

PNRR Project AGRITECH: A Web of Agriculture connecting citizens with advanced services

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Abstract—The Agritech project is a significant initiative in Italy, funded by the National Recovery and Resilience Plan. It aims to drive the digitization of agriculture in the country and establish an information technology platform known as the Web of Agriculture (WoA). The platform, along with its web-based abstraction, is designed to support various activities in the agrifood sector, including research, production, and commercial endeavors, and, above all, to reach citizens with advanced services related to traceability and certification of agrifood products. The project incorporates innovative artificial intelligence tools to enhance agricultural practices. In this summary, we will delve into the platform's design, the concept of the WoA, and highlight relevant case studies that demonstrate its potential applications and benefits.

Index Terms—data sharing, data space, architecture, digital agriculture

I. INTRODUCTION

The European Green Deal [1] and the UN Agenda 2030 [2] have called for sustainable development, with specific goals set for the agricultural sector to achieve climate neutrality by 2050. The objectives of the European Green Deal fall on the partner countries that are responsible for their implementation. In the case of Italy, this is declined in the National Recovery and Resilience Plan (PNRR) and, in the specific case of the agri-food sector, on the National Research Centre for Agricultural Technologies (AGRITECH). This is a wide complex national project structured into several Spokes, in which Spoke 9 aims at developing new technologies and methodologies for traceability, quality, safety, measurements and certifications to enhance the value and protect the typical traits in agrifood chains". The strategy pursued by this Spoke is to develop these services over a new technological platform, called METRIQA, which creates an Italian agrifood data space and that supports the abstraction of the "Web of Agrifood" (WoA), which provides web-like access to data and services.

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The platform is expected to benefit both researchers and productive stakeholders, facilitating resource sharing, AI-based retrieval services, and innovative agrifood services [3].

Data platforms and data spaces are key components in the digital transformation of various sectors, including agriculture. To depend less on monopolistic players, the European Union (EU) strategy for data launches several data spaces until 2027. Following this approach, the International Data Spaces (IDS) [4] and GAIA-X are initiatives focused on secure and standardized data exchange using a standardized connection across institutions boundaries. Over the past few years, there have already been several projects that contributed to the digitization of agriculture. Among them are the EU H2020 projects "DESIRA," "OPEN DEI," and "i4Trust" [5]. The latter platform makes it possible to share relevant vineyard data with the wine value chain in a secure fashion and is currently the only available solution on data spaces at technical readiness level 9 up to the authors' best knowledge at the time of writing. Overall, the use of data federation and federated digital ecosystems improves data availability and enhances machine learning and AI capabilities.

The Agritech project is in its early stage, consequently also the activity of design of the METRIQA platform and of its WoA abstraction is still preliminary: we collected and analysed interviews with various research and production stakeholders, we sketched the high level architecture and we are now developing its core components. The platform itself is designed as a scalable data space that can grow over time with the contribution of independent resources and service providers, following a data space model similar to that of IDS. In this work we present the current state of the project and we will discuss about the planned future steps of development.

II. THE METRIQA PLATFORM DESIGN AND ARCHITECTURE

METRIQA serves as a comprehensive platform for Agritech, providing storage and sharing capabilities for unstructured and heterogeneous digital resources. Its design is

based on the WoA abstraction, which shares similarities with the web but tailored for the agrifood sector. The platform incorporates decentralization and AI-driven metadata enrichment to enhance data management and discovery.

A. Design issues

METRIQA encompasses an "authority" node, and a number of decentralized nodes. One of these nodes is the "public" node, managed by the Agritech center itself. The platform defines four roles for participants: service and data providers, end users, WoA (Web of Agrifood) node managers, and a governance body known as the WoA authority. This architecture enables flexibility and customization, allowing each node to host specific services based on the needs and preferences of participants.

The nodes can be servers or clusters of servers located in the cloud or at the network edge, managed by public or private entities. Each node hosts data and services specific to its participants' needs. The public node hosted by the center focuses on research data and provides services for researchers to upload, share, and analyze their data using AI-based tools.

Technical requirements for nodes primarily focus on web-style publishing of resources. The public node managed by the Agritech center has specific functionalities, such as a search engine for the entire platform and individual workspaces for researchers to host, share, process, and publish their resources within the WoA. Private nodes can implement additional services tailored to companies or specific production processes. For example, companies along a production and distribution chain can share traceability data, enabling food traceability services from grower to consumer. Integration of data from different sources and export through various services is required for such services. While there are no strict requirements for nodes, they should be registered at the authority node, which functions similarly to a Domain Name Server on the Internet. The WoA authority node manages node accreditation and maintains a database of node descriptors, including specifications of services provided. This information is used by the search engine to retrieve public resources and respond to queries.

The platform defines three cases for describing node services. The first case is web-style access to digital resources using HTTP, where the descriptor includes the web server address and port. For proprietary services, an informal textual description is stored, along with a reference to the server's address and port. For public services with specific client-server interactions, an interface compliant with the International Data Spaces initiative is used alongside web-style access.

Service and resource providers populate the platform with data, knowledge, and services, including researchers, companies, professionals, and public bodies. End users consume data, information, and services offered by the platform. Node managers are entities running nodes, which can include IT companies, individual researchers, or the Agritech center itself.

B. Progress and expected outcomes

The initial phase of the project involved gathering requirements and use cases through interviews with researchers and

companies in the agrifood sector. The interviews revealed that researchers have well-established data acquisition and analysis methodologies but are interested in exploring AI technologies that complement their research activities. Companies, on the other hand, expressed a strong interest in food traceability services and blockchain technologies for certification of supply chains.

An example research-oriented use case is provided to illustrate the platform's expected behavior. In this case, research teams located in different regions of Italy collect soil and biological samples for chemical analysis related to wine production. The samples are associated with specific grape production sites and used for certification, quality assessment, and product traceability. Each team performs multiple samples, which undergo various analysis steps using different machines. The teams produce final reports that contain structured and unstructured data. The researchers utilize the platform to upload their data, share resources with other teams, and make selected documents publicly available. The platform also allows them to experiment with AI tools for alternative analysis methods.

In a separate scenario, a wine center in another country needs to test the authenticity of a wine delivery purportedly produced with grapes from different locations in Italy. They use the WoA search engine to find methodologies for verifying the authenticity of wines from that region and discover the required chemical tests and parameters.

Overall, the METRIQA project aims to address the diverse needs of researchers and companies in the agrifood sector by providing a platform that handles unstructured and heterogeneous data and offers a range of services and functionalities, including data sharing, analysis, and traceability.

C. Conclusions

METRIQA, through its WoA abstraction, aims to support the digitization of the agrifood sector in Italy. The platform facilitates resource sharing, AI-based retrieval services, and the integration of research and productive worlds. By providing a decentralized and technology-neutral environment, METRIQA enables collaboration and innovation in the sector. With the potential to enhance traceability, authenticity verification, and overall data-driven decision-making, METRIQA is poised to contribute to the sustainability and development of the agrifood industry in Italy and beyond.

REFERENCES

- [1] European Commission and Directorate-General for Communication, *European green deal : delivering on our targets*. Publications Office of the European Union, 2021.
- [2] United Nations, *The 2030 Agenda and the Sustainable Development Goals: An Opportunity for Latin America and the Caribbean*. Santiago, 2018.
- [3] Ministero dell'Università e della Ricerca (MIUR). (2022) Agritech - national research centre for agricultural technologies. Accessed: 2023-03-16. [Online]. Available: [https://www.mur.gov.it/sites/default/files/2022-10/Scheda di progetto - CN 2.pdf](https://www.mur.gov.it/sites/default/files/2022-10/Scheda%20di%20progetto%20-%20CN%202.pdf)
- [4] B. Otto, M. ten Hompel, and S. Wrobel, Eds., *Designing Data Spaces*. Springer Cham, 2022.
- [5] A. Goncharuk, "Wine value chains: Challenges and prospects," *Journal of Applied Management and Investments*, vol. 6, no. 1, pp. 11–27, 2017.