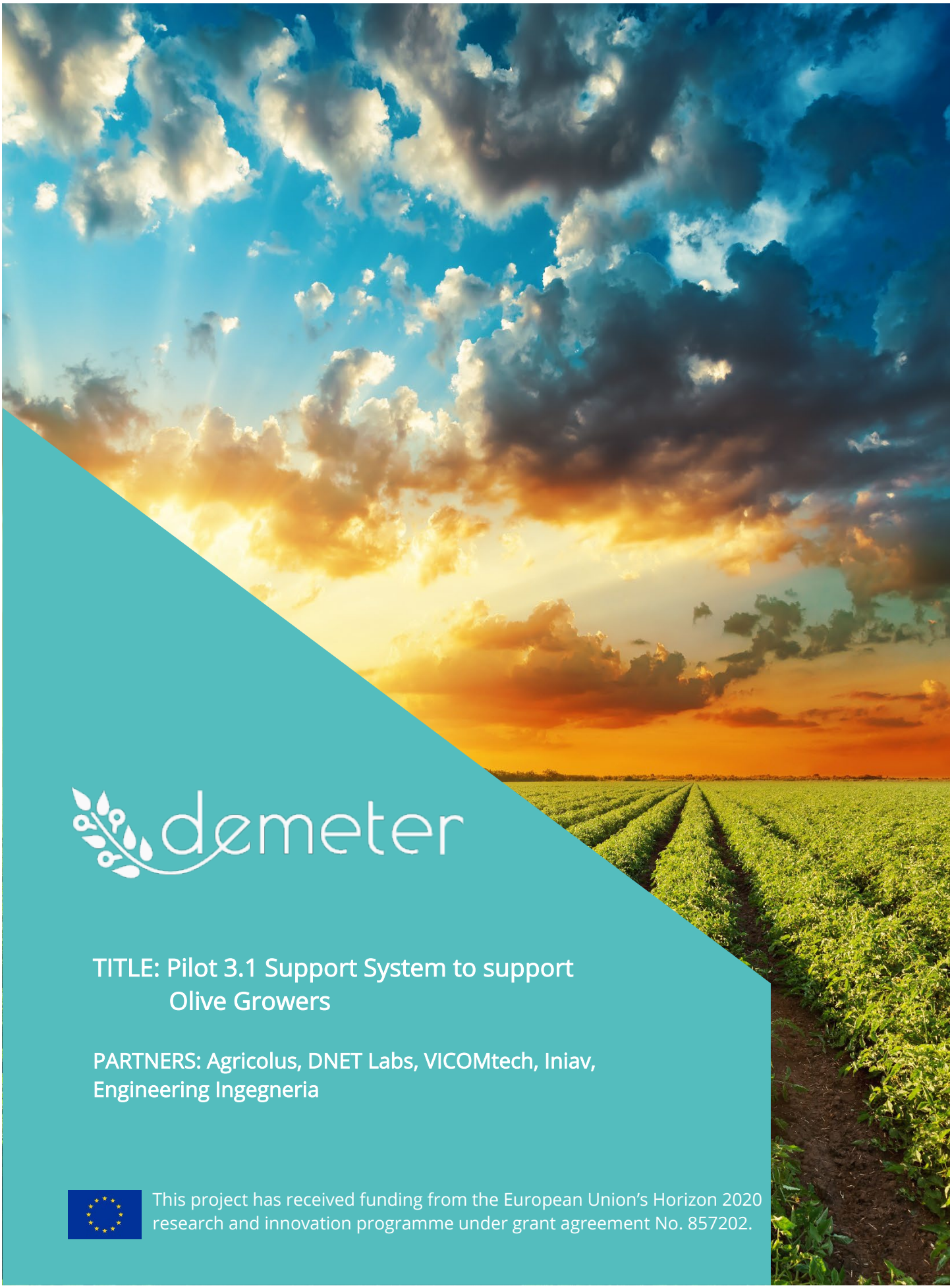

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TITLE: Pilot 3.1 Support System to support Olive Growers

PARTNERS: Agricolus, DNET Labs, VICOMtech, Iniav, Engineering Ingegneria

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Pilot 3.1 Smart Irrigation Service in Rice & Maize Cultivation

1 Introduction

DEMETER aims to lead the Digital Transformation of the European agrifood sector based on the rapid adoption of advanced technologies, such as Internet of Things, Artificial Intelligence, Big Data, Decision Support (DSS), Benchmarking, Earth Observation, etc., to increase performance in multiple aspects of farming operations, as well as to assure the viability and sustainability of the sector in the long term. It aims to put these digital technologies at the service of farmers using a human-in-the-loop approach that constantly focuses on mixing human knowledge and expertise with digital information. DEMETER focuses on interoperability as the main digital enabler, extending the coverage of interoperability across data, platforms, services, applications, and online intelligence, as well as human knowledge, and the implementation of interoperability by connecting farmers and advisors with providers of ICT solutions and machinery.

DEMETER focuses on the deployment of farmer-centric, interoperable smart farming-IoT (Internet of Things) based platforms, to support the digital transformation of Europe's agri-food sector through the rapid adoption of advanced IoT technologies, data science and smart farming, ensuring its long-term viability and sustainability.

Twenty real-world pilot projects, grouped into five pilot clusters, are running within DEMETER to demonstrate and evaluate how agricultural innovations and extended capabilities benefit farmers, technology providers, and society. The topics, scope and size of the pilots are diverse, from saving resources, such as water and energy, to a more environmentally compatible crop management with reduced application of fertilisers and pesticides, to improved animal welfare and the tracing of complete supply chains.

This white paper describes the pilot 3.1 "Decision Support System to support olive growers". The aim of this pilot is to improve irrigation, fertilization, and olive fly control in olive orchards using the online platform: Agricolus Olives, a Decision support System able to support olive growers, advisers, and agri-food processors.

2 Importance of digital agriculture

Agriculture and the agri-food sector today face an increasingly urgent set of challenges. One of the most important needs is to move towards more sustainable systems that make more efficient use of available resources. 4.0 technologies have opened new possibilities for agriculture sustainability. By using these new technologies, it is possible to, along with many other things, foresee the onset of certain diseases or the attack of pests. Moreover, a continuous monitoring enables timely action and reduction of input used to ensure environmental sustainability. It is also possible to determine the irrigation and nutritional needs of crops to prevent the overuse or unnecessary application of fertilisers and pesticides. Depending on the product's final use, the best time to harvest can also be determined. The advantages for the farmer are therefore both quantitative and qualitative: on the one hand, producers can save on inputs while also increasing production, and on the other hand, they may produce goods that are of higher quality. However, there are still several difficulties that need to be addressed to foster the spread and use of technologies in agriculture. Firstly, there is a moderate uptake of the use of digital technologies by farmers due to the costs, different investment capacities in digital technology and data, lack of technical skills and a not always clear awareness of the possible benefits.
Finally, there is a critical challenge with the limited interoperability and lack of openness of different technical systems, which restricts the options available to farmers between different technologies. The DEMETER project tries to address these problems.

3 Pilot Overview

Efficient olive orchard management requires complex decision-making processes to face the risks and uncertainties associated with farming. The process of growing olives is susceptible to a variety of hazards and uncertainties. These include abiotic factors related to soil and climate and biotic factors such as pest and insect infestations. In order to deal with unpredictable situations, it is crucial to ensure that the process by which decisions are made in the production cycle is steadily improving.
For this reason, this pilot aims to help enhance the decision-making process by assisting olive growers, advisers, and agri-food processors in integrated pest management of olive fruit fly, irrigation, and fertilisation management and optimization. To achieve this goal, the pilot project will test and integrate DEMETER components with the Agricolus Oliwes online platform, a Decision Support System.

The DSS combines meteorological and soil data sensed data, a modelling platform, and a farm management system (FMIS) to boost data-driven decisions in the use of external input thus improving the sustainable production of olive groves.

To address various environmental and farming situations, Agricolus Oliwes has been deployed and configured in 45 small to medium-sized olive farms, spread throughout Italy (18), Turkey (11) and Crete (18), three of the best areas for the production of olive oil.
Agricolus Oliwes can integrate software, sensors and open data sources to provide farmers with complete and efficient assistance in olive growing and olive oil production. Agricolus Oliwes is, therefore, a control and forecasting tool that helps apply effective defence and management strategies in the olive orchard to increase both the yield and quality of olives and oil.
There are several benefits to be achieved thanks to the pilot. These include, for example, the reduction of the volume of irrigation water used per year and the improvement of water use efficiency. These two elements are particularly important in the context of increasingly frequent periods of drought. The use of DSS also allows the nitrogen supply to be improved and the amount of nitrogen used as fertiliser to be reduced.
The collection of data on environmental and soil parameters obtained using the platform makes it possible to decrease the number of control treatments.
These two benefits are particularly important considering that European guidelines aim to reduce the overall use of chemical pesticides by 50%, the use of the most dangerous pesticides by 50%, and the reduction of nutrient losses by at least 50% (with a reduction in the use by at least 20%) by 2030.
Finally, DSS help farmers to make choices based on the real needs of the crops and the relationship with the surrounding environment this allows farmers to increase average yield thanks to more efficient management of crop operations.

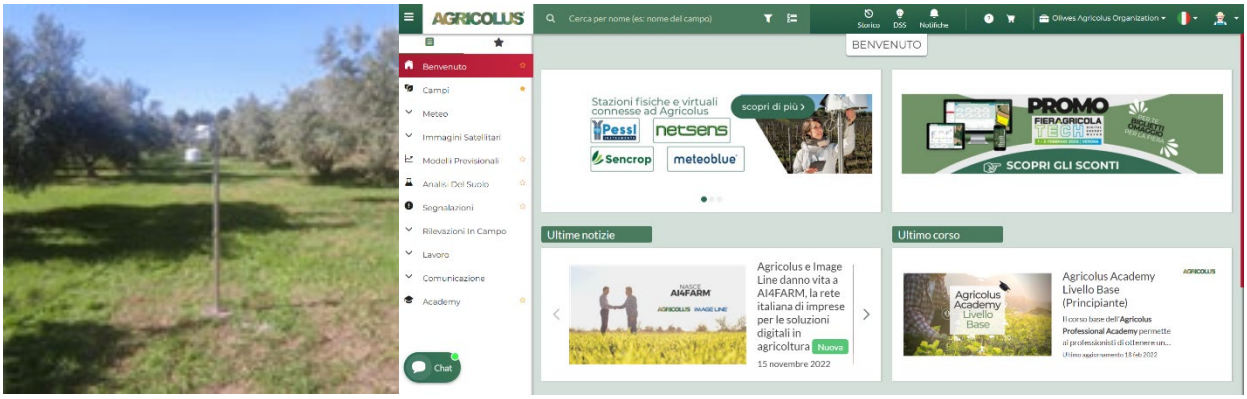

Image 1-2: Pilots in use

4 DEMETER Integration

One of DEMETER's objectives is also to respond to one of the characteristic problems of the digitalisation of agricultural systems; the lack of interoperability between the various systems. Therefore, the pilots also face this challenge.
In the pilot we have integrated the Agricolus proprietary technologies with a set of DEMETER enablers to support farmers in decision making and to improve the possible solution that can be used.

To ensure the interoperability, we have integrated the basic DEMETER enablers:
DEMETER Access Control System to access DEMETER protected resources;
DEMETER AIM to support interoperability: the farm data are published in AIM Complex farm data model, and the benchmarking and DSS are accessible using AIM data format;
We have registered the Agricolus resources in **DEH** to support the exploring of the available service.

We have then implemented a set of components and a Decision Support System:

- A.X: elaborate olive phenology using machine learning;
- E.2: calculate olive fruit fly day degree;
- DEMETER Benchmarking tools: support farmers in comparing the farmers' performance: generic (comparison with a set of indicators calculated with similar farms using the FADB database) - neighbour: comparing the yields and water efficiency indicators with a cluster of farms in the same areas; technology collect data to calculate the performance of the DSS.

AIM is interesting to exchange information with other solution providers. The basic FMIS data available in Agricolus has been mapped using AIM complex farm data model improving the interoperability of our platform. Using the components with AIM input and output simplifies the interaction in Agricolus of other components.
DEH can be a way to show other pilots and users the capabilities of the Agricolus OLIWES and the DEMETER integrated components, to support more general use of this type of solutions in other context.

5 Feedback from farmers

The purpose of this pilot project is to evaluate and integrate Agricolus Oliwes, a DSS (Decision Support System), with DEMETER components to help olive growers, advisors, and agri-food processors with integrated pest management (IPM) of the olive fruit fly, irrigation management, and fertilisation optimization. To achieve this, Agricolus Oliwes was deployed on farms located in the most important areas for olive oil production.
The choice of farms in different countries (Italy, Turkey, and Greece) allows the use of DSS to be tested in different environmental and agricultural conditions. Table 1 summarises all the details of the farmers involved. The farmers are using the DSS and testing it in the optimizing decision process in planning and applying agronomic practices.

Country	Italy	Greece	Turkey
Olive growers involved (n°)	18	16	11
Average farm dimension (ha)	4.8	1.9	27.2

Table 1: Farmers involved in pilot 3.1

In pilot 3.1 the multi-actor approach (MAA) with farmers is applied in different ways.
Agricolus hosted online meetings to explain the project and its objectives, train farmers on the use of our platform and collect requirements.
Focus groups were also conducted both to guide the farmer in the use of the platform and to collect feedback from them.
Lastly, surveys were carried out. Some results emerged from user involvement. First of all, farmers appreciated the use of decision support models in particular for tools to support IPM of olive fruit fly and irrigation management.
However, there was a need to reduce the time needed to use the systems, which is why the Agricolus UX team worked to simplify access to the data and models.
Another need concerns costs: small farms highlighted the issue of not being able to afford high investment costs.
For small farms providing solutions to the farmers' organisation or cooperative can be a way to avoid direct costs for farmers by including the digital service with the general assistance they receive from consultants.

6 Benefits

Agricolus provides a specific Decision Support System DDS, Agricolus Oliwes, to help oil farmers to improve their environmental impact. Using a DSS lets farmers to make decisions based on the real needs of the crops and their interactions with the environment, which helps them save resources like water, treatments, and fertilisers. These features help to achieve the three goals of sustainability: environmental, economic and social. From an economic point of view, it allows production to be optimised and yields to be improved thanks to timely and optimal continuous monitoring of the fields and decision support to save time and resources. In this way, it is possible to prevent the overuse or unnecessary application of fertilisers and pesticides. Agricolus Oliwes enables farmers to prevent infestations of, for example, damaging insects such as the olive fly and respond in a timely and effective manner to safeguard the crop.

The use of digital tools, such as the Agricolus platform, also has an impact at the social level. Farms can have more control over the economic management of their farm with benefits for their income. Benefits that are even more important in the context where climate change often causes yield reductions. In addition, farmers will be trained by Agricolus technicians and will be able to acquire new skills and grow professionally.

Each pilot must reach goals to demonstrate its impact, each goal is measured through the use of key performance indicators (KPI). KPIs should have an agronomic, environmental, economic and technical impact. To increase the economic impact, the pilot has to involve and give access to the system to a target of 110 farmers. In addition, to have an impact not only economically but also technically, it has to ensure that at least 45 farmers enter data into the platform and use the DSS. Another economic and agronomic impact is to increase the average yield (ton ha-1) by 10% compared to the 2016-2020 seasons.

In addition, there are other KPIs with an agronomic, economic but also environmental impact. For example, each year, compared to the average value for the 2016-2020 olive growing seasons, the pilot should ensure a 10% reduction in the nitrogen used for fertilisation (kg ha-1); a 10% reduction in the volume of irrigation used (mm ha-1) and a 10% reduction in the number of treatments for the olive fly. Finally, with the pilot, the water use efficiency irrigation (ton mm-1) should be increased by 10% compared to the average value for the 2016-2020 olive seasons.

The collection of data entered into the platform by individual farmers will help the other partners in the project to develop their activities.

7 Conclusion

Agriculture must increase environmental and climate performance while maintaining profitability and competitiveness; these goals can be achieved through the use of data and digital technologies.
There are, however, some barriers that may hinder the spread of digital agriculture, such as investment costs, difficulties in the use of digital tools by farmers, lack of interoperability between tools, etc.
The goal of DEMETER is to enable interoperability between digital technologies while making digital tools available to farmers. Pilot 3.1 aims to offer farmers complete and efficient support in the production of olive oil and olive trees by involving 45 farms in the most important production areas for this crop: Italy, Greece and Turkey. This can be achieved through the use of an online platform 'Agricolus Oliwes', a Decision Support System, which helps olive growers, advisers, and agri-food processors in integrated pest management (IPM) of olive fruit fly, irrigation and fertilisation management and optimization.
From an economic point of view, these tools improve yields and, through constant field monitoring and predictive models, increase the timeliness of intervention and reduce the resources used. Avoiding excessive or unnecessary use of fertilizers and pesticides also increases the environmental sustainability of production.
For these reasons, the pilot has several targets to achieve with an agronomic, technical economic and environmental impact.
As a result of participation in the DEMETER project, interoperable digital technologies are encouraged to be used in more sustainable olive growing.
However, it must be said that these tools remain a support that succeeds in mitigating adversity and aiding management, although environmental and weather/climate conditions will always have the greatest influence in terms of production and management efficiency.

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