demeter

PILOT PROJECTS

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ABOUT **DEMETER**

DEMETER is a Horizon 2020 project which aims to lead the digital transformation of Europe's agri-food sector through the rapid adoption of advanced Internet of Things (IoT) technologies, data science and smart farming, ensuring its long-term viability and sustainability. The project seeks to create a secure and sustainable European IoT technology and business ecosystem. DEMETER will demonstrate the real-life potential of advanced, standards-based, interoperability between IoT technologies by adapting and extending existing standards into an overarching Agricultural Information Model.

For more information visit:
WWW.H2020-DEMETER.EU

KEY **FACTS**

FUNDING SCHEME:

Horizon 2020 Industrial Leadership, ICT-08-2019

CONTRIBUTION OF THE EUROPEAN UNION:

€15 million

TOTAL BUDGET:

€17.5 million

DURATION:

3 ½ years (Sept 2019-Feb 2023)

CONSORTIUM:

60 partners

5 PILOT CLUSTERS:

Arable crops, Precision farming, Fruits and vegetables, Livestock and Supply chain

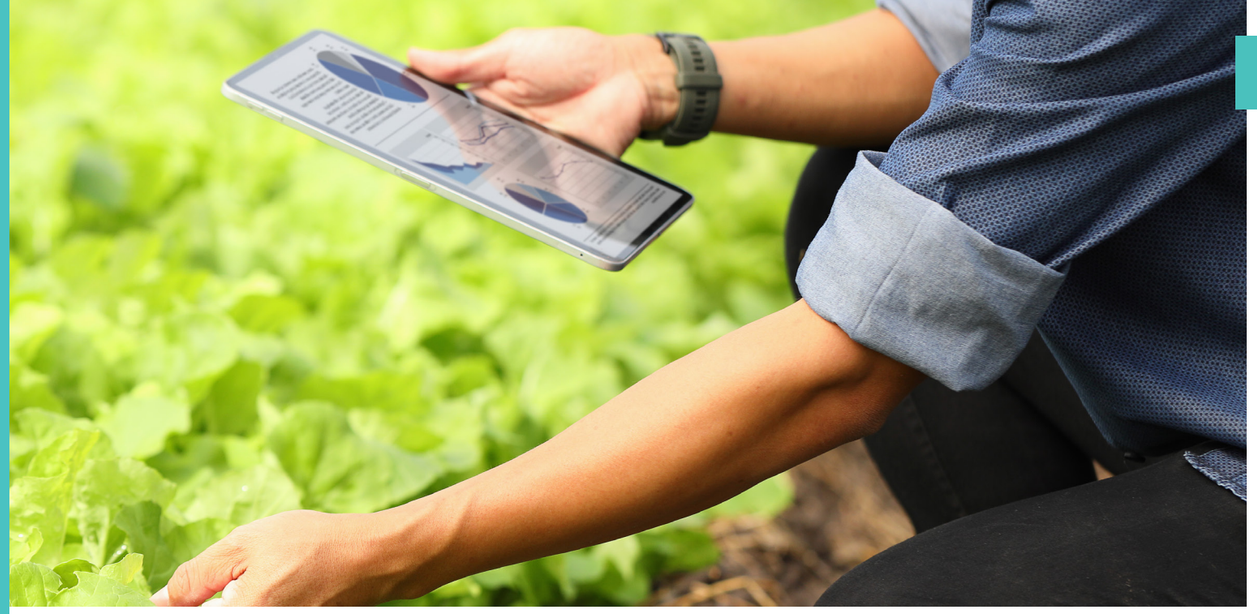
USE CASES:

20 use cases in 18 EU countries

DEMETER
OBJECTIVES

The overall DEMETER goal is to empower farmers and farmer cooperatives to use their existing platforms and machinery to extract new knowledge to improve their decision making. Equally, we aim to ease the farmer's acquisition, evolution and updating of platforms, machinery, and sensors by focusing their investments where they are needed.

EMPOWER FARMERS AND FARMER COOPERATIVES



SIX KEY OBJECTIVES ARE DEFINED:

INFORMATION MODELLING

Analyse, adopt and enhance existing and, if necessary, introduce new Information Models in the agri-food sector. This will ease data sharing and interoperability across multiple IoT technologies, Farming Management Information Systems (FMIS) and associated technologies.

DATA OWNERSHIP

Empower the farmer, as a prosumer, to gain control in the data food chain by identifying and demonstrating a series of new IoT-based, data-driven, business models for profit, collaboration and co-production for farmers and across the value chain.

USER ORIENTATED SOLUTIONS

Reverse the relationship with suppliers, through an innovative model in which suppliers are responsible for ensuring that a final solution is optimal to the farmer's existing context and expressed needs.

BENCHMARKING

Establish a benchmarking mechanism for agriculture solutions and business, targeting end-goals in terms of productivity and sustainability performance of farms, services, technologies and practices.

REAL WORLD IMPACT

Demonstrate the impact of digital innovations across a variety of sectors and at European level.

KNOWLEDGE EXCHANGE MECHANISMS

Build knowledge exchange mechanisms, delivering an Interoperability Space for the agri-food domain using a core set of open standards.

MULTI-ACTOR **APPROACH**

DEMETER uses a multi-actor approach (MAA) which aims to make innovation fully demand-driven, involving various actors such as farmers/farmers' organisations, advisors, businesses, etc. during the whole cycle.

DEMETER implements this multi-actor approach across the full chain, from farmers to service advisors and suppliers. In this MAA, suppliers cover the full diversity of providers of useful digital and digitally connected components including ICT, data sources, machinery, knowledge, software and hardware providers.

SUPPORTING **INTEROPERABILITY**

As data interoperability is of critical importance, DEMETER uses an overarching approach which integrates various technologies, platforms, services and applications while supporting fluid data exchange across the entire agri-food chain. DEMETER has developed a reference architecture that facilitates this interoperability, enabling secure integration of different platforms as well as data sets. The reference architecture also supports open innovation, where different standards can be combined for interoperable solutions. This, in turn, will not only increase the uptake of smart agriculture technologies for farmers, but will also open opportunities for SMEs to develop new technologies.

BOOSTING INTERACTIVE & DEMAND-DRIVEN INNOVATION

DEMETER
CONSORTIUM

The DEMETER consortium consists of 60 partners bringing together farmers and farmers' organisations, academic institutions, and small and large public and private organisations representing demand and supply sides. Led by project coordinator Walton Institute, the partners deliver a significant outreach capability globally, to cover a representative sample of the stakeholders needs and demands, thereby answering market potential and innovation enablement aspects.

60 PARTNERS REPRESENTING THE DEMAND AND SUPPLY SIDE TO DELIVER A SIGNIFICANT GLOBAL OUTREACH.

WALTON Institute for Information and Communication Systems Science
ENGINEERING
ΕΠΙΣΕΥ ICCS
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eagasc Agriculture and Food Development Authority
AGRICOLUS
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FATTORIA LATTE SANO ROMA
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Tragsa GrupoTragsa
JOHN DEERE
WORLD FARMERS' ORGANISATION
Atos
Fraunhofer
SINTEF
COLDIRETTI
UNIVERSIDAD DE MURCIA
Plantaže
AVR
SIMAVI Software imagination & vision
asplan viak internet
MACCARESE
Centria UNIVERSITY OF APPLIED SCIENCES
LD Landbrukets Dataflyt
FENADEGAS ADEGAS COOPERATIVAS DE PORTUGAL Grandes vinhos portugueses
AGROPRODUKT ŠINKOVIĆ
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ControlBee Twój bezpieczny ul
INESCTEC
ubiwhere SUITING THE FUTURE
HELLENIC AGRICULTURAL ORGANIZATION-"DEMETER"
m2Xpert NETWORKED SUCCESS

MIMIRO

Pede
Connected to agriculture

OdinS
Let us invent Smart Solutions

tracelabs
origintrail Core Developers

IFA

PROBOT

PSNC

iniav
National Institute for Agrarian and Veterinary Research

ITC
INOVACIJSKO TEHNOLOŠKI GROZD
INNOVATION TECHNOLOGY CLUSTER

AGRIFOOD
DIGITAL INNOVATION HUB

ρlechnology

Georgian Farmers' Association

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Tyndall
National Institute
Instituiúid Náisiúnta

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Trøndelag Forskning og Utvikling
Trøndelag R & D Institute

Gospodarstwo Rolne Ryszard Napierala

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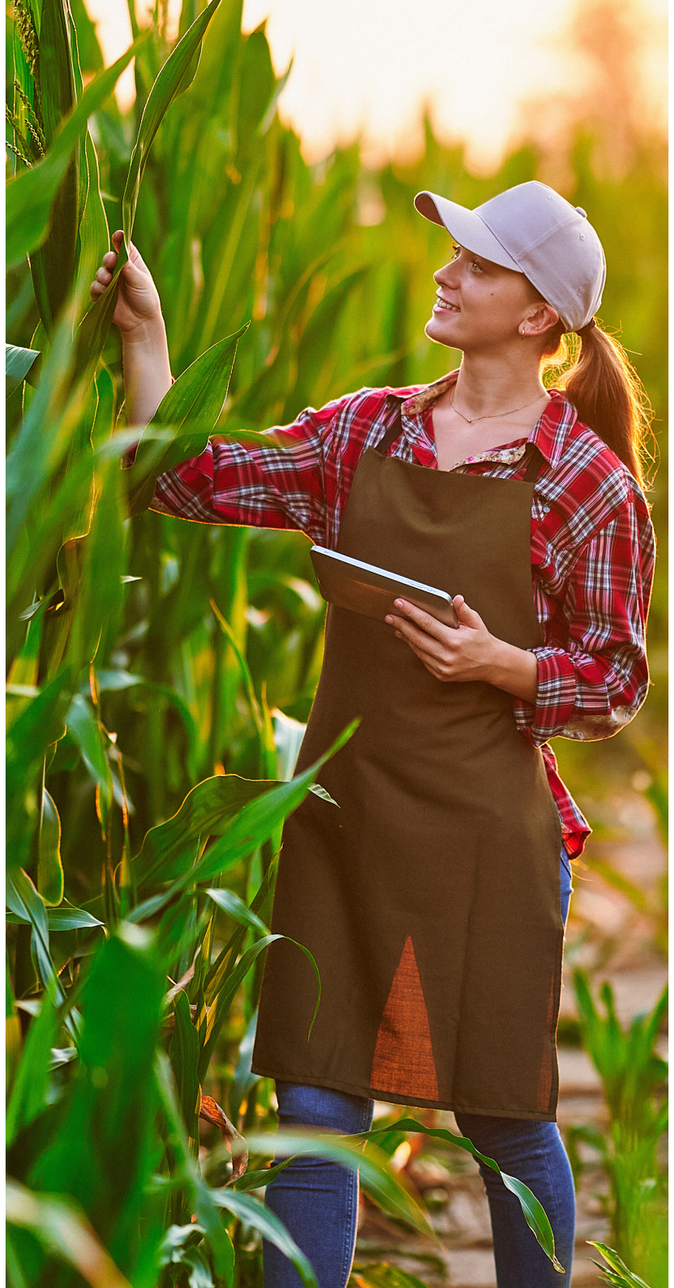
zoetis



PROJECT **STRUCTURE**

DEMETER is structured into seven Work Packages to enable the project to meet the defined objectives.

1. **Project Coordination**
2. **Data and Knowledge**
3. **Technology Integration**
4. **Performance Indicator Monitoring, Benchmarking and Decision Support**
5. **Pilot Management**
6. **Business Modelling, Innovation Management, Exploitation and Standardisation**
7. **Multi-Actor Ecosystem Development**

THE DEMETER **PILOTS**

5 Clusters, 20 Use Cases

The DEMETER pilot projects are used to demonstrate and evaluate how innovations and extended capabilities benefit from the interoperability mechanisms. The pilots, running across 18 European countries, are also used to monitor the evolution of the maturity in the stakeholders involved.

The pilots are grouped into 5 clusters: arable crops, precision farming in arable crops, fruit and vegetable production, livestock (poultry, dairy, animal welfare) and the supply chain.

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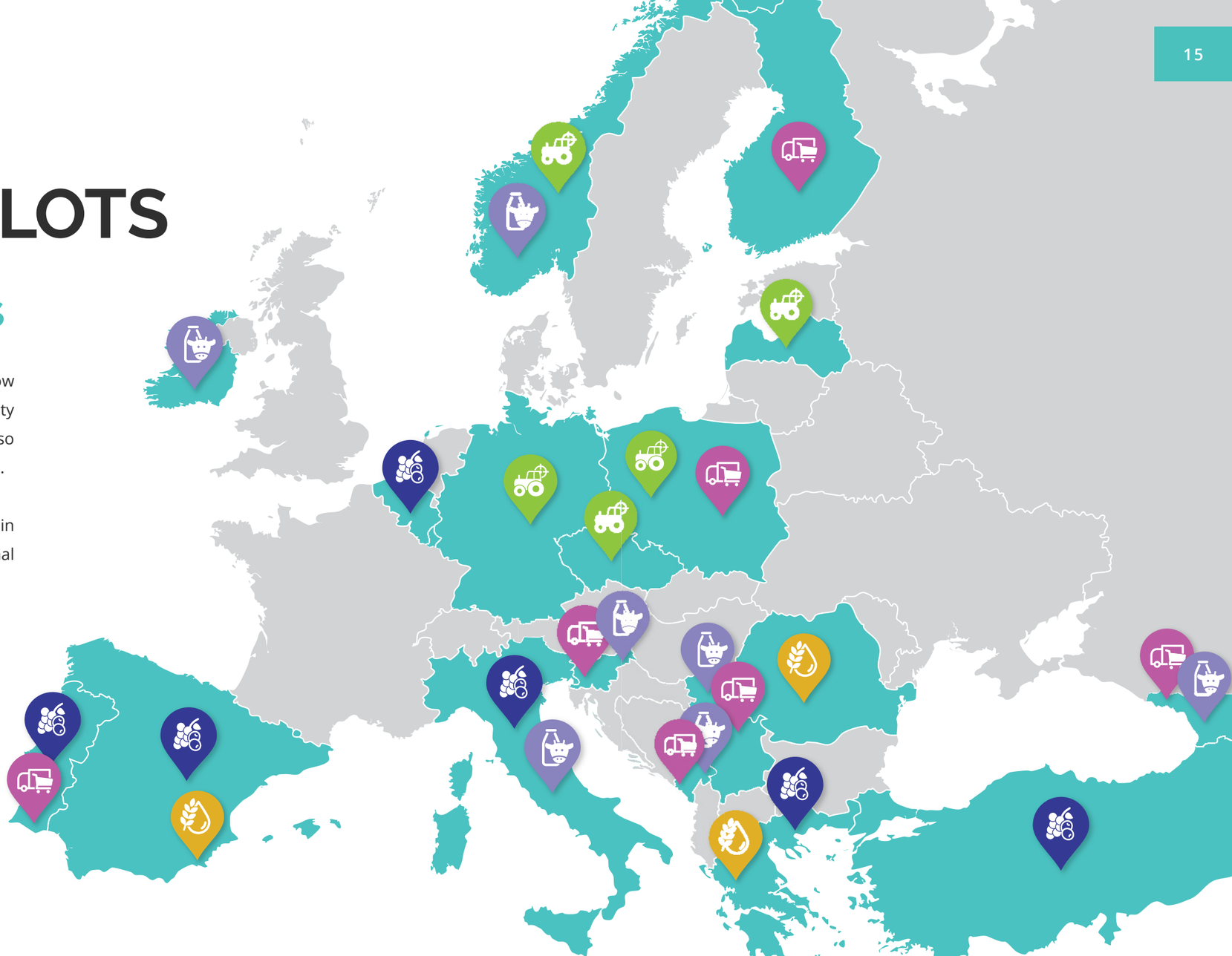


DEMETER **CLUSTER ONE**

ARABLE CROPS

ARABLE **CROPS**

FOCUS:

Water and Energy Management.

This cluster focuses on an efficient, integrated management of water and energy, from sources to end users, to optimise both the quality and quantity of the resources in irrigation systems applied to irrigated and arable crops. The pilots involve different technologies such as IoT sensor networks, satellite imagery and advanced farming platforms.

LOCATION

Spain

PARTNERS

1.1 & 1.2

Water and Energy Savings in Irrigated Crops

CHALLENGE

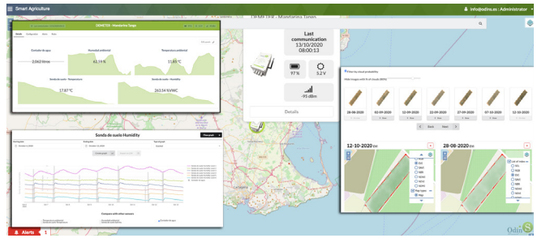
With the impact of climate change being felt by farmers across the EU, the need for irrigation has become an increasing issue. Water saving and energy saving are also key challenges for farmers. Many of the national modernised irrigation systems are closed solutions, limiting their interoperability and extension mechanisms.

AIM

This pilot aims to optimise the irrigation of arable crops by improving the automation of irrigation zones. By using open and standards-based technologies, it will allow irrigation communities to choose and combine hardware and software from different providers ensuring interoperability.

HOW

Using interoperable remote-control systems and robust management systems, inputs from both soil sensors and meteorological stations, as well as satellite images, will optimise the irrigation system. The use of real-time monitoring and control of water supply, in combination with energy efficiency improvements, is based on informed decisions from farm to fork. The adoption of standards and open protocols makes it easy to integrate IoT devices which are standard compliant.



BENEFIT

The implementation of standards-based and interoperable elements will facilitate the exploitation and maintenance of irrigation systems achieving greater efficiencies in water and energy savings. This adds a level of long-term investment security.

LOCATION

Spain

PARTNERS

DEMETER Integration

The Pilot's DEMETER components, once virtualized using Docker technology, are registered in DEMETER by means of the ACS, DEH, and BSE/FIE core enablers using available REST APIs and user interfaces. The pilot has a proprietary service to register agronomic, sensor, weather, and satellite imagery data in the cloud. All of the pilot's DEMETER components are integrated using the DEMETER AIM for interoperability. Some are integrated with the proprietary service to expose registered data using the AIM data model to be used by others to compute their results orchestrated by the main DSS for Irrigation Management component. This DSS component is also integrated with DEMETER Adaptive Visualization Framework (Knowage) to show the results to end-users, who are registered in advance in the DEMETER identification system (ACS).

Feedback From Farmers

Their main motivation has been to try to improve the management of the plots with the aim of being able to reduce water consumption to some extent, and therefore energy consumption, by means of automatic irrigation hydrants and the use of software that allows better irrigation decisions to be made, that is extensible and interoperable in deployments in new plots.

Outcomes

This pilot offers valuable information about irrigation recommendations for crops to optimise irrigation, and improving the automation of the irrigation zones. Using interoperable remote-control systems and robust management systems, inputs from water counters, soil moisture sensors, weather stations, and satellite multispectral imagery, the pilot offers valuable information by means of a Decision Support System dashboard to optimize the irrigation tasks. The adoption of standards and open protocols, not only has made it easier for farmers in irrigation communities to choose and integrate IoT devices and software from different vendors which are standard compliant, and combining them ensuring interoperability by means of DEMETER Agriculture Information Model (AIM), but it has also facilitated the exploitation and maintenance of the irrigation systems achieving better efficiencies in water and energy savings and adding a level of long-term investment security.

LOCATION

Central Macedonia region in Greece

PARTNERS

1.3 Smart Irrigation Service in Rice & Maize Cultivation

CHALLENGE

Rice is a high-input cultivation, especially in terms of irrigated water needs. Rice farmers frequently crop-rotate with maize, which also has substantial needs for irrigated water during the cultivation season. Current irrigation systems, especially for rice, are mainly based on farmers' experience and make suboptimal use of water, increasing the cultivation's cost, energy consumption particularly and the environmental footprint.

AIM

This pilot aims to maximise water use efficiency in the rice–maize crop rotation system, through the deployment of appropriate sensor systems and science-based decision making. Since irrigation is tightly linked to fertilisation, a nitrogen fertilisation advisory service is also provided by the pilot. This will lead to optimisation of the spatial distribution of nitrogen application based on the real needs of the field.

HOW

Customised in-field sensors are used for determining rice irrigation needs and remotely-controlled water electrical valves are employed for automatically optimising the irrigation. Additionally, remote sensing imagery and inputs from meteorological stations are used for determining the irrigation needs of maize crops. Sub-parcel nitrogen fertilisation needs are estimated through UAV and satellite imagery, leading to optimal fertiliser use via variable rate application machinery.

BENEFIT

The pilot will achieve increased, or standardised, crop production and improve the efficiency in the water and nitrogen fertilisation savings. This will decrease the carbon and, in general, the environmental footprint of both crops. Apart from the immediate benefits, this also adds a level of long-term investment security, especially in view of probable changes in water use strategies/policies due to the impact of climate change.

LOCATION

Central Macedonia region in Greece

PARTNERS

DEMETER Integration

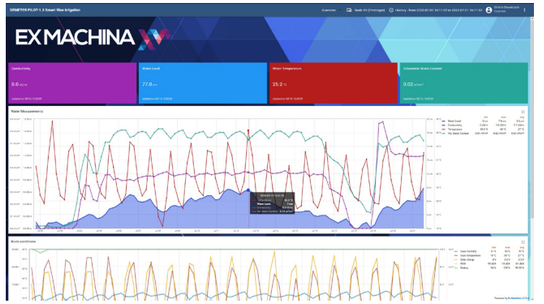
Support for efficient rice irrigation is provided via a specialised IoT sensor called WISyNode, which monitors water status (salinity and water height) in rice fields, together with IoT electric water valves, which are remotely operated via SMS commands. The Smart Irrigation Service for Rice (SIS-Rice) can then optimise water usage in rice irrigation by automatically operating the IoT valves in accordance with the crop's real-time needs. The Smart Irrigation Service for Maize (SIS-Maize) integrates satellite imagery and weather forecasts to recommend irrigation scheduling. The Fertilization Advisory Service for Rice and Maize (FertiRM) provides variable rate technology (VRT) fertilizer recommendations by analysing management zones within each field. The DEMETER system is designed to flexibly incorporate data streams from any vendor through open interfaces. This allows fusion of diverse data sources and analytics to enable the specialised irrigation and fertilization services for rice and maize crops.

Feedback From Farmers

To collect user feedback on the usefulness and usability of the digital services, the DEMETER project held multiple meetings and workshops with farmers and other stakeholders. Feedback was gathered through in-person discussions and phone calls. Overall, users were highly satisfied with the digital solutions, recognizing their potential to cut costs and optimise farm operations. A few specific concerns were raised. Some users felt that the current water pricing policy, which charges a flat rate regardless of consumption, should be updated to reward efficient water use. However, the prevailing sentiment was that the DEMETER services could generate significant benefits by reducing expenditures and improving work schedules.

Outcomes

The DEMETER apps have been deployed into seven pilot sites: two experimental sites and five active farms owned by farmer groups. The SIS reduced water use by about 15% while keeping salinity below harmful levels for the crops. Using the FertiRM recommendations resulted in a 20% average gain in cost efficiency, measured by fertilizer cost per unit area and yield. Overall, the pilot deployments demonstrated that the DEMETER Smart Irrigation Service in Rice & Maize Cultivation empowers farmers to optimize irrigation and fertilizer practices for their rice-maize crop rotations. The tools helped them make informed decisions to sustainably boost yields and improve cost-efficiency, thus offering digital solutions to increase productivity and profitability for farmers.



LOCATION

Romania

PARTNERS

1.4

IoT Corn Management & Decision Support Platform

CHALLENGE

Inefficient fertiliser practices and the demand for irrigation water contribute to environmental impacts, such as rising greenhouse gas emissions (GHG) and poor water quality, driving business risks in corn production. Efforts are necessary to limit GHG and handle environmental threats by promoting environmentally-friendly production technologies, practices and products and encouraging investments in green technologies. Scouting and monitoring of fields is required to identify any problems early, such as plant emergence issues, nitrogen shortages, insect build-ups, disease outbreaks, weed problems and moisture stress effects.

AIM

This pilot aims to implement an IoT Corn Decision Support System Platform for farmers to improve water management, including water quality, save energy and reduce greenhouse gas emissions. This will be done via an integrated platform, INOVAGRIA, that gives the farmer access to data at physical block level (as recorded in the National Paying Agency APIA) throughout Romania. This will assist the farmer in making informed and robust decisions regarding the technical mix to be employed in the production process.

HOW

Local weather stations and soil sensors installed in farms, together with estimations based on calculation algorithms for data collected from other weather forecast services and data provided by weather satellites, will be the basis for platform integration and decision support for corn farm management. This enables efficient collaboration and information exchange in a short local chain. The platform will allow and encourage enrolment of compliant IoT devices through open protocols and interoperable elements.

BENEFIT

The use of the platform will provide the users with appropriate risk management tools for adapting farms to climate change. This will allow them to respond to the current CAP greening requirements by changing their agronomic practices, while being able to access both Pillar 1 eco-schemes funding and Pillar 2 investment support. The results generated during the project implementation will be shared with the Romanian corn producers as well as their counterparts from Europe. This will provide stakeholders with access to project knowledge, regarding agriculture and ICT-related technologies.

LOCATION

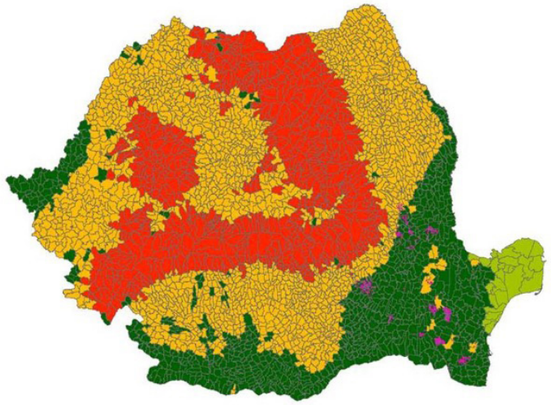
Romania

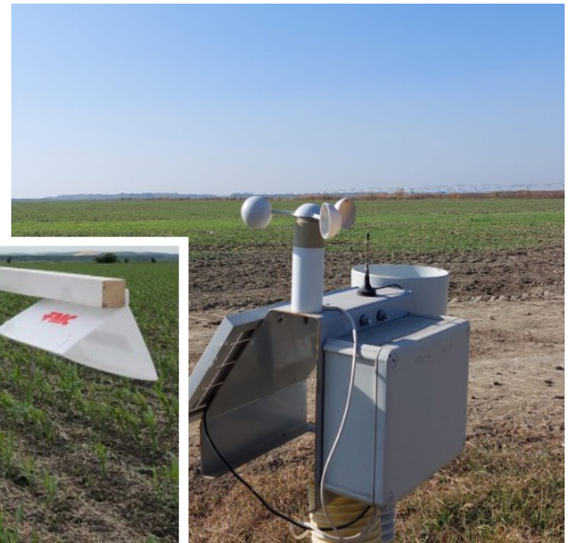
PARTNERS

DEMETER Integration

Pilot 1.4 uses inputs such as soil and weather information which is provided by ground sensors, weather stations and satellite images . The figure below presents a general picture of how this information is gathered through the different platforms (INOVAGRIA, DEMETER Services, weather station services), tailored to DEMETER Enhanced Entities (DEEs), and integrated into the DEH.

The DEMETER enablers directly used by Pilot 1.4 are Agricultural Information Model (AIM), Semantic Interop/Mappings to AIM, Plant Stress Detection (A.3), Nitrogen Balance Model (C.1) and DSS Visualization Dashboard (KNOWAGE) and indirectly are: DEMETER Enabler Hub (DEH), Brokerage Service Environment (BSE) and Access Control Server (ACS) (called from KNOWAGE).





Feedback From Farmers

Farmers involved in pilot 1.4 received access to INOVAGRIA and were asked to provide feedback for gradually improving the capabilities of the application according to their needs. They interacted regularly with the APPR agronomist team, participated in surveys, and provided timely assessment of the tools deployed, especially in terms of developing a user-friendly interface and data input. They indicated tangible benefits associated with the digital platform in terms of cost reductions from fertilizers and crop protection products. As non-tangible benefits, they mentioned peace of mind and the number of working hours. Participation in the project, including stakeholder consultation activities, increased awareness of the role of digital tools in ensuring operational profitability, improving crop quality and helping sustainability of farming systems were all mentioned by the farmers as additional benefits.

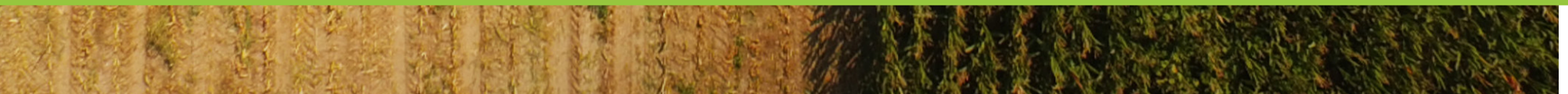
Outcomes

Pilot 1.4 has been very beneficial in terms of helping farmers to rationalize maize production costs, determine plant stress, enhance maize production yields, improve nutrient management, fertilizer quantity calculation for corn crop and establishing the optimal fertilization period based on the weather forecast.

By being involved in DEMETER, the pilot benefits from the project's resources to accomplish the established objectives. The pilot uses inputs such as soil and weather information which is provided by ground sensors, weather stations and satellite images, amongst others. This information is gathered through the different platforms (INOVAGRIA, DEMETER Services, weather station services), tailored to DEMETER Enhanced Entities (DEEs), and integrated into the DEH.

DEMETER **CLUSTER TWO**

PRECISION FARMING



PRECISION **FARMING**

FOCUS:

Agricultural Machinery,
Precision Farming.

This cluster also focuses on arable crops but specifically on the usage of agricultural machinery and the establishment of precision farming. The pilots concentrate on monitoring arable crops through sensors and their documentation, while decision support systems will be developed for live support of agricultural process in a secure and trusted way. The data will reuse existing platforms and services and link the results to the DEMETER platform.

LOCATION

Germany

PARTNERS

Fraunhofer IESE

JOHN DEERE

2.1

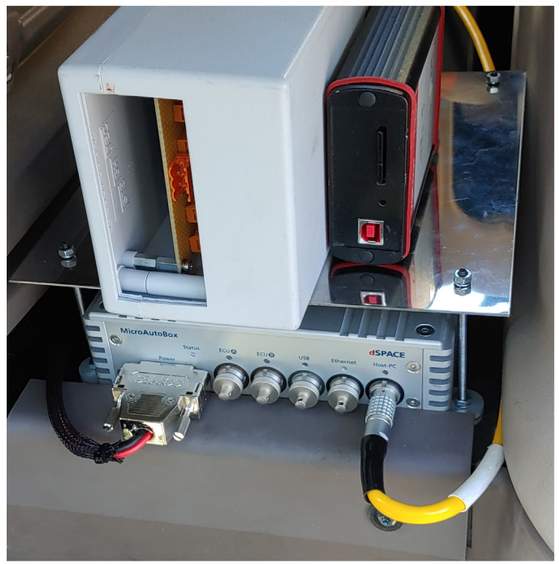
In-Service Condition Monitoring of Agricultural Machinery

CHALLENGE

Using onboard sensors for in-service monitoring of engine data as well as data of the exhaust gas after treatment decreases the need for PEMS (Portable Emissions Measurement System). Storing and analysing selected data as well as providing defined information to legal institutions helps to monitor that machines follow the regulations and offers the possibility to use the collected data for further improvements (e.g. optimising machine and simplify maintenance).

AIM

This pilot aims at demonstrating the potential application of onboard sensors for in-service monitoring, as well as testing the legal applicability of existing After Treatment (AT) sensors as an alternative to PEMS, while considering aspects of data management, privacy and integrity.



HOW

Using data from existing sensors, algorithmically ensuring high quality of continuous data streams, and analysing the data in real-time by making use of the most appropriate algorithms and technologies, will allow monitoring, documentation, and the use of the analysed results for further actions.

BENEFIT

Using the collected data will result in better knowledge of machine and engine conditions. On the one hand this can be used to simplify maintenance and thus reduce costs and machine down time. On the other hand, when in-service condition monitoring is mandatory this approach helps to fulfil regulations.

LOCATION

Germany

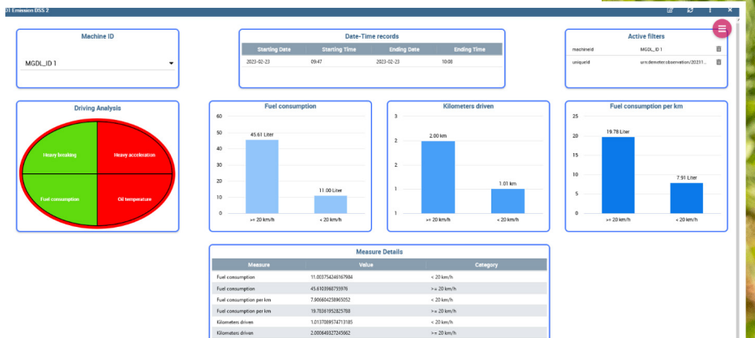
PARTNERS

Fraunhofer IESE

JOHN DEERE

DEMETER Integration

The pilot tracks and analyses tractor machinery data with a data logger which is cooperating with a number of DEMETER components. First, the pilot uses the “Data Quality Assessment” (DQA) enabler for structured data for the data analysis pipeline to ensure adequate quality of data is gathered and monitored. A second DEMETER component is the decision support system (DSS) DEMETER 4.D.1 “Emission DSS 1” which assesses the criticality of different engine and after-treatment parameters. Another decision support component, the DEMETER 4.D.1 “Emission DSS 2”, has been developed collaboratively across DEMETER work packages and is used on the gathered data for performing a driving analysis on road sections which is also rated based on previous weighted analysis. By means of the DEMETER AIM, these assessments are integrated into the DEMETER Adaptive Visualization Framework to have a visualized dashboard based on Knowage.



Feedback From Farmers

Throughout the project, there was a regular exchange of feedback and interaction between agricultural experts and the pilot members. The DEMETER 4.D.1 Emission DSS 1 component was seen as beneficial regarding time and expenses for checking machine conditions. This can help in the case of identifying malfunctions or even help to prevent them. Additionally, the DEMETER 4.D.1 Emission DSS 2 could be useful for farms with many contractors to have a better understanding of how the machines are used. This can also be used to show rookie drivers how they drive and how they could improve their driving behaviour. Farmers value both the impact and being part of the process of digitalising agriculture.

Outcomes

The data logger in combination with the data analysis tools provide a holistic view on the machine condition and field works. In addition, by giving the farmer visual feedback on the condition of the machine, time spent checking the machine, and time and money spent on maintenance can be reduced. The use of the solutions developed can improve the efficiency, environmental impact of agricultural machinery, safety, and overall experience of the farmer. Providing the output data in a DEMETER AIM compliant format makes it possible to visualize the results of the analysis using the DEMETER Adaptive Visualization Framework and also increases interoperability for future applications. In summary, the data from the logger along with its visualisations and analyses provide a simple and intuitive overview of the machine’s condition.

2.2

Automated Documentation of Arable Crop Farming Processes

LOCATION

Germany

PARTNERS

JOHN DEERE

Fraunhofer IESE

m2Xpert

CHALLENGE

Today, agricultural processes are often documented with a considerable time lag after they are carried out, leading to inaccuracies. In addition, the cost of a job depends on various factors like the fuel consumption of a machine, labour time, and the efficiency of the job with regard to the weather conditions. Due to these influences, and others, occurring over a period of several months, farmers and contractors cannot assess the total cost of a job. Most farmers mainly rely on themselves and their resources for documentation, impairing the quality and quantity of the outcome.

AIM

This pilot will develop an automated job identification and documentation, and job cost calculation for fertilisation, tillage, seeding, and spraying applications. This will largely eliminate the need for manual documentation.

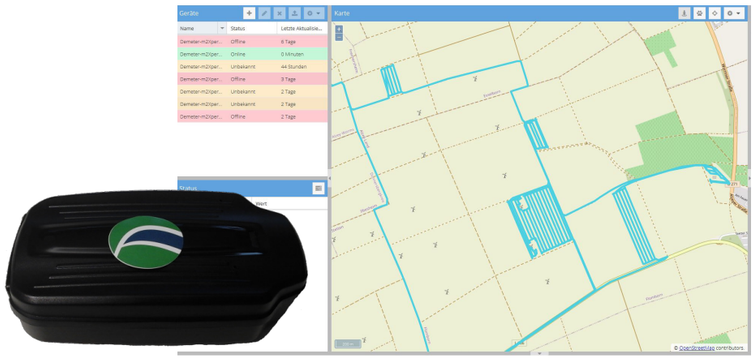
HOW

The focus of the job cost calculation element of the pilot will be on fertilisation and spraying applications for winter wheat. These jobs are done several times in the year and will therefore deliver more data than seeding or harvesting, which are only executed once per field.

For the development of an automated documentation tool, the detection of the difference between fertilisation spraying, tillage and seeding jobs will be the most challenging part of job identification. It is based on sensor data from machines and external sensors such as satellites (e.g. sentinel) and on data from weather stations.

Position and movement data are analysed for automatic process identification. Other external data like the seasonal date of measurement for estimating the relevant process season and weather data or satellite images for checking the plausibility of processes are added. This system is to make process forecasts for automated documentation.

Furthermore, this pilot will make use of data quality assessments to support the development, and to further increase the quality, of these data-driven services.



BENEFIT

Given the many factors influencing a profitable job application, the abovementioned approach delivers three major benefits. On one hand, job cost prediction has the potential to increase farmers' and contractors' productivity. In addition, the automated job documentation and collected weather information will improve decision support. Finally, automated documentation will help in terms of time efficiency and precision of the process.

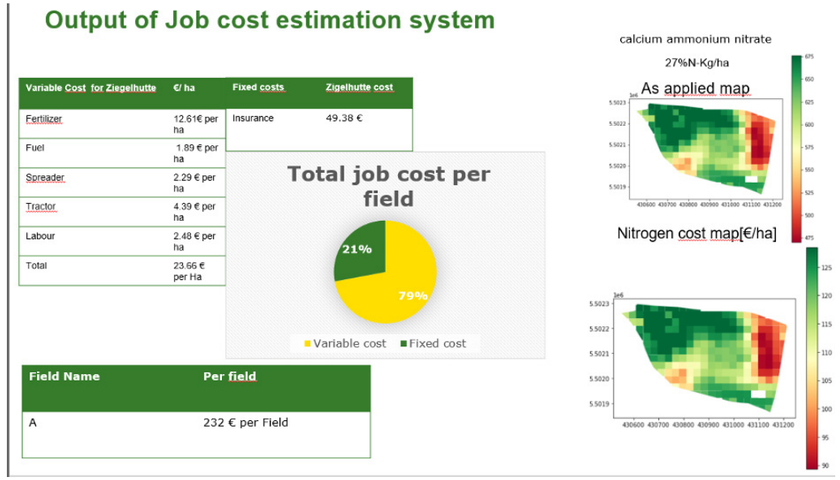
LOCATION

Germany

PARTNERS

DEMETER Integration

The pilot tracks machinery movement data and tries to identify the process for an automated documentation which will replace manual documentation. By utilizing smart analysis of GPS positional data over time and circumstantial data of agricultural processes the system is trained to understand patterns of movement and agricultural processes. The system then translates these into ready-made decision templates by which the farmer can validate an already-documented process supplied by the engine saving substantial amounts of time. First, the pilot uses the 'Data Quality Assessment' (DQA) enabler for structured data for the data analysis pipeline to ensure adequate quality of gathered and monitored data.



Feedback From Farmers

Throughout the project, there was a regular exchange of feedback and interaction between agricultural experts and the pilot members. The feedback on the solution in development was consistently positive. Even if an automated system has a few bugs at the beginning, they will see great benefits of timely documentation. Most of the time, farmers only know approximately what they did at what time in the fields therefore measuring and documenting the approximate time. By using this solution, even if the system has only an 80% hit rate in process recognition, the date and duration of the process is 100% correct. In case of a misinterpretation, the error can easily be corrected by the farmer. Thus, one initially has a support function which was welcomed very positively by the end user. Test farmers see great potential in a future version, but it must be seamlessly integrated to fulfill its potential.

Outcomes

With further training of the algorithms and linking the results to external process data, the automation success will continue to increase. The solutions developed can improve efficiency and overall experience for the farmer. Job cost prediction has the potential to increase farmers and contractors' productivity. In addition, automated job documentation and collected weather information will improve decision making while automated documentation will enhance both efficiency and precision. Providing the output data in a DEMETER AIM compliant format could make it possible to visualize the results of the analysis using the DEMETER Adaptive Visualization Framework increasing interoperability for future applications. In summary, the data from the GPS-Logger and its visualisations and analysis provide a simple and intuitive overview of farming processes.

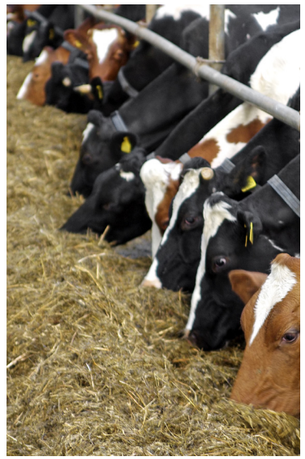
LOCATION

Czech Republic, Poland, Latvia and Norway

PARTNERS

2.3

Data Brokerage Service and Decision Support System for Farm Management



CHALLENGE

Farming related data is produced by several suppliers, using different systems, data models and APIs. This data varies from machinery data, satellite data, meteorological data, land parcel information systems, water bodies data, erosion data, soil data and more. For farmers, it is important to have access to the complete data to help decision-making, which is currently not available. The challenge is to integrate this data allowing analysis and visualisation applications for a Decision Support System.

AIM

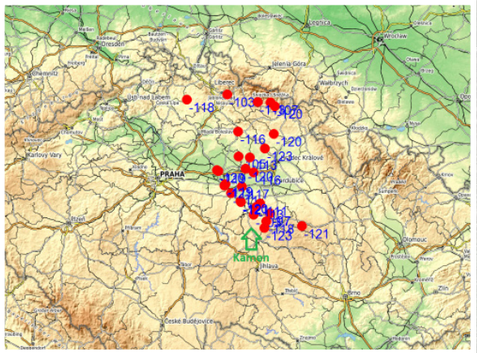
This pilot will establish a trust-based and compliant data market for agricultural enterprise data that sits between the owners and operators of agricultural data clouds and the farmer. This will include both a technical platform and advisory services that will ensure easy adoption of data and technology by farmers.

HOW

Pilot farms will implement relevant data generated in the process of managing their farm, as well as indicating expectations and comments regarding the functionality of the system. Three main groups of input information are used. First, data from precise online and long-term measurements on the farm (e.g. meteorologic stations, IoT sensors on the farm etc.). Next, external data specific to the farm such as satellite picture and information, external weather forecasts etc. Finally, data from other sources used at the farm (e.g. governmental regulations, subsidy calculation, work planning information). This data is combined and adjusted to a format that will describe all inputs in one application. Visualisations using a combination of charts and meteograms/multi-charts for sensor and meteorological data will be developed. This more effective utilisation of the data provides support for the decision-making process. Furthermore, a mobile application will provide alarms and warnings with information about suitable/ unsuitable conditions for defined interventions.

BENEFIT

Using the Data Brokerage Service and Decision Support System will enable farmers to have access to complete and integrated data, providing support for decision-making; something currently not available. This will have a positive influence increasing efficiency, reducing time and effort, and delivering cost savings.



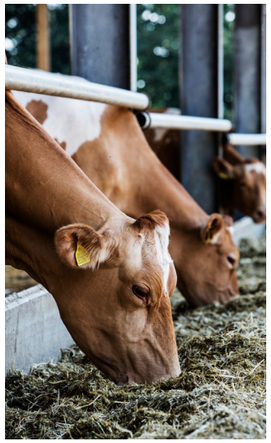
LOCATION

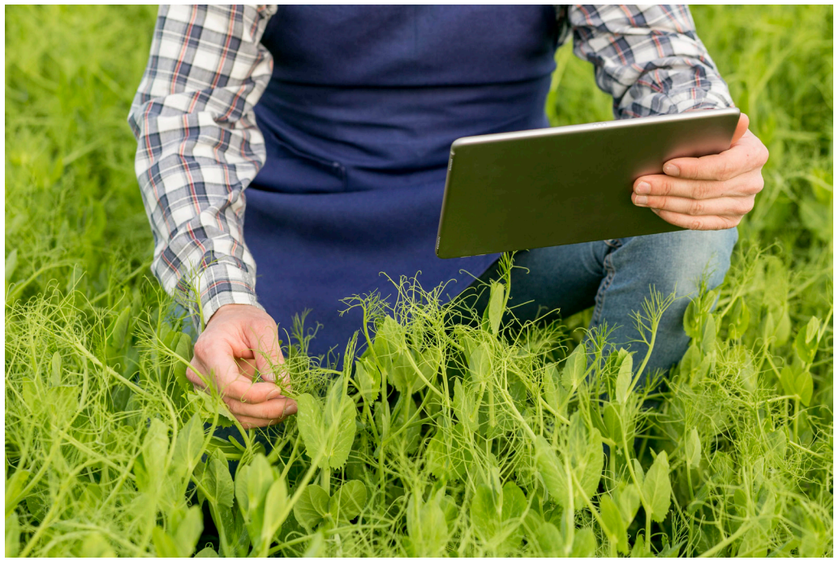
Czech Republic, Poland, Latvia and Norway

PARTNERS

DEMETER Integration

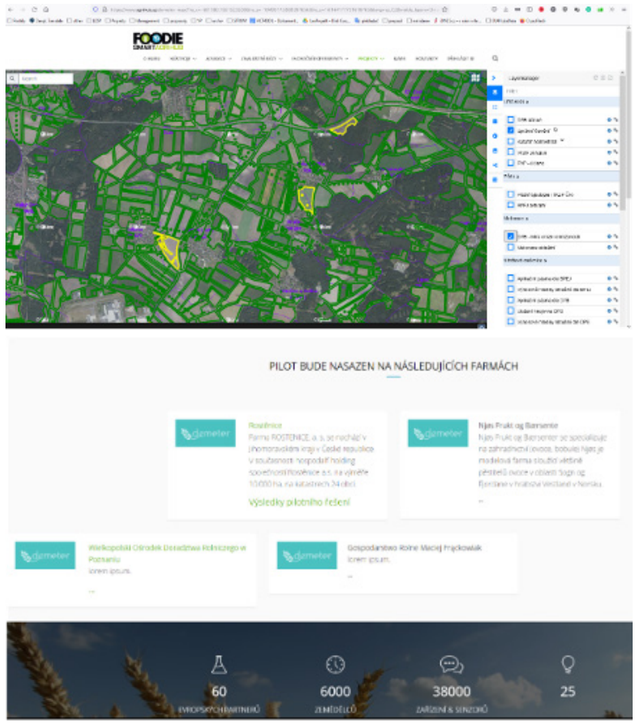
Pilot 2.3 established a trust-based and compliant data market for agricultural enterprise data which sits between the owners and operators of agricultural data clouds and the farmer. It includes both a technical platform and advisory services that ensure easy adoption of data and technology by farmers. Lesprojekt adopted an approach to utilise DEMETER enablers without the need to significantly change the data models and data flows used on the portals operated by the company.





Feedback From Farmers

One of the most limiting factors for farmers adopting technologies is the time they perceive it to take. Typically farmers did not assess the benefits of DEMETER enablers in isolation and rather viewed the whole solution as time consuming until they adopted the pilot. To date, farmers have provided positive feedback while outlining the benefits of being able to access available farm data in advance which in turn allows them to customize their outputs and address any issues the data illustrates. These process improvements provide the farmer with more time to spend on different aspects of the farms, such as on field operation planning.



Outcomes

Lesprojekt developed decision support tools which are made available to farms and agricultural advisors. To facilitate the decision-making process the user must have all the data and services. These datasets and services in many cases have different owners and use different standards, formats, and protocols. The infrastructure used by Lesprojekt includes portals for farmers and other agricultural data users based on the HSLayers NG map client, using Micka as a metadata catalogue, and sensor solutions made available through Senslog. To expand the functionality and data resources available on Lesprojekt platforms, DEMETER enablers were tested to offer added value to the services created by Lesprojekt.

LOCATION

Poland

PARTNERS

2.4

Benchmarking at Farm Level Decision Support System

CHALLENGE

There are several different data sets for agriculture, but many of them are rarely used in practice. Farmers often have challenges with the practical use of data when making decisions on the farm, especially in management. Data interoperability is a problem and furthermore, the data does not indicate how their farm performs against others of similar economic size. ICT systems are available, but time is needed to learn how to use these technologies, when the farmer is needed in-field.

AIM

This pilot aims at developing services to support benchmarking on the productivity and sustainability performance of farms, leveraging and extending existing Decision Support Systems (DSS) for farmers. This will involve monitoring different conditions and parameters affecting such indicators, collecting the data and integrating it in a unified layer accessible by the DSS.

HOW

This pilot will provide a simple to use benchmarking system that allows the use of ICT and IoT technologies in practical management and decision support, with a focus on data integration. The system will be developed on a layer of decision support based on modelling and data processing from many sources and structures like local data, public data, Farm Accountancy Data Network, and market information. This will be complemented with security mechanisms and implement computational benchmarking models with interfaces that reuse/ extend existing decision support and farm management systems (as an added value feature).

The system contains farm management interfaces for the farmer and their advisor alongside data exchange with external and internal systems, e.g. DSS and benchmarking methods on many levels of data. The main functionalities will be a calculation of the economic size of the farm based on dedicated algorithms and instructions, the presentation of graphs showing the current and historical state of affairs for farms of similar economic size and the presentation of information on prices of agricultural products and materials needed for production in previous years. The benchmarking system will be complementary with existing advisory systems such as Electronic Platform of Services for Users (EPSU) and the polish national advisory project, eDWIN.

BENEFIT

Facilitation of farm management at various levels of production volumes and types is expected to help with decision making for farmers by using a broad spectrum of data. This will also improve farmers' access to comparable data from his/her own farm with others. Data will be aggregated at the farm advisory system level. All activities are also aimed at increasing the knowledge of farmers and the accessibility of digital skills.

LOCATION

Poland

PARTNERS

DEMETER Integration

Pilot 2.4 supports the productivity and sustainability performance of the farms, leveraging and extending existing decision support systems for farmers, by means of monitoring different conditions and parameters affecting such indicators, collecting the data, and integrating it in a unified layer accessible by the DSS. It uses implemented services - eDWIN advisory platform including advisory backoffice and Farm Management System interface. eDWIN platform is provided by WODR and PSNC and has developed components and tools for data collection and integration, as well as three benchmarking models. Pilot 2.4 uses FADN data, on the EU and local Polish level. All of this integrated by means of DEMETER AIM interoperability and benchmarking enablers

Feedback From Farmers

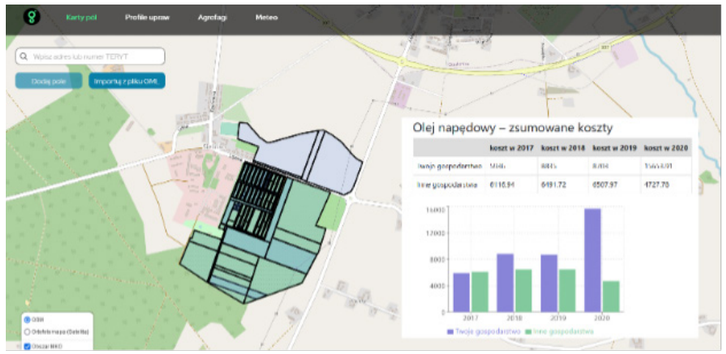
Most farmers calculate the costs and revenues that occur on the farm in a traditional way, i.e. with a paper, a pen and a calculator. According to the respondents, information on agricultural markets is important in farms, which is why most of them are interested in obtaining this information free of charge. Most farmers expressed their willingness to compare themselves with another farm in terms of costs incurred.

Advisors believe that economical data like farms parameters and market information is important in farms and farmers would be willing to take advantage of free information on this topic. Farmers would be interested in comparing their own results with that of another farmer in terms of costs incurred and income obtained, and would be willing to use the information service and selected tools for making calculations and comparisons.

Outcomes

Systems produced in Pilot 2.4 were integrated with a platform in the eDWIN Advisory Platform. Integration is based on the data layer. The user creates its account in the eDWIN platform to aggregate its reference fields data. If a user decides to use a benchmarking module, systems calculate and publish benchmark results to the farms of their region, size, production type and economical type.

The eDWIN platform consists of a number of applications dedicated to farmers, advisors, but also other actors who may be interested in using the data produced within eDWIN. The new one is developed in Demeter benchmarking pilot service.



DEMETER **CLUSTER THREE**

FRUIT & VEGETABLE PRODUCTION

FRUIT & VEGETABLE **PRODUCTION**

FOCUS:

Health and high-quality crops.

This cluster focuses on supporting farmers in protecting the health and the quality of production, focusing on several fruit and vegetables crops in several European countries. The pilots involve the integration of several technologies: existing farming digital platforms, IoT sensor networks, model and Decision Support Systems, remote sensing data and advanced data analysis tools.

LOCATION

Italy and Greece

PARTNERS

3.1 Decision Support System to Support Olive Growers

CHALLENGE

The efficient management of olive orchards requires complex decision-making processes. This is because of the increasing uncertainty and risk associated with olive fruit and olive oil production in a rapidly changing environment. Climate change is adding to erratic Mediterranean weather conditions, soil variability and pest outbreaks.

AIM

The aim of this pilot is to develop and demonstrate a Decision Support System (DSS) for olive tree growers, advisers and agri-food processors to address common issues associated with olive tree growing and olive oil production, including fertilisation, irrigation and integrated pest management (IPM). The DSS integrates in-field sensor data, remotely sensed data, a modelling platform, and a farm management system, combining weather patterns and soil information with crop traits, to foster the sustainable production of olive tree orchards.

HOW

An integrated solution, Agricolus© OLIWES, will be configured and deployed in selected olive tree farms to address different climatic and farming conditions. OLIWES is a cloud ecosystem, which provides the most modern technologies of data collection, analysis, and visualisation, delivered with a user-friendly interface. The functional features of OLIWES include the following areas: i) orchard management; ii) field scouting; iii) forecasting models; iv) Decision Support System. Open protocols and standards facilitate the integration of IoT sensors, interoperability, and data exchange.

BENEFIT

The expected benefits are the following: optimisation of water and nutrient management with data-driven decisions, implementation of IPM solutions and preventive measures through forecasting models, time series analysis of long-term data records and comparison of farmer performances to achieve sustainable crop production and protection.

LOCATION

Italy and Greece

PARTNERS

DEMETER Integration

The pilot has integrated the Agricolus proprietary technologies with a set of components like DEMETER enablers to support farmers in decision making and to improve the possible solution that can be used. The DEMETER enablers integrated are DEMETER Access Control System, DEMETER AIM and DEMETER DEH. Using the components with AIM input and output simplifies the interaction in Agricolus of other components. Moreover, the pilot has also implemented a set of components to elaborate olive phenology using machine learning and calculate olive fruit fly growing degree day. Finally, the pilot has implemented DEMETER Benchmarking tools to give farmers the opportunity to compare their performance with neighbouring farms.

Feedback From Farmers

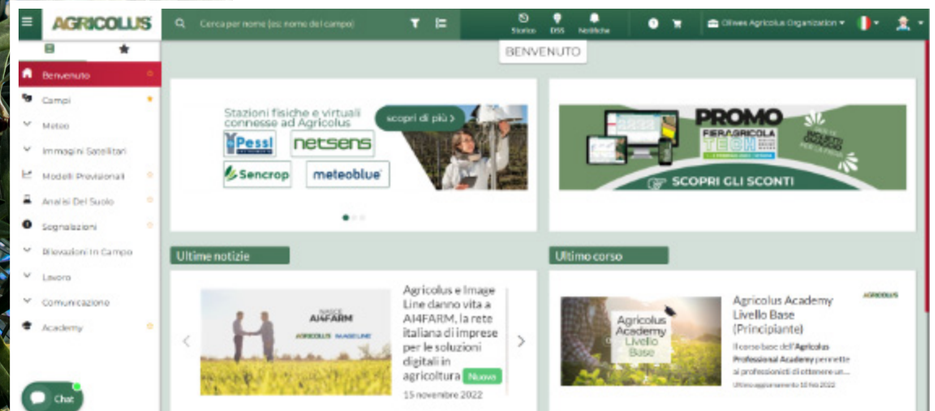
Farmers involved in the pilot project have used Agricolus Oliwes and tested the optimising decision-making process in planning and applying agronomic practices. They appreciated the use of decision support models in particular for tools to support IPM of olive fruit fly and irrigation management. Feedback from farmers was also collected during the project to understand how farmers perceive the use of the tools. Farmers find it useful to reduce the time needed to use the tools. For this reason, the team worked on simplifying access to data and models. In addition, farmers appreciated how Agricolus has provided video lessons to give them the necessary skills and support to use the tool.

Outcomes

This pilot project allowed Agricolus Oliwes to be tested on several farms in the three main olive-growing areas: Italy, Turkey and Greece.

Farmers are given access to these tools and are provided with training in how to operate them. The pilot increased the adoption of this decision support system among farmers, who welcomed its benefits. Agricolus OLIWES helped farmers in improving their decision-making process with a specific focus on integrated management of the olive fruit fly, irrigation management, and fertilisation optimization.

The use of DSS has optimized water and nutrient management, improved the IPM solution and preventive measures through forecasting models, time series analysis of long-term data records and comparison of farmer performances to achieve sustainable crop production and protection.



LOCATION

Portugal

PARTNERS

INESCTEC

INIAV National Institute for Agrarian and Veterinary Research

ubiwhere SUITING THE FUTURE

FENADEGAS ADEGAS COOPERATIVAS DE PORTUGAL Grandes vinhos portugueses

3.2

Precision Farming for Mediterranean Woody Crops

CHALLENGE

Mediterranean Woody Crops have been severally affected by several challenges such as climate change (water scarcity), pests and diseases. Most of the farms specialising in these crops are small, low on profit and technology, and face high labour costs. Furthermore, Mediterranean Woody Crops owned by medium/small farmers have limited access to technology, due to the associated costs, and the low levels of systems interoperability. These farmers need simple, intuitive, and cost-effective technologies to help them overcome the challenges outlined and become more profitable by maximising the use of smart and precision agriculture.

AIM

This pilot aims at promoting technology, methods and IoT solutions to optimise precision farming practices of Mediterranean Woody Crops (Apple, Olive and Grape), considering the small farmers' economic constraints. The proposed solutions (IoT and Ground Robots) will enable a more efficient usage of inputs such as water, energy, macro-nutrients, and pesticides, thus increasing the profits of small farmers and reducing their environmental impact.

HOW

This pilot will promote the use of open-source, plug-and-play, cost-effective and modular technology that can be considered by small holder farmers. The pilot will demonstrate real-time monitoring and control of plants, water supply and nutrients, using IoT sensors and Agricultural Robots on the field for phenotyping. This will also enable precision-spraying and use satellite/aerial imagery for yield potential estimation.

BENEFIT

The implementation of standards-based and interoperable elements will facilitate the exploitation and maintenance of irrigation systems achieving greater efficiencies in water, nutrients and energy savings, with cost effective solutions that can be acquired by small holder farmers.

LOCATION

Portugal

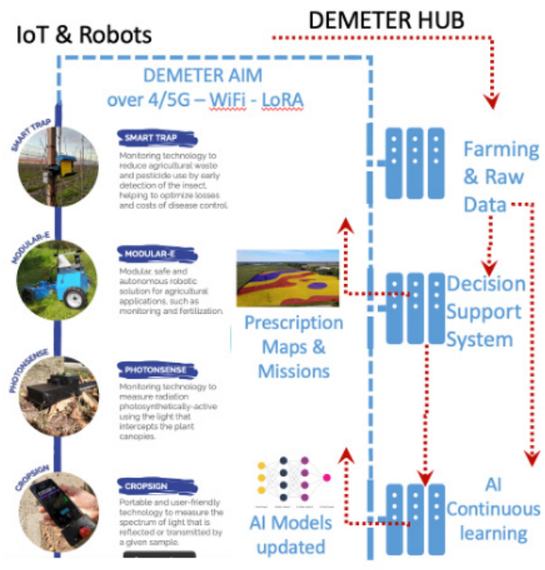
PARTNERS

DEMETER Integration

On the Pilot 3.2, technology developers (INESC TEC and Ubiwhere) have developed and deployed technological solutions (hardware and software) that considers the Agriculture Information Data Model (AIM) on which DEMETER bases its interoperability. Advanced DEMETER enablers are virtualized, deployed and integrated in DEMETER infrastructure by means of the Access Control Enabler (ACS), DEMETER Enabler Hub (DEH) and Brokerage Service Environment (BSE). The results of the processed data are shown to the final user through the Adaptive Visualization Framework Hub (Knowage) and by NodeRed based viewer, that were accessed by end-users (INIAV and FENADEGAS)

Feedback From Farmers

Farmers have reported that the use of SmartTrap, CropSign, and PhotonSense is beneficial for managing crop treatments and reducing treatment costs. They suggest establishing a regional or national network of smart traps to detect diseases earlier, as many disease vectors tend to emerge in the vicinity of crops. However, farmers face challenges in adopting these technologies due to inadequate 4G/5G coverage and high prices. They seek solutions that provide concise information instead of overwhelming them with large amounts of complex data.



Outcomes

All the IoT devices developed, such as SmartTrap, Modular-E, PhotonSense, CropSign, and AgloT4Power, are equipped with smart modules or smartphones that have Edge-AI processing capabilities. This allows them to process the acquired information (raw data) locally and generate pre-processed data. In cases where the AI model exhibits uncertainty in estimation, the raw data is sent to the cloud to support the supervised learning of new Edge AI models.

Furthermore, the IoT devices have the ability to receive prescription maps, missions, or updated AI models from the cloud. These updates can come from Decision Support Systems and/or AI Continuous Learning systems, enabling local usage on the IoT devices. Implementing these IoT solutions has the potential to reduce pesticide usage by up to 30% and achieve earlier pest detection by 3 days.

LOCATION

Spain

PARTNERS

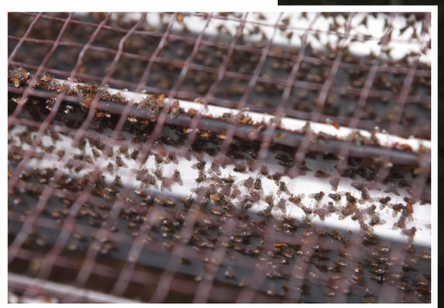
3.3 Pest Management Control on Fruit Fly

CHALLENGE

The Mediterranean fruit fly (Ceratitis capitata) is a dangerous pest for a wide range of distribution and host plants. A key challenge is how to deal with agricultural pests like fruit flies while reducing the use of chemical treatments. Currently traps are used and serviced manually each week. Captures are classified individually in the lab into sterile and wild flies. Sterile male flies are then released into the field to mate with wild females. No progeny will be produced and the wild population will decrease after several generation. However, the manual work involved is costly and time-consuming.

AIM

This pilot aims to optimise the release strategy of sterile male fruit flies by collecting enough field data in an efficient way.



HOW

The pilot will test the use of automatic traps that capture the fruit flies and sensors that detect when insects are inside the trap. The automatic trap will take real-time images of the captures. These images are sent to a server and based on machine learning approaches, the captures will be counted and identified as wild and sterile.

BENEFIT

The main benefit of this pilot project is achieving a more precise method to manage fruit fly control programs. Real-time capture data will allow improvements to be made to the release strategy of sterile males, thus reducing the occurrence of the pest over time. The automatic counting traps will result in a reduction in time, effort and cost associated with servicing the traps. Furthermore, real-time data will be sent to farmer relating to the status of the pest in the field.

LOCATION

Spain

PARTNERS

Tragsa

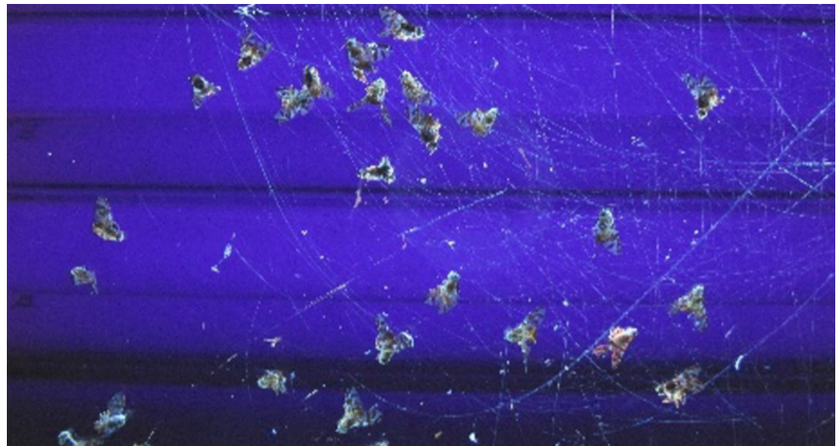
Atos

DEMETER Integration

Pilot 3.3 has benefited from several components developed within the DEMETER project. These advanced DEMETER enablers (Pattern Extraction with computer vision and Pest Estimation with Sterile Fruit Flies) are virtualized, deployed and integrated in DEMETER infrastructure by means of the Access Control Enabler (ACS), DEMETER Enabler Hub (DEH) and Brokerage Service Environment (BSE). The results of the processed data are shown to the final user through the Adaptive Visualization Framework Hub (Knowage) making usage of the Agriculture Information Data Model (AIM) on which DEMETER bases its interoperability.

Feedback From Farmers

Five farmers are directly involved in the pilot, however since the network of automatic traps and the image recognition system developed in the pilot are managed and used by technicians related to the Valencian Council, the indirect impact will be seen by a large number of farmers and owners of citrus crops in the entire Valencian Community.



Outcomes

The solutions developed allow cost savings and a significant reduction in the carbon footprint, preventing each inspector from traveling around 3,000 km per month. In addition, they allow better monitoring, traceability and evolution of the pest, as they will know the times of maximum activity of the flies in the field. This information varies throughout the year and is vital to determine the most appropriate hours to carry out the release of sterile males and other support actions, all with the aim of optimizing the effectiveness of the program for the integrated fight against the Mediterranean fly in the Valencian Community.

LOCATION

Belgium

PARTNERS

3.4

Open Platform for Improved Crop Monitoring in Potato Farms

CHALLENGE

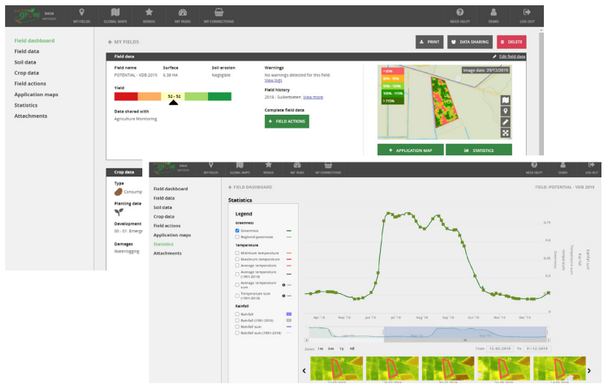
Farmers with large areas of potato fields, spread out geographically over several communities, often suffer from lack of sufficient ground truth data (measured yields, crop variety, exact planting date). This hampers the calibration and validation of crop growth models and the provision of specific advice on field management practices. Early identification of the fields that need extra activities (irrigation, fertilisation) to boost production, and estimating the expected crop yield as a result of these activities, can optimise the farmer's revenues. At the same time, an estimation of crop yield is important for the downstream potato processing industry, securing storage facilities, and accepting purchase orders. However, this data is not always readily available.

AIM

This pilot aims to integrate field machinery data from AVR potato harvesters with remote sensing, meteorological and soil data into the WatchITgrow (WIG, watchitgrow.be) platform, to increase ground truth data. Using detailed data from the machinery in the field (detailed yield information, planting dates), the manually fine-tuned physical crop model can be replaced by a purely data-driven approach using machine learning (ML) techniques.

HOW

AVR Connect is the recently started IoT cloud platform that collects data from the AVR field machinery (potato planters, yield sensors on the potato harvesters) using 4G communication and makes the data available to third parties. Geotagged yield data are collected at a frequency 1Hz, which leads to very detailed yield maps. The data collected via AVR will be used as training data for machine learning models that predict yield based on satellite imagery (Sentinel 1 and 2, Copernicus program), weather and soil data.



BENEFIT

Physical crop growth models need to be manually fine-tuned for every crop type and variety, using ground truth data. The increase in ground truth data (AVR harvesting machines) is expected to lead to better crop growth and yield prediction models, while the conformance to DEMETER standards ensures that the data is discoverable and accessible to third parties that might want to develop their own algorithms.

LOCATION

Belgium

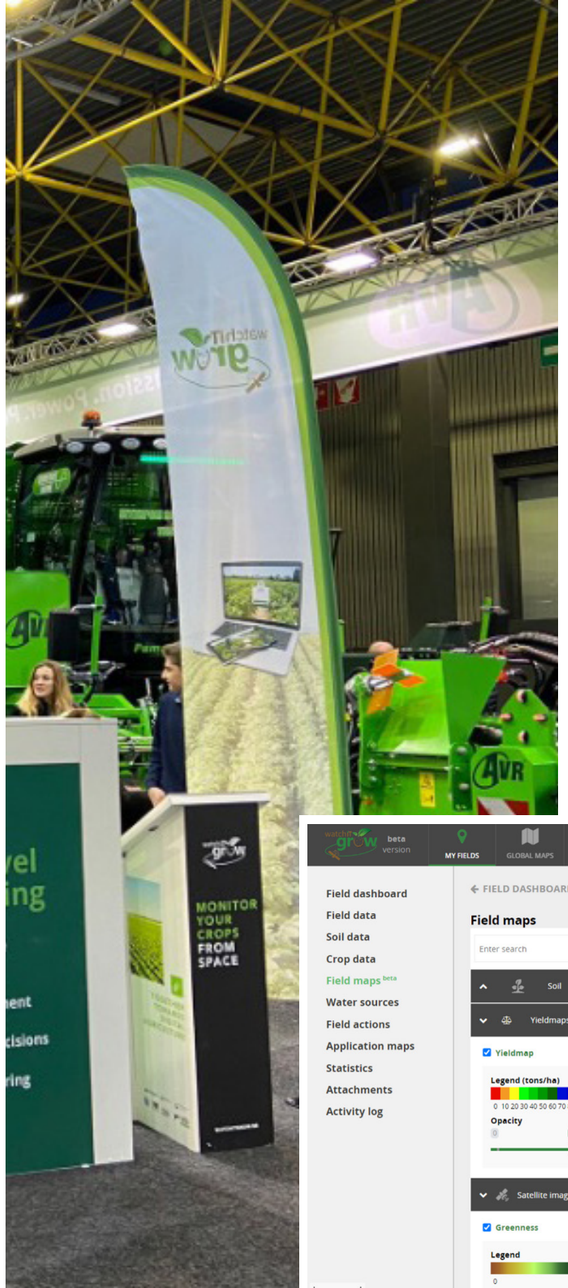
PARTNERS

DEMETER Integration

An automatic and standardized data exchange between WatchITgrow and AVR Connect platforms was set up using DEMETER AIM (Agriculture Information Model) standards. Through WatchITgrow farmers can create task maps for variable rate applications for fertilization or irrigation, making use of DEMETER's "Variable rate" component. The yield data from AVR's potato harvesters are also used to train a yield prediction model for potatoes. Therefore, we used DEMETER's "Plant yield estimation" component. Both components are available in the DEMETER Enabler Hub (DEH), with inputs and outputs defined in the AIM format so that the components are ready for integration in other pilots or other platforms if needed.

Feedback From Farmers

Through the connection of WatchITgrow and AVR Connect digital platforms, potato farmers in Belgium, Northern France and the Netherlands can visualize their yield data and compare them with data from other sources, such as satellites. This way, farmers can gain a better knowledge of their fields. They get an idea of the yield potential of their fields which allows them to better steer the inputs. Thanks to DEMETER, potato farmers can also benefit from more reliable yield predictions for their fields, not only farmers that have AVR machinery, but also other farmers that are growing potatoes in the same region.



Outcomes

This pilot developed a solution to assist potato farmers in using the data they collect, specifically data from harvesting machines, to make well-informed decisions for future field-operations and downstream supply chain actions. Thanks to DEMETER, AVR and VITO were able to connect their platforms (AVR Connect and WatchITgrow), allowing potato farmers to visualize yield data, compare them with satellite, soil and weather data, create task maps for variable rate fertilization or irrigation and get yield forecasts for their potato fields. Together with other stakeholders from the Belgian potato sector, VITO and AVR are contributing in this pilot to the promotion of the use of digital tools for decision-making and help potato farmers in the transition towards sustainable and future-proof agriculture.

DEMETER **CLUSTER FOUR**

LIVESTOCK

LIVE**STOCK**

FOCUS:

Animal Health, High Quality & Optimal Management of Animal Products.

This cluster focuses on supporting farmers for livestock animal health and high-quality production of animal products using farmers' dashboards with AI-based prediction and decision support for animal health and animal products.

LOCATION

Norway

PARTNERS

4.1

Dairy Farmers' Dashboard for the Entire Milk and Meat Production Value Chain

CHALLENGE

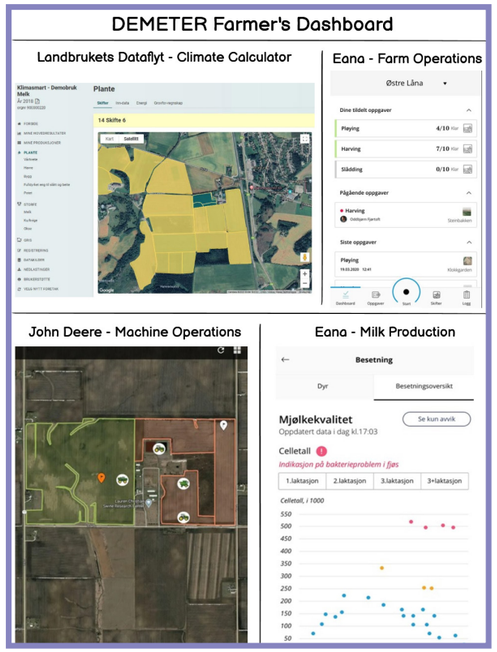
Farmers have to handle an increasing number of digital systems and solutions that affect their daily work as well as production and investment decisions. Today's digital solutions do not communicate or integrate well enough together and are not largely based on the needs of the farmer. In addition, administrative and production systems produce different types of data that is difficult to use for decision support. Thus, the dataflow for farmers is a big challenge and equally an opportunity for business development in the sector.

AIM

The main aim of this pilot is to develop a farmer's digital dashboard delivering a better view or outlook of the farm activities and the farmer's cooperation with both private and public actors. This will ensure a more efficient use of digital tools by the farmer and a better and more customised decision support. In addition over time, the pilot aims to develop a new system for data collection, modelling and calculation of greenhouse gas emissions on farm level, and a new model for milk prognosis that are essential to optimise production in economic terms, animal numbers, milk quality and feed production.

HOW

With regard to the farmers' dashboard element of the pilot, Agricultural Dataflow, pilot partner, will build data infrastructure and models of farmers' dashboard for external suppliers, researchers, farmers and advisors. These are based on the existing dataflow infrastructure that 14,000 farmers use and the systems that are developed in technical parts of DEMETER. In the development process, farmers and related partners and industries in Norway will be involved. New apps and solutions for Norwegian farmers will be launched with easier registration and insight to continuously improve production. The focus from pilot partner, Mimiro is to use data from more than 500 dairy farms with automatic milking systems and apply machine learning techniques to develop algorithms for milk yield forecasting and culling strategy.



BENEFIT

The main benefits of developing a farmer's dashboard are more efficient production and better investment decisions. In addition, there are benefits for related partners with data access and solutions that optimise their production and activities. The pilot is expected to share knowledge and solutions regarding the main decision variables for each farmer and how these variables can be presented in one overall dashboard. It will also give information on how to get system suppliers and partners of the farmers to cooperate and interact, sharing data and web-interfaces. The cost-benefit for the farmer, related businesses and society will be detailed and what business models can be used for the developed tools in the pilot will be outlined.

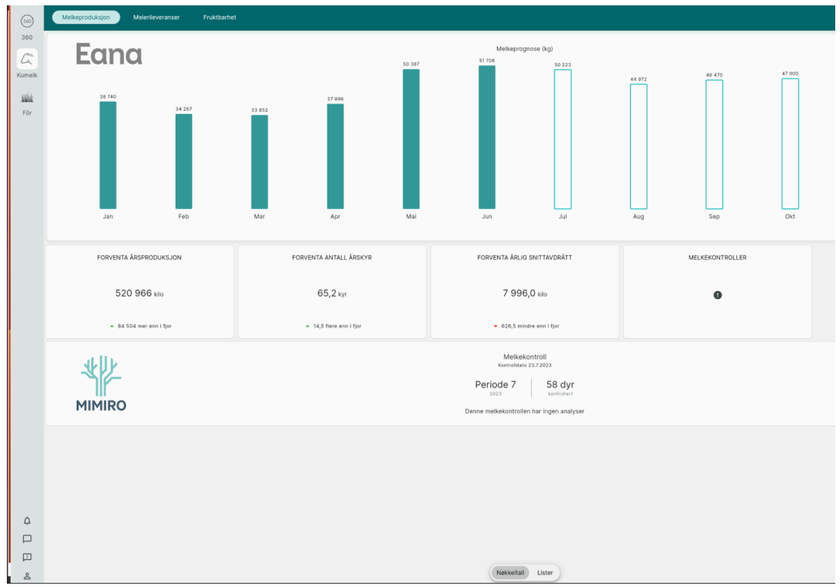
LOCATION

Norway

PARTNERS

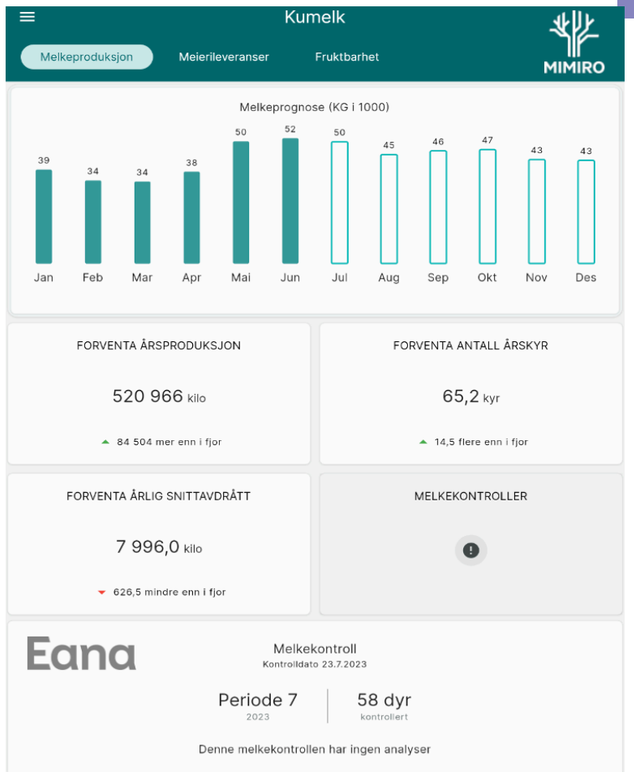
DEMETER Integration

Pilot 4.1 developed a milk prediction solution and a dashboard for farmers that are made available as Demeter enablers. In the work other Demeter solutions are tested and adapted in the final solutions. The AIM ontology is of clear value for farmers to see how they are performing compared to their quota. It is also a building block for a culling assistant in order to simulate herd strategies and optimize production goals. AIM is also of clear value because of how the Farmers dashboard is structured. AIM is also the data format used in the different components that makes up the milk yield prediction tool.



Feedback From Farmers

The milk prediction solution gives farmers more databased support for important but difficult decisions about culling and cow management. Core feedback from farmers is the need to trust the underlying data, it has to clearly represent their perception of the current status. It is also key to give a better understanding of why the prediction looks as it does. When you trust the data, and understand the prediction, you can start use it for simulations. The dashboard is useful and adds something to the existing solution including easy access to an overview and some details such as prices, costs and benchmarking.



Outcomes

The developed DSS for milk prediction is going to be commercialized as part of bigger solution from Mimiro that is currently used by over 6300 farmers in Norway. The developed DSS for Farmers Dashboard gives farmers and their advisers easy access to data in a way that provides relevant overviews and the ability to use the many digital solutions they have more effectively, including new data presentations that are more easily available than before. Landbrukets Dataflyt, with 14000 farms as users of their digital platform today, has great interest in continuing to work further in the direction of a full commercialization of the farmers dashboard, which will allow actors to develop dashboard components, which can be shared with other actors, or kept internally.

LOCATION

Italy

PARTNERS

ENGINEERING

plechnology

MACCARESE

FATTO LATTE SANO ROMA

COLDIRETTI

4.2

Consumer Awareness: Milk Quality and Animal Welfare Tracking Management

CHALLENGE

Many farmers already monitor their animals by using different smart devices which collect data in a scattered way. However, they often miss an overall vision of the most important animal welfare and milk yield indicators. In addition, processing companies are interested in data relating to the milk's quality levels while consumers want more transparency regarding the food they eat. However, data is not exchanged between actors in the supply chain. The challenge is therefore to optimise the flow of this information.

AIM

The pilot aims to integrate the data collected from the breeding farm and from the processing company in order to optimise the flow of information between the actors within the milk value chain. By using open and standard-based technologies, it will allow actors of the milk value chain to get an overview of animal welfare and insights on the quality of milk, that is strictly connected to the health of the animal. The data collected will be acquired by a traceability system, to improve communication between actors right up to the consumer, increasing food liability and trust.

HOW

New wearable devices for animals will be installed and their data will be integrated with data coming from sensors already existing on the pilot farm in order to implement an information flow optimisation and optimise processes. Devices will be installed to allow automatic milk composition analysis and to guarantee the traceability of milk collected. Deployed solutions will adopt standards protocols and DEMETER data formats to enable interoperability.

BENEFIT

The implementation of standards-based and interoperable elements will enrich the overview of the animal welfare and milk yield indicators, easing the extension of the information flow to new data sources and optimising the availability of scattered data in a single access point. This will result in a higher quality of milk and a fairer price for producers. It will lead to greater transparency on milk production and animal health for farmers and processors. For consumers, it will deliver improved transparency on product nutritional values, origins and animal welfare.

LOCATION

Italy

PARTNERS

DEMETER Integration

Pilot 4.2 built a digital ecosystem that optimized the collection, visualization, management, and exchange of a large amount of data, collected through multiple new and existing devices on the milk supply chain by a farm and a milk processing company improving the overall value of the product.

Facilitating the integration between data and systems by using the DEMETER solution and specifically the Agricultural Information Model, the pilot improved animal welfare monitoring, milk quality measurement and, through a blockchain solution, its traceability. This eased the collaboration among the actors of the milk chain and improved consumers awareness on milk origin, potentially increasing their trust toward such widely consumed food.

Feedback From Farmers

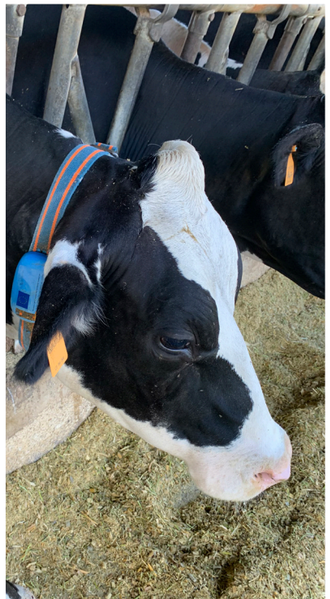
The pilot helped both end-users improving the way they used their data. Maccarese appreciated the unique interface developed, where all data is clearly visible and meaningful, and the flexibility of the solution, adaptable to different conditions and future exploitations. Moreover, thanks to the pilot, the farm realized that its data has an economic value which, so far, has not been carefully considered.

Lattesano, the processing company, highlighted the improvement of its capacities in collecting, detecting, managing, and storing data relevant for monitoring its activities. Lattesano has been enabled to connect in a dispatchable and effective system, with a strong degree of automation, reliability and transparency. They were impressed by the data collected from its milk process and expressed an interest in extending the system across their overall production.

Outcomes

The collaboration of the end-users and the technological providers developed three DSSs which helped the farm to make more informed decisions to guarantee animal welfare, milk quality and productivity; this consequently benefitted the processing company which collects milk from the farm. One DSS was on the animal welfare to evaluate cows' health (no ketosis, mastitis, lameness); one was on the heat-stress the cows are exposed to; and one on milk quality to analyze both raw and processed milk samples. Once developed, the prediction algorithms have been trained and fed and the generated output tested and assessed to ensure its compliance to end-users needs.

From a technological point of view, the information model has been enriched and transformed into AIM; AI algorithms on animal welfare have been integrated with this model and a new dashboard designed and developed using the data visualization tool.



LOCATION

Ireland

PARTNERS

4.3 Proactive Milk Quality Control

CHALLENGE

Traditional farming involved management systems based on direct observation of animals and intuitive decision making by the farmer. Larger animal numbers and reduced available time of the farmer have necessitated changes, potentially resulting in less available time to observe and detect welfare and health issues of individual animals. At the same time, societal expectations are increasing in terms of animal well-being and animal health. Thus, it is necessary to develop alternative mechanisms to predict welfare and health issues.

AIM

This pilot aims to integrate animal behaviour and physiological data into a welfare and health scoring framework with progression to a reference system to increase animal wellbeing standards on dairy cow farms.

HOW

The use of different indicators and technological sensors will enable a large number of measured variables to be recorded, the integration of which information will allow very strong robust prediction models to be established. Biochemical tests will also be conducted to confirm health status. Thus the IoT will be used in establishing a farming system that will (a) predict when an animal is not "functioning" properly; (b) establish a target that e.g. 95% of cows had no significant issue throughout their lactation; and (c) satisfy claims of the wellbeing of animals.

BENEFIT

The development of such a system using precision technologies will provide real benefits in profitability and an improved system by providing informed, real-time solutions to the farmer. Such solutions will be delivered in ways that are comprehensible to the farmer. The pilot will result in improved dairy cow health and well-being through an early warning system, meaning early intervention during health/welfare challenges. Documentation, enabled by data capture, analysis and record keeping developed in the pilot will allow transparency in animal health and welfare status and management on-farm. It will also help achieve national objectives around continuous quality assurance and better welfare standards for cattle.

LOCATION

Ireland

PARTNERS

DEMETER Integration

Pilot 4.3 used three key technologies in the project. The SMARTBOW was a commercial ear tag that allowed the monitoring of dairy cow behaviour including rumination, activity and lying behaviours. A key innovation was development of a novel sensor or point-of-care test for determining milk analyte concentrations with the potential to allow the identification of cow health conditions in early lactation. Individual animal health data were also recorded by farm personnel using the Uniform-Agri database. UNIFORM-Agri was a commercial platform that allowed the recording of animal health problems, treatment of health issues, body condition score, and milk production data.

Feedback From Farmers

The key engagement was with the farmer on whose farm the 'proof of concept' data was collected. While this farmer successfully used milk recording data and behaviour data, cow health conditions were not observed to influence the milk analyte concentrations in the biosensor. As this was to be a key data source for the solution, it was not possible to engage with a large group of farms on the biosensor. Also, the digital behaviour sensor was discontinued during the project and thus proved difficult to install on farms. However, engagement with the farmer community and other stakeholders has taken place by sharing our work through social media, blog articles, external presentations, and conferences.

Outcomes

One outcome may be represented through knowledge acquisition of a new technique to create multiplex electro-chemical sensors using milk and blood as substrates. Relationships between milk biomarkers and extra-mammary health conditions were not observed in this study, but a second outcome, in the form of scientific knowledge has been accumulated on different milk markers which can aid in progressing the use of milk for prognostic and diagnostic purposes. A further outcome can relate to the partner, Zoetis being in a position to potentially benefit by new commercialisation opportunities in this space in the future, including the potential application of the milk biosensors to other biomarkers of interest.

LOCATION

Serbia, Slovenia and Montenegro

PARTNERS

4.4 Optimal Chicken Farm Management

CHALLENGE

Growing food demand has increased the need for animal protein. This need currently exceeds the demand by 1.7% per year, resulting in global annual poultry production reaching over 103.5 million tons (Foreign Agricultural Service/USDA, Livestock and Poultry: World Markets and Trade). To meet growing demands, poultry producers need to improve production to allow them to produce enough high-quality meat while respecting animal welfare.

Chicken farms in general do not have integrated farm management systems that can provide a holistic view of the farm activities. In many cases, partial solutions exist, enabling farmers to see raw measurements indicating the current temperature, humidity etc. using sensors provided by vendors of the farm equipment (e.g. Big Dutchman, Fancom, etc.). Usually, these measurements are available on-site only, thus limiting their usability. Additionally, rather frequent infrastructure problems, especially on smaller farms in rural areas, are a source of potentially huge losses for the farmer. These problems include ventilation not working, feeders not running, electricity issues, etc.

AIM

This pilot focuses on poultry farm management, from providing guidance and support regarding biosafety and feed mixture preparation to continuous monitoring of environmental conditions, operations and animal welfare. It also focuses on creating a transparent supply chain sharing information about animal wellbeing and the resources used during production.

HOW

DNET's poultryNET platform is used as a basis for achieving the main functionalities for the pilot. A number of IoT devices are installed and integrated with already existing sensors on the pilot farms. These include IoT devices for measuring environmental conditions (air temperature, air humidity, CO_2/NH_3 level) and for recording chicken behaviour and vocalisation. The devices collect the data, that are later processed and analysed on the cloud to provide real-time alerts and instructions to farmers. These include advice on activities to be undertaken in order to optimise growing conditions and early-detect stress issues, created by using expert modules and analysis. The deployed solution is improved and extended using DEMETER defined APIs and data formats to enable interoperability with other DEMETER components, services as well as 3rd party systems.

BENEFIT

The pilot will deliver a complete insight into the whole poultry production process such as production costs optimisation, better product quality and improved animal welfare.

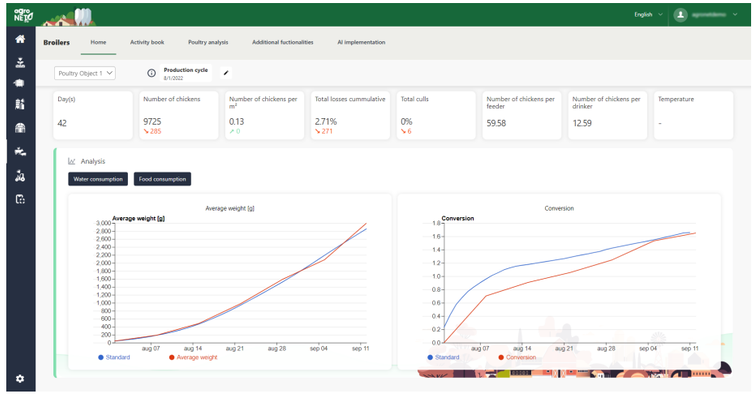
LOCATION

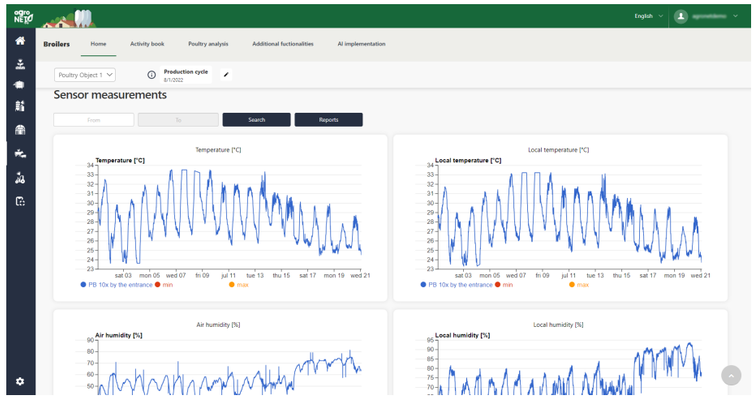
Serbia, Slovenia and Montenegro

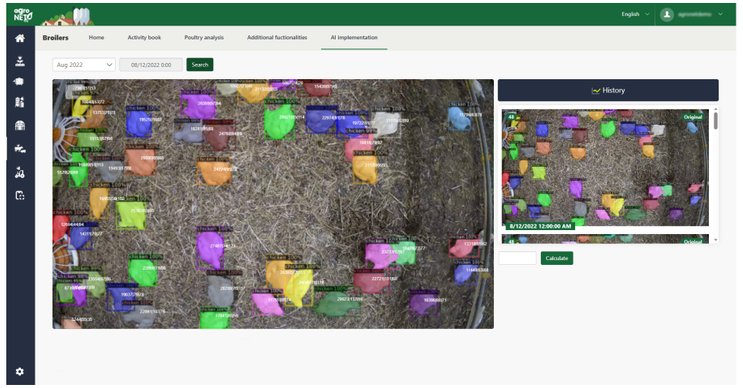
PARTNERS

DEMETER Integration

To facilitate decision-making, the proprietary service poultryNET was used. To enhance interoperability with other systems and maximize the value provided by poultryNET, the DEMETER AIM information model has been integrated. The poultryNET modules for Poultry Well-being and Poultry Feeding have been specifically adapted and made available as DEMETER enablers. Alongside these enablers, a visualization front-end based on the DEMETER Adaptive Visualization Framework has been developed. This integration empowers the system to assess the overall stress levels of the chickens by leveraging environmental measurements, as well as video recordings. By utilizing the DEMETER integration, the poultryNET platform is able to leverage the power of advanced data analytics and visualization, providing poultry farmers with valuable insights and actionable recommendations.







Feedback From Farmers

Farmers participating in Pilot 4.4 reported significant improvements in reducing manual labor, lowering mortality rates, and achieving improved feed conversion ratio. Using cameras and IoT sensors, enabled comprehensive monitoring of environmental conditions, while machine learning algorithms were updated to track poultry weight and behavior patterns. Real-time monitoring of environmental conditions allowed on-time reactions that provide optimal conditions for raising chickens resulting in decreasing losses and optimization of inputs. Additionally better labour management was reported as well. These benefits not only increased profitability but also contributed to a more sustainable and efficient production process. All pilot farmers expressed their intent to continue using the digital solutions beyond the project, highlighting the value it brings to their poultry production.

Outcomes

The Optimal Chicken Farm Management solution empowers farmers with clear and concise data, enabling them to make informed decisions and optimize their poultry farms management. The main outcomes of the pilot are:

- Fully validated solutions with implemented interoperability mechanisms and an expanded feature list,
- Improved poultry farm management based on validated decision support service,
- Established new partnerships,
- Better understanding the needs of all stakeholders in the value chain.

DEMETER **CLUSTER FIVE**

SUPPLY CHAIN

SUPPLY **CHAIN**

FOCUS:

Full supply chain,
Interoperability.

The goal of this cluster is to run pilots across several sectors (fruit, vineyards, cattle, poultry) and to address both supply and demand sides of the supply chain. Such an approach will enable validation of the interoperability of platforms and solutions used in different sectors as well as to validate interoperability of platforms used for management of on-farm and post-farm (supply chain) activities.

LOCATION

Serbia, Montenegro, Georgia and Slovenia

PARTNERS

5.1

Disease prediction and supply chain transparency for orchards/vineyards

CHALLENGE

Pest and disease appearance as well as their spread is one of the main problems in fruit and grape production. Disease control is usually based on experience instead of hard facts, although prediction models are available. However, these models often provide only general instructions instead of precise advice for each user. Additionally, there is a lack of easily accessible traceability data for consumers who would like to know which pesticides and other products their food has been treated with.

AIM

This pilot focuses on complete farm management in vineyards and orchards, providing pest and disease management tools to optimise pesticide usage and increase crop quality. Furthermore, pesticide usage data is collected and stored to enable a transparent supply chain.

HOW

The DNET agroNET platform is used to provide decision support in pest and disease management to farmers, as well as collecting data through the whole supply chain and providing the relevant information to each stakeholder. agroNET gathers information about pesticide usage from Pulverizadores Fede cloud-connected smart sprayers, thus being able to provide the data to be incorporated into the product passport.

IoT devices are deployed and information from Pulverizadores Fede sprayers is integrated to collect knowledge about the environment, spraying cycles, and data directly from field and machines. Throughout the pilot, data are collected, processed and insights generated, providing instructions for farmers in real-time. A blockchain-based data exchange protocol (OriginTrail) is used to ensure trust and transparency between actors and the integrity of the data exchanged in the value chain. The service provides pest and disease control in orchards and vineyards in different regions by using digitised prediction models and cloud connected sprayers.

BENEFIT

The pilot will result in pesticide usage optimisation, leading to a decrease in costs and an increase in the quality of the various fruits and grapes. It will also deliver a trustworthy supply chain based on collected information from all stakeholders.

LOCATION

Serbia, Montenegro, Georgia and Slovenia

PARTNERS

DEMETER Integration

A range of IoT devices were used to collect relevant parameters providing inputs in expert modules resulting in decision support to farmers in irrigation, pest and disease management. agroNET platform developed by DNET was used as a main decision support system across all deployments in vineyards and orchards, providing data visualization and easy to use instructions to the farmers. Integration with FEDE sprayer enabled automation in pesticide application. Also, integration with additional proprietary platforms (Product Passport, fleetNET, DKG) through DEMETER AIM as the main information model, provided a basis for supply chain transparency. APIs facilitated interaction between the platforms, while the AIM and Semantic Mappings played a crucial role in remodeling information from IoT sensors.

Feedback From Farmers

Farmers participating in Pilot 5.1 shared their satisfaction by using digital solution in everyday practice. They highlighted the benefits of having real-time insight into environmental parameters and decision support for irrigation optimization and pesticide usage resulting in costs decreasing, better farm management and less environmental footprint. Furthermore, farmers expressed their willingness to share relevant information with end-users, thereby fostering supply chain transparency. This feedback showcases the tangible benefits and value that the digital solution brings to farmers, empowering them to enhance their agricultural practices and sustainability.

Outcomes

By utilizing expert modules for pest and disease prediction, pesticide usage has been reduced. The irrigation expert module has optimized water usage, conserving this valuable resource. Furthermore, the pilot has improved supply chain transparency by introducing QR codes on wine bottle labels.
The main outcomes after successful use of the solutions are:

- Fully validated current digitized prediction models in grape/apple production,
- Established new partnerships,
- Increased awareness of the end-users' communities,
- Developed a basis for establishing new business models based on the data sharing between different stakeholders.

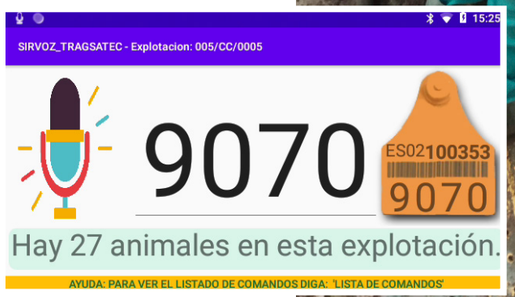
LOCATION

Finland and Spain

PARTNERS

5.2

Farm of Things in Extensive Cattle Holdings



CHALLENGE

Current production environments for dairy and related products suffer from problems in relation to the lack of information from farms about animal well-being, crop and soil properties, inaccuracy of animal details such as animal identification and lack of transparent production processes.

AIM

This pilot focuses on improving animals' well-being and health in dairy farms, and how this can affect the quality and information of processed products, also considering cereals and eggs as raw materials. This pilot also considers the collaboration of farmers and end-user involvement in quality testing and feedback provision.

HOW

The problem is approached from the following perspectives: (i) ensuring the optimal feeding of cows by managing animal wellness and measuring crops and soil properties (irrigation, need for fertilising), (ii) improving the production management in a livestock farm integrating new technologies into the daily operations, (iii) integrating data brokering solutions in current production systems of dairy products and pastries, and (iv) end-user feedback management. New technologies such as sensor and surveillance systems as well as new software on smart glasses and a smart watch will be implemented.

BENEFIT

The project will result in production costs optimisation, better product quality, improved animal welfare, better farm work organisation and reliable traceability through animal identification and livestock management. Also, it will increase end-user involvement by allowing feedback on items such as recipes, ingredients and more.

LOCATION

Finland and Spain

PARTNERS

DEMETER Integration

The three use cases that compose Pilot 5.2 have successfully integrated their solutions with DEMETER. Key technologies used include smart glasses to obtain animal data, IoT platforms (AFarCloud Middleware, FIWARE Orion Context Broker and QuantumLeap) and sensors to monitor soil, grass digestibility and environmental conditions. The integration of these technologies was carried out through the DEMETER core enablers, i.e., Agricultural Information Model, Semantic Mappings to AIM, Data Management and Data Preparation & Integration.

Regarding service discoverability, the DEMETER Enabler Hub, the Brokerage Service Environment and the Access Control System enablers are being used. The DEH Client enabler is used to monitor the metrics of components. Finally, the Benchmarking enablers offer an assessment on the farms' productivity compared to other farms.

Feedback From Farmers

Concerning UC#1, the Farmer Collaboration Tool (FCT) has been successfully used during the 2023 harvest in the Kotipelto farm, to monitor activity in the fields and instruct workers in 6 vehicles. The real-time monitoring of the tractors and the degree of performance of the tasks was a highly valued feature since it allows workers to better plan next phases.

The veterinarians and farmers participating in UC#2 highlighted the usefulness of the tools developed. Veterinarians can check livestock in an easier and more comfortable way, reducing errors and time spent.

End users in UC#3 provided feedback related to integrating data brokering solutions into today's bakery production systems. DEMETER ecosystem provides tools to ensure that quality information on primary products is present and can be used in agreements and contracts with food providers.

Outcomes

The FCT allows farmers organize harvesting activities efficiently, considering data collected from diverse data sources (robots, open weather stations, ISOBUS devices, sensors) using a DEMETER ecosystem. Three ad-hoc enablers have been developed to foster the interoperability with the AFarCloud smart farming community, two of them for data transformation and integration, and another one to adapt AFarCloud data to the DEMETER Adaptive Visualization Framework (AVF).

LOCATION

Poland

PARTNERS

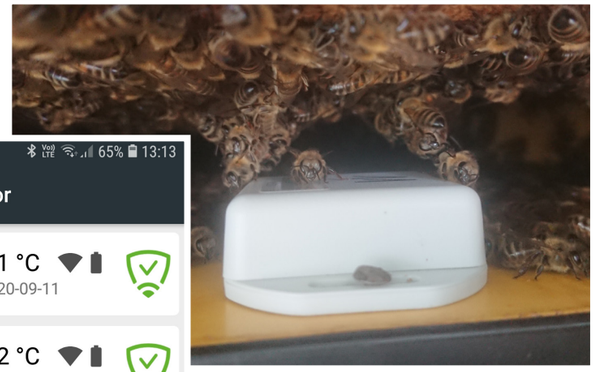
5.3 Pollination Optimisation in Apiculture

CHALLENGE

Honeybees, mainly Apis mellifera, remain the most economically valuable pollinators of crop monocultures worldwide. Yields of some fruit, seed and nut crops decrease by more than 90% without these pollinators (Klein, 2007). Thus, pollination is the highest agriculture contributor to yields worldwide, contributing far beyond any other management practice (Why bees matter, FAO, 2018). The challenge is to protect the honeybee to ensure pollination services for crop production. However, there is a lack of detailed information regarding the field saturation of pollinators and a lack of integrated control on pollination.

AIM

This pilot aims to develop and provide a service for pollination optimisation. The service will connect farm management systems and apiary management systems with advisory and decision support services. The goal of the integration of different agriculture systems is to enable better communication between farmers and beekeepers, to protect bees and to optimise pollination of crops with the aim of improving their yields.



HOW

In this pilot, the eDWIN[1] Virtual Farm is connected with the apiary management system, ControlBee, to manage beekeeping information, including apiaries and farming activities like planned sprayings (based on the information from farmers). Existing systems will be improved with new functionality, enabling collaboration without needing to use a new system. Moreover, as part of the project, existing sensors will be improved, and new apiary sensors are developed to allow remote monitoring of mobile apiaries.

BENEFIT

Benefits will include improved yield and quality of crops for farmers and better gains for beekeepers. It will also deliver better control and management of pollinators and result in better communication between farmers and beekeepers (e.g. notification of the start of flowering of plants). Using DEMETER enhanced services will enable easy integration of the apiary management system with multiple and potentially different farm management systems.

[1] eDWIN is a nation-wide farm management IT system for plant protection, being developed as part of a national project in Poland.

LOCATION

Poland

PARTNERS

DEMETER Integration

Pilot 5.3 integrates several technological components to optimize crop pollination by honeybees. One of the key DEMETER enablers used by the pilot solutions is EstimateBeehive which is a domain specific enabler that provides an estimated number of beehives required to optimally pollinate a crop field. Moreover, the pilot adapts the AIM model together with data preparation and integration enablers to enable semantic mapping of data between Pollination Optimization Service and the systems it integrates (ControlBee, eDWIN and EstimateBeehive). Finally, core DEMETER technical components and enablers such as: SOCS, DEH, BSE and ACS are used to enable sharing information about the pilot activities, partners and services/endpoints with providers and consumers of other components in DEMETER ecosystem.

Feedback From Farmers

Farmer and beekeeper communities have been engaged in the pilot since the beginning of the project. The first interactive workshop conducted in January 2020 involving both groups allowed to identify the end users' needs and define the expected scenarios of the pilot solution. Very valuable feedback to the pilot requirements has been provided by the pilot surveys conducted in 2020 among 68 beekeepers and 447 farmers. They verified the interest in the planned functionality, helping to define requirements and priorities for the development of the pollination optimisation service. Moreover, individual beekeepers, farmers and agriculture advisors were involved in providing data, collaborative design, development and testing of the solution and its components by participating in workshops, interviews and meetings.

Outcomes

The pilot provides a digital solutions for beekeepers and farmers to support the optimization of pollination by honeybees that consist of the following digital innovations:

- an improved IoT system for remote monitoring of apiaries (ControlBee) to better supervise apiaries set up in farmers' fields for pollination purposes, as well as monitor hives and bees' welfare during the wintering,
- a working prototype of a Pollination Optimisation Service
- a communication mechanism connecting farm and apiary management systems supporting collaboration of farmers and beekeepers, integrated with national farm management and an advisory system for farmers and apiary management system,
- a more pollinator friendly farming system - thanks to the integration with the pollination optimisation service the eDWIN WG farming system promotes more pollinator friendly agricultural practices.

5.4

Transparent Supply Chain in the Poultry Industry

LOCATION

Serbia, Slovenia and Montenegro

PARTNERS

DNET Labs

AGRIFOOD

UDG

tracelabs

AGROPRODUKT ŠINKOVIĆ

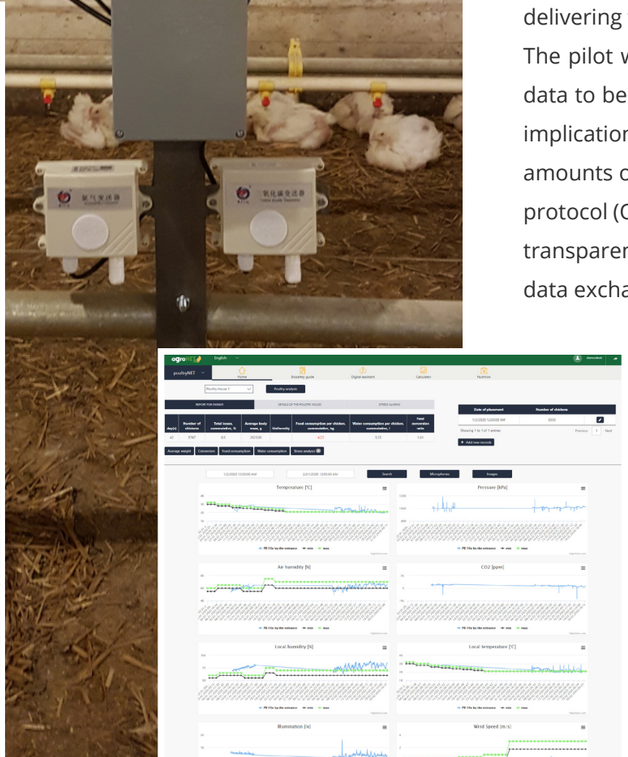
CHALLENGE

The supply chain in the poultry industry is well developed with several stakeholders involved. However, there is a lack of information about chicken wellbeing, medical treatment, feeding patterns etc., which is required by stakeholders, especially consumers. Even if some of this information is available, it is isolated and lacks an integrated overview of the complete supply chain, from the breeding process to retail and consumers.

Providing insights into the whole meat production process including information from all the involved stakeholders is a key challenge. Information about each step of chicken production, from feed intake, medical treatments, conditions provided during the production, resources used, feed origin etc. must be collected and recorded, enabling a transparent supply chain.

AIM

This pilot focuses on the supply part of the poultry industry. It will enable information sharing about animal wellbeing and resources used during production, thus creating the basis of a transparent supply chain.



HOW

DNET's poultryNET platform will be used for gathering data from the breeding process perspective, including the amount of feed. Inputs and feedback from the farmer will be used to improve and validate the functionality. The outputs of poultryNET will be combined with information provided by fleet management systems from transport companies delivering the feed and transporting chicken.

The pilot will investigate the required granularity of data to be collected, its lifespan, as well as technical implications of processing such potentially large amounts of data. A blockchain-based data exchange protocol (OriginTrail) will be used to ensure trust and transparency between actors and integrity of the data exchanged in the value chain.

BENEFIT

The pilot will deliver increased transparency of the complete supply chain, providing trustworthy information to consumers about the production process.

LOCATION

Serbia, Slovenia and Montenegro

PARTNERS

DEMETER Integration

Pilot 5.4 integrates various solutions to address the challenge of limited information across the poultry industry's supply chain. Key technologies employed include poultryNET platform for data collection, fleetNET for animal transit information, Product passport for standardized production batch identities, and OriginTrail DKG for trust, transparency, and data integrity. By utilizing OriginTrail DKG, the pilot enhances the trustworthiness and transparency of data exchanged in the value chain. Integration efforts focus on elements and parameters that represent production batch quality and leverage the AIM standard for data collection and processing. The product passport solution, with unique item-level identifiers and Knowledge Assets on the OriginTrail DKG, enables traceability and consumer access to supply chain information.

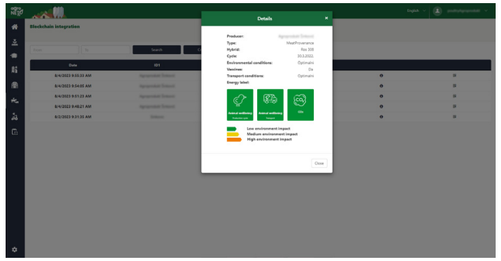
Feedback From Farmers

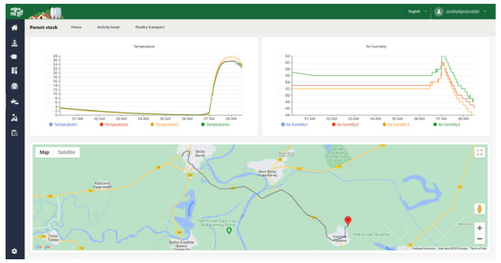
Pilot 5.4 engaged with farmers through Multi Actor Approach (MAA) activities, including meetings, workshops, and farm field days. Farmers expressed their satisfaction of the solution and even decided to expand the application of the solution on their farms. Their input highlighted the importance of monitoring environmental conditions during chicken transportation one day and ensuring data transparency throughout the supply chain. The solution helped them to decrease losses during transportation and provide transparency to relevant stakeholders.

Farmers found the solution to be very useful when sharing specific data gathered through the production line to relevant stakeholders. They see it as a tool to outline their skillset and also as a means to improve their production and transportation process.

Outcomes

The main outcomes include validated solutions that ensure transparency in the supply chain and automate activity recording, making reporting to stakeholders easier. With these solutions, consumers can now access crucial information about the breeding process, resource usage, and the treatment of chickens. Moreover, farmers can efficiently manage the entire process, providing transparency to important stakeholders such as broiler producers, slaughterhouses, and consumers.
Moving forward, further plans involve expanding user adoption, continually improving based on feedback, and utilizing the solution's adaptability and compliance with industry standards.





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European Commission

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 857202.