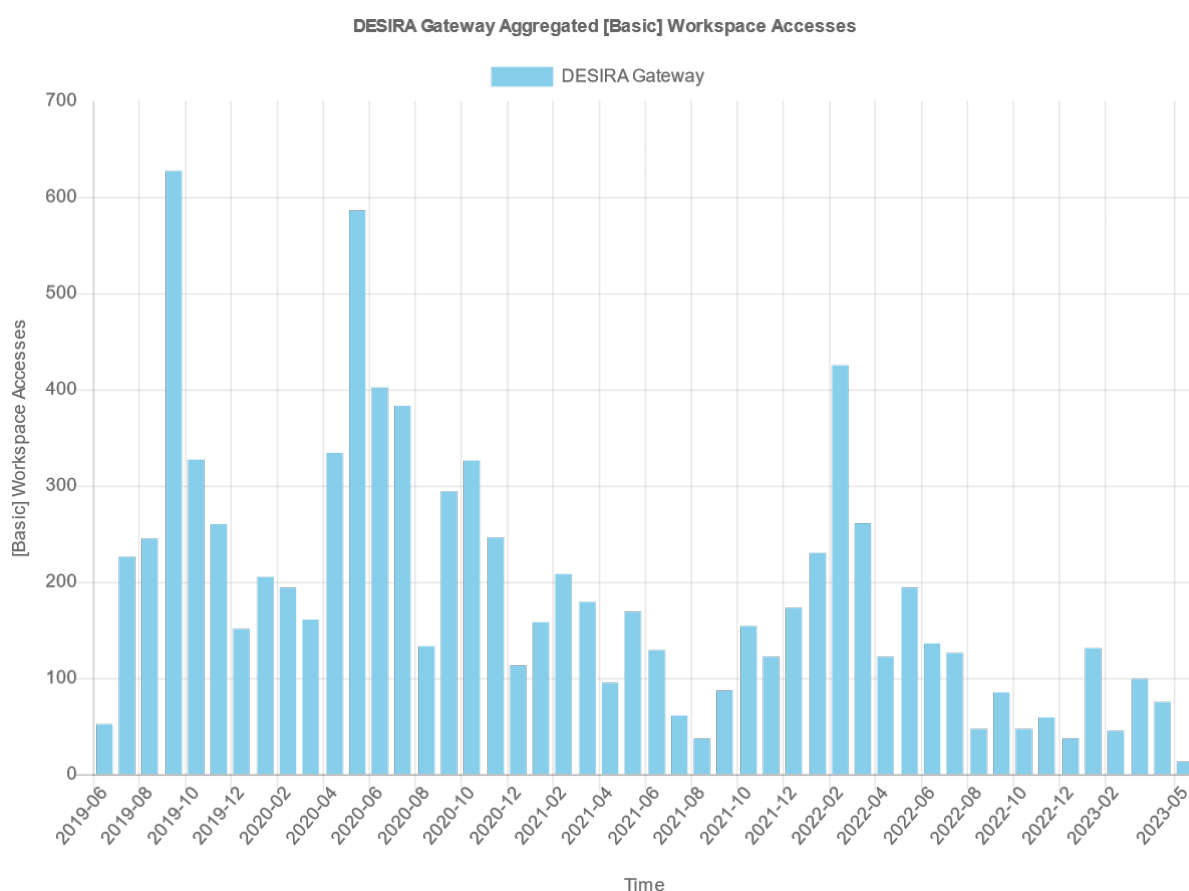


Figure 9: A Screenshot of the DESIRA workspace accesses per month.

3.1. DESIRA Project VREs

DESIRA Project VREs a series of services to manage, coordinate and enable collaboration among the DESIRA Consortium members.

In addition to the issue tracker, all the project VREs are equipped with a collaborative WIKI which has also been used to share project working documents (see figure 10) between projects members.

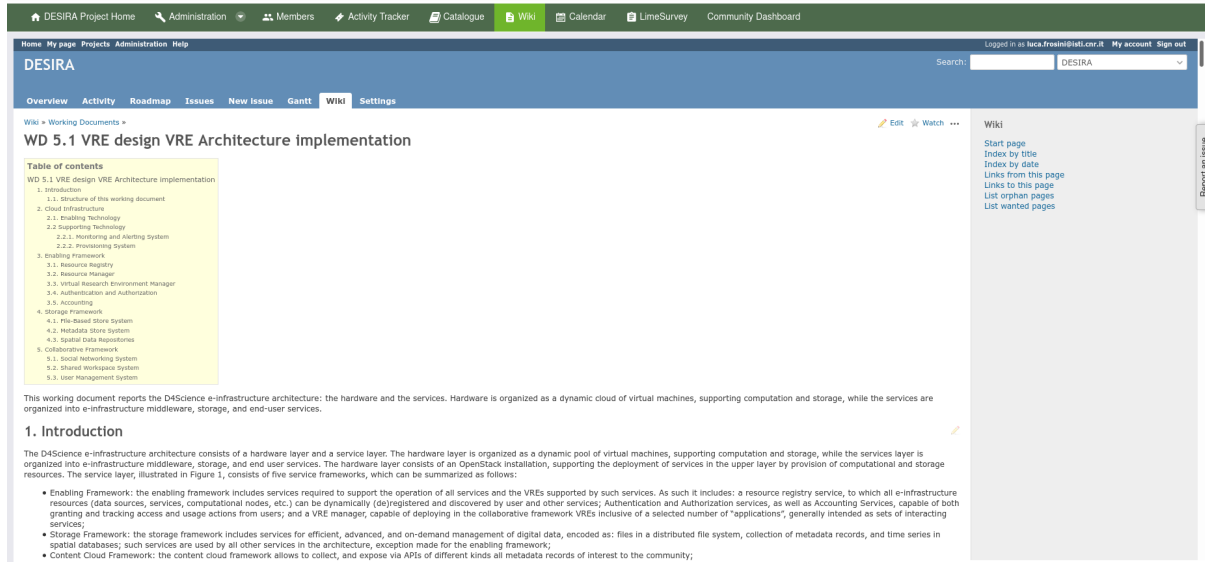


Figure 10: A Screenshot of the DESIRA Wiki showing Working Documents W.D. 5.1.

3.1.1. DESIRA Project VRE

This Virtual Research Environment is conceived to be the working environment supporting cooperation and collaboration among the DESIRA project beneficiaries. This VRE has been created before the Kick-Off meeting to allow the DESIRA consortium members to be able to interact and share information from the very beginning of the project.

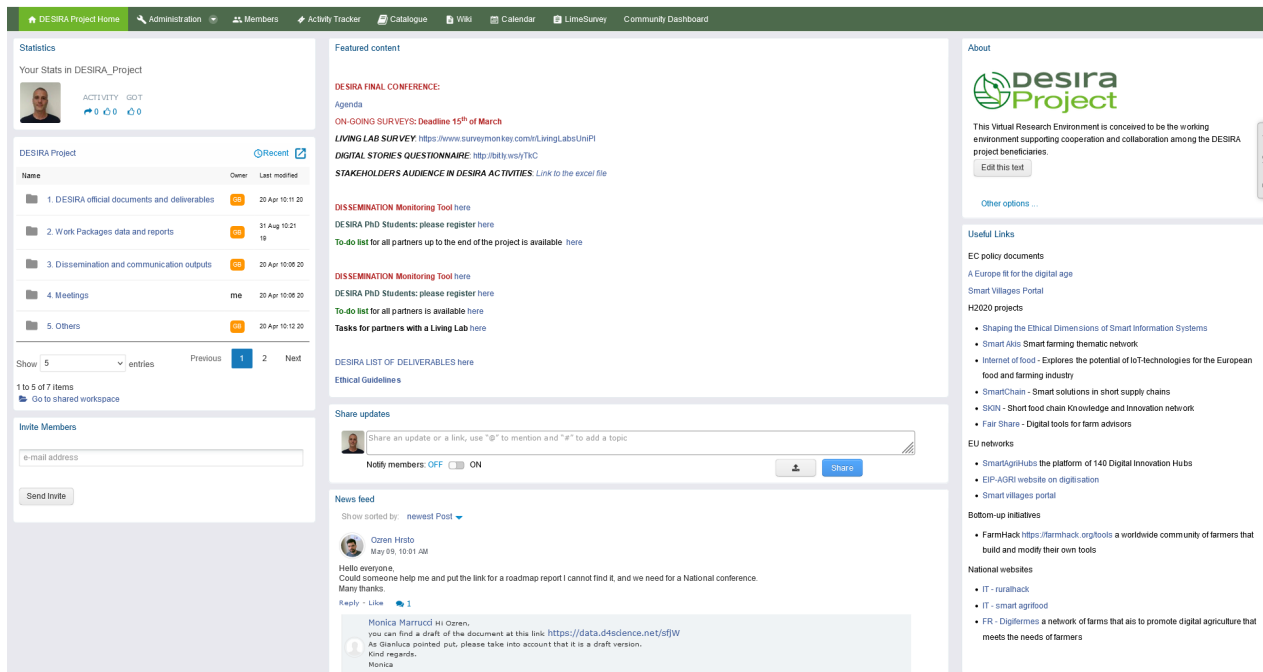


Figure 11: A Screenshot of the DESIRA Project VRE Home tab.

The home page of the VRE (see figure 11) has been organised to provide an effective way to communicate, disseminate information and share files between the project members. In particular, it provides:

- Highlights of the most important communication for project members;
- Useful links for the research activities;
- Quick access to the project VRE workspace files;
- Social communication facilities.

Figure 12 shows the social interactions, i.e. posts, likes (a way to follow a discussion), and replies in this VRE.

Apart from the facilities provided in all DESIRA VREs, this VRE is equipped with:

- **Catalogue facility** used by any member to publish their research objects and made them available to the DESIRA community. The catalogue allows publishing such research objects on Zenodo¹.

¹ Zenodo is a open-access repository. It allows researchers to deposit research papers, data sets, research software, reports, and any other research related digital artifacts. For each submission, a persistent digital object identifier (DOI) is minted, which makes the stored items easily citeable. <https://zenodo.org/>

- **OpenAIRE Community dashboard** provides access to publications, research data, projects, and software to assess the socio-economic impact of digitalisation in rural areas in Europe.

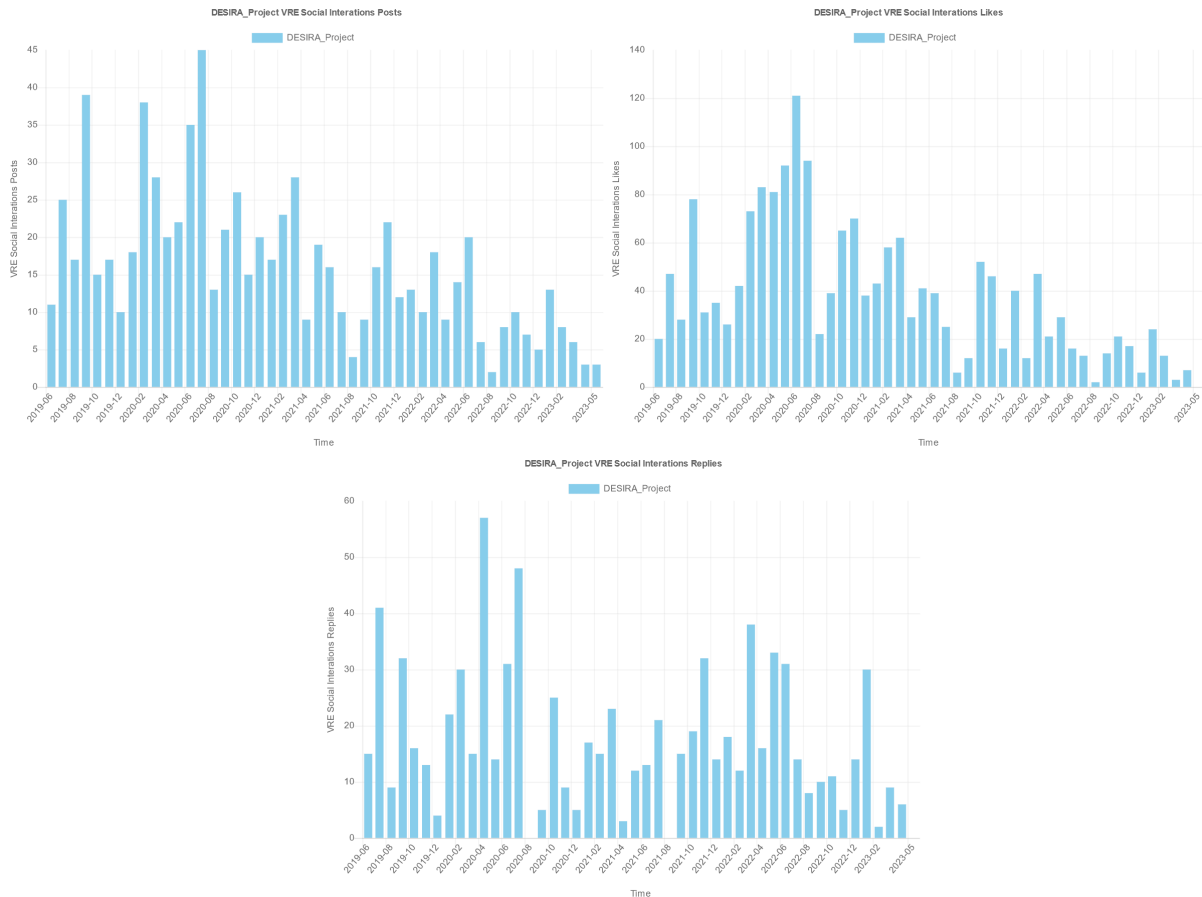


Figure 12: Social Interactions in DESIRA Project VRE per month.

3.1.2. DESIRA Coordination Management VRE

This VRE is used for the management and coordination of the DESIRA Project. It is used by a restricted number of people involved in the project to schedule meetings, discuss and take decisions about the management of the project. It is also empowered with facilities to retrieve usage data about the DESIRA gateway, such as the graphs used in this deliverable, e.g. figures 1, 2, 5, 6, 8, 11.

3.1.3. Rural Digitization Forum

The Rural Digitization Forum is an EU-level network composed of representatives from the Living Labs, Rural businesses and services, Public Authorities, Citizen groups, Digital technology operators, Farmers, Media, Scientists, and representatives of other relevant projects.

The VRE is empowered with the community dashboard, see figure 13, to enable any forum members to discover publications, research data, projects and software to assess the socio-economic impact of digitalisation in rural areas in Europe.

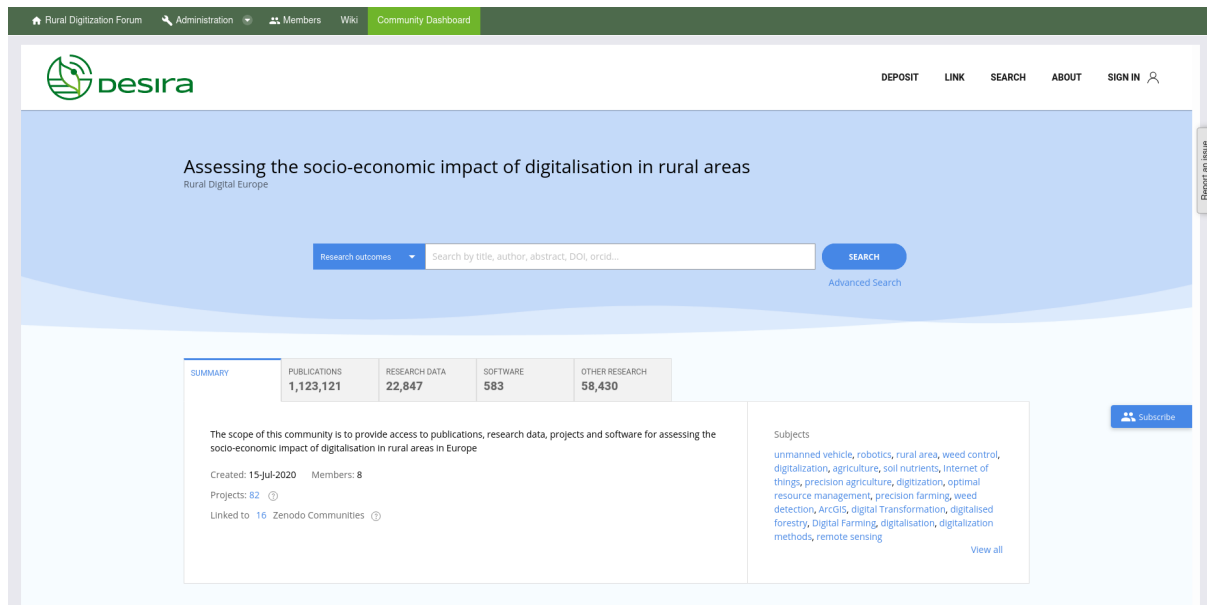


Figure 13: DESIRA Community Dashboard.

3.2. DESIRA Living Lab VREs

User-centred, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings.

Specific local communities use these VREs to support Living Labs activities. The communities use their native languages.

3.2.1. Biolaakso



Combining and utilising know-how in organic and inorganic chemistry creates new types of activities and products. The by-products of the mills can be utilised as agricultural fertilisers.

The socially acceptable utilisation of physical by-products in Central Ostrobothnia following the principles of the circular economy is a demanding goal, as it requires the involvement of people. The biggest obstacle to the progress of the circular and bio-economy is the uncertainty related to both the company's internal processes (functionality, costs, etc.) and the operating environment (regulation, standards, social acceptability, consumers' willingness to pay, etc.). Information technology facilitates the resilience breakthrough by effectively disseminating information.

3.2.2. Digitalais Marketings Latvia (Digital Marketing Latvia VRE)



The rearing of beef cattle determines the added value of beef on the market following high animal welfare standards. Latvia's landscape and environment are favourable so that farmers raising beef cattle can use the conditions of good agricultural practice in their farming to increase the value of their production. Latvian farmers can ensure high animal welfare standards and produce quality beef. Unfortunately, the Latvian beef industry has so far not been able to inform consumers sufficiently. The live practice laboratory aims to use digital solutions to gather information and inform consumers about it.

Focal question: To create an innovative digital strategy platform to raise the profile of beef farmers by exploring the local meat market and providing consumers with comprehensive information on the origin, value and preparation of beef. (promotion of direct sales by raising awareness).

3.2.3. Digitalisierter Obstanbau Bodenseeregion (Digitized fruit cultivation Lake Constance region VRE)

Fruit growing in the Lake Constance region is characterized by small and medium-sized family businesses, of which significantly more organic areas are grown than the national average. Difficult weather and production conditions, high competitive pressure, the need for seasonal workers, the protection of biodiversity and the environment and changed consumer preferences pose great challenges for both IP and organic fruit growing. In the Living Lab "Digitized Fruit Growing in the Lake

Constance Region”, the needs are to be identified and analysed, how from the perspective of the stakeholders the cultivation practices can benefit from digitized technologies and which undesirable effects are associated with them.

The objectives of the LL are: (1) Building a network of stakeholders from the areas of IP and organic fruit growing with different farm sizes and marketing concepts, fruit growing advice, research and development, technology development, fruit wholesaling, retail and consumers, nature conservation; (2) Discussion of current and future developments in digitized fruit production; (3) Qualitative assessment of the effects of digitized fruit production on the basis of socio-economic and other sustainability indicators from the perspective of the stakeholders. During the term of the Living Lab, individual interviews and a webinar with experts from the field of digitization in fruit growing and agriculture in Germany as well as a workshop will be held. Focal question / key question: Can digitization improve the sustainability of fruit production in the Lake Constance region?

3.2.4. Oosterwold



The ambition is that the new Oosterwold district will contribute to the local food supply of the city of Almere. It is up to the residents of Oosterwold to organize the supply of their products and to match them to the demand of the city. Digital innovation can contribute to coordinating and organizing supply and demand in short chains. In the Living Lab Oosterwold, DESIRA wants to explore together with residents and experts which digital innovation is suitable for short chains between Oosterwold and Almere. Central Question: a) How can digital innovation contribute to the exchange of knowledge and experience about organizing (distribution networks in) short food chains among residents of Oosterwold? b) How can digital innovation contribute to the establishment and maintenance of lively short food chains -distribution networks- within Oosterwold and between Oosterwold and Almere?

3.2.5. Timber Regulation - Wood Traceability Italy



The wood-energy sector is emblematic of the weakness of the Italian forestry chains, generally characterized by poor infrastructure and investments and low incomes. These technical and economic barriers reduce the quantity of wood collected in Italy which is however the first importer of wood for energy purposes in the world (largely without traceability).

Given this situation and in order to increase the traceability of wood from legal sources in Europe, the European Union has issued the European Timber Regulation (EUTR - Reg. N. 995/2010). In this context, the Living Lab will explore the possibilities to strengthen the adoption of digital tools to support the traceability of firewood, wood chips and pellets (in accordance with the EUTR). The adoption of digital tools in the Italian forestry sector (historically underdeveloped from this point of view) could lead not only to compliance with the EUTR but also to an increase in the competitiveness of Italian forestry companies.

3.2.6. Toscana Nord



The North Tuscany Living lab of the DESIRA project intends to focus attention on how digitalization can support the public administration in improving the efficiency of land management in mountain areas in order to reduce the risks of landslides, floods and other extreme events. The research question around which we will organize the activities of the living lab is "how can better communication between citizens, local actors and administrators make the ordinary management of the territory more efficient?"

3.2.7. Vlaanderen



In recent years, the demand for emission reduction in the livestock sector has increased. Part of emission reduction is the measurement and control of emissions from agriculture. New developments in sensor technology make it possible to monitor emissions in great detail.

It is possible that future emissions can be traced back to individual farms. In this Living Lab, these developments are jointly studied, with a focus on the impact of this technology on the agricultural sector and other parties in the agri-food chain, policy and society. The central question is: What is the

impact of individual emission monitoring in intensive livestock farming on the agri-food chain, policy and society?

3.3. DESIRA Rural Digitalisation Forum (RDF)

It is composed of four multi-actor Working Groups that provide space for rural stakeholders and experts to exchange and share knowledge about digitalisation in Agriculture, Forestry, Rural Life and rural Digital Policies.

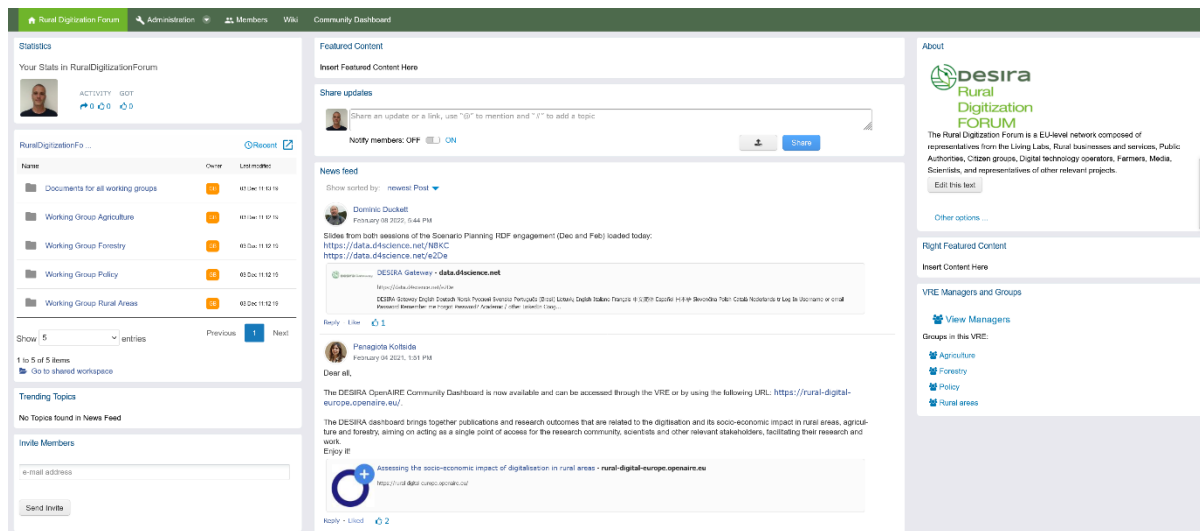


Figure 14: A screenshot of RDF Forestry VRE home page.

All the RDF VREs are quite similar in the provided functionalities. They are all empowered with the community dashboard, to enable any forum members to discover publications, research data, projects and software for assessing the socio-economic impact of digitalisation in rural areas in Europe. Figure 14 shows a screenshot of the RDF Forestry VRE home page.

3.3.1. RDF Agriculture

The Rural Digitalisation Forum is an EU-level forum composed of representatives from the Living Labs, Rural businesses and services, Public Authorities, Citizen groups, Digital technology operators, Farmers, Media, Scientists, and representatives of other relevant projects. This is the RDF Working Group on 'Agriculture'.

3.3.2. RDF Forestry

The Rural Digitalisation Forum is an EU-level forum composed of representatives from the Living Labs, Rural businesses and services, Public Authorities, Citizen groups, Digital technology operators,

Farmers, Media, Scientists, and representatives of other relevant projects. This is the RDF Working Group on "Forestry".

3.3.3. RDF Rural

The Rural Digitalisation Forum is an EU-level forum composed of representatives from the Living Labs, Rural businesses and services, Public Authorities, Citizen groups, Digital technology operators, Farmers, Media, Scientists, and representatives of other relevant projects. This is the RDF Working Group on "Rural life".

3.4. DESIRA supported initiatives

Services and working environments conceived to support Initiatives, Communities of Practice and Projects.

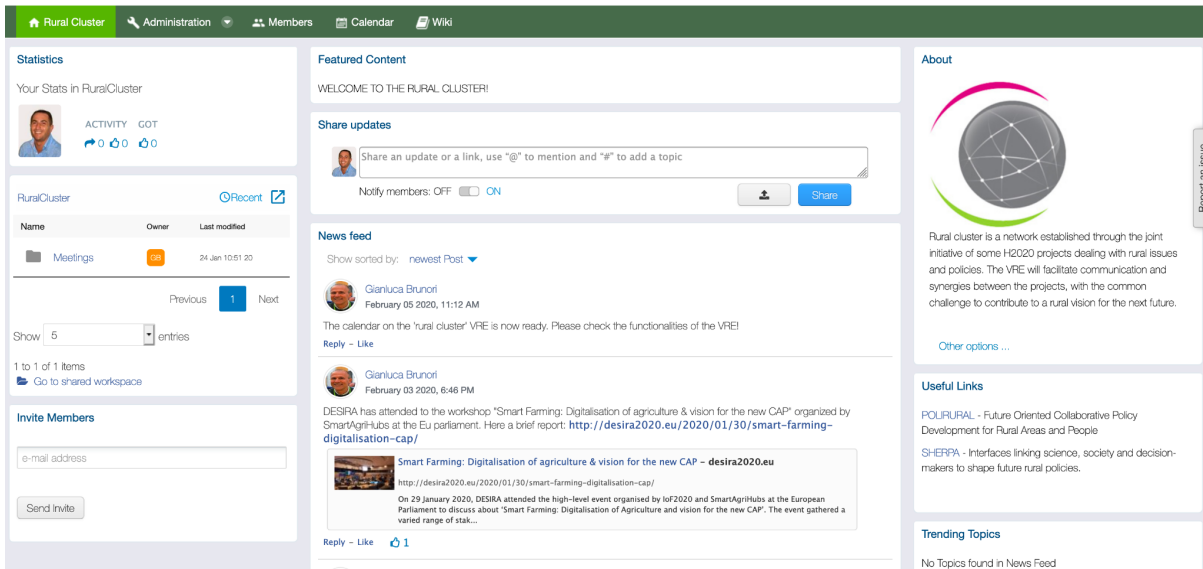
3.4.1. Rural Cluster

Rural cluster is a network established through the joint initiative of some H2020 projects dealing with rural issues and policies. The VRE will facilitate communication and synergies between the projects, with the common challenge to contribute to a rural vision for the next future.

Among the other features available in all VREs, the rural cluster VRE is empowered with

- **calendar facility** to share event information
- **collaborative WIKI facility** to create documents collaboratively.

Figure 15 shows a screenshot of the Rural Cluster VRE home page.



The screenshot shows the 'Rural Cluster' VRE home page with a dark green header containing navigation links: 'Rural Cluster', 'Administration', 'Members', 'Calendar', and 'Wiki'. The main content is organized into several columns:

- Left Column:**
 - Statistics:** 'Your Stats in RuraCluster' with a profile picture and 'ACTIVITY GOT'.
 - RuralCluster Table:** A table with columns 'Name', 'Owner', and 'Last modified'. It shows one entry: 'Meetings' with an owner icon and a date '24 Jan 10:51 20'. Navigation buttons for 'Previous' and 'Next' are present.
 - Invite Members:** A form with an 'e-mail address' input field and a 'Send Invite' button.
- Middle Column:**
 - Featured Content:** A 'WELCOME TO THE RURAL CLUSTER!' message.
 - Share updates:** A text input field for sharing updates, with a 'Notify members' toggle (currently OFF) and a 'Share' button.
 - News feed:** A list of posts sorted by 'newest Post'. The first post is by Gianluca Brunori from February 05, 2020, announcing the VRE is ready. The second post is from February 03, 2020, reporting on a workshop. A third post is a link to a report on smart farming digitalisation.
- Right Column:**
 - About:** A circular graphic with a globe and network lines, accompanied by text describing the Rural Cluster as a network established through H2020 projects.
 - Useful Links:** Links to 'POLIRURAL' and 'SHERPA'.
 - Trending Topics:** A section indicating 'No Topics found in News Feed'.

Figure. 15 A Screenshot of the Rural Cluster VRE home page.

4. Concluding Remarks

Virtual Research Environments are among the key products to be enhanced and delivered by the DESIRA project to support Project coordination, Living Labs activities and Rural Digitization Forums activities.

This deliverable has detailed the Virtual Research Environments deployed and operated for the DESIRA Project in the 4 years of the project duration. Overall, 14 VREs have been deployed and operated. The DESIRA Project VRE (cf. Sec 3.1.1) was created first and before the project kick-off. The remaining ones according to the project requirements and needs.

These VREs served more than 390 users in total spread across 25 countries (195 cities) and more than 10.200 user sessions in the period. The creation and operation of these environments required 185 tickets (121 related to the project management, 43 requests for tasks, support and enhancements; 7 requests for incidents and bugs; 14 requests for VRE creations).

5. References

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