DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

# FIRST SET OF PRACTICE ABSTRACTS

## SEPTEMBER 30, 2020


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DESIRA receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818194.

# D1.4 – First set of Practice Abstracts

| | |
|---|---|
| **Project name** | **DESIRA \| Digitisation: Economic and Social Impacts in Rural Areas** |
| **Project ID** | 818194 |
| **H2020 Type of funding scheme** | Research and Innovation Action (RIA) |
| **H2020 Call ID & Topic** | H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas |
| **Website** | www.desira2020.eu |
| **Document Type** | Deliverable |
| **File Name** | FIRST SET OF PRACTICE ABSTRACTS |
| **Status** | Final |
| **Authors** | *(see cover page)* |
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# INTRODUCTION

This document provides the first set of 50 practice abstracts (PAs). Those have been compiled building on the collected digital tools and projects in WP1 activities, task 1.2 “Taxonomy and Inventory of Digital Game Changers”.

Each PA describes a digital tool or project in both textual and tabular forms, and highlights the distinctive key elements. In the first page, a short summary is presented, *i)* providing a short description of a tool or of the experience in a project, *ii)* highlighting the main achievements, results, or outcomes, and *iii)* outlining the plausible positive or negative impacts. Such a description is provided in both textual and tabular form, the latter prepared according to the format defined in the report D1.3, section 5. The table presented therein summarizes the key elements useful to provide an overview of each digital tool from both technological and socio-economic aspects. Both aspects build upon the use of the toolkit proposed in D1.3, and comprising the identification of the function of the digital tool, the reference application scenario, the high-level description of the CPS layers conceptually in use, the core digital technologies exploited by the digital tool, and finally the qualitative evaluations of plausible areas of socio-economic impacts.

The aim is in providing descriptions relevant for practitioners in a plain language, pointing out key elements that may attract their interest.

# 1. Rural4learning

*Fabio Lepore (UNIPI)*

Rural4Learning is a project promoted by the Italian Ministry of Agriculture that communicates rural development policy to young students. Through the involvement of enterprises that work sustainably and innovatively, the project aims to share successful experiences and transfer information on these issues to the next generations. A web platform allows registration and user participation, and hosts a database of case studies and companies involved.

The aim is to increase awareness of these issues through specific training. In this way, European agricultural policy is enhanced through the dissemination of values and results. This initiative is recognised as a school-work activity and therefore brings young students closer to the world of work. An important result is the strengthening of the link between school and university, territory, and enterprises.

**Application scenario**

Rural domain: training and promotion of knowledge to students.

**Digital technologies**

Web platform and online lessons.

**Socio-economic impact**

- Economic: Collaboration with companies that can benefit from the results obtained.
- Governance: Promotion of entrepreneurship and youth employment.
- Social: Promoting sustainability practices and creating a new and more aware generation.

**More info:** http://www.rural4learning.it/site/

The main added value of this technology is that the online platform enables distance learning and reaches a high number of end-users (though several practical project activities take place in the enterprise). Moreover, the training does not only concern the students, but also the teachers, who can modify their lessons according to the sustainability footprint.

# PURPOSE OF THE TOOL

This tool is a project promoted by the Italian Ministry of Agriculture, which aims to provide a useful platform to communicate rural development policies and opportunities of European funds to young university and *Istituto Agrario* (Agriculture Schools) students. This tool also allows the sharing and transfer of experiences and knowledge between actors in the world of work. Its aim is to promote sustainable growth through the training of new generations and the improvement of development models, taking into account good rural development practices and by achieving a replicable model.

# DESCRIPTION OF THE TOOL

This project is composed of two initiatives. “Rural4University” is dedicated to university students. The specific training concerns the themes of sustainability and innovation. The activities are organised in three different steps: RuralLEARN (training - in-presence and online - with exercises, analysis of technical documents and exchange of opinions with the people involved at the Community level), RuralCAMP (field activities in enterprises that adopt sustainability and innovation practices, through visits and practical workshops), and RuralLAB (a business laboratory for the exchange of opinions and experiences with entrepreneurs and professionals).

“Rural4School” is dedicated to students and teachers of Agriculture Schools. The specific training concerns rural development policy. This initiative is recognised as a school-work activity and aims to strengthen the links that make up the network composed by school, territory, and enterprises. The activities are organised in three different steps: RuralGOOD (educational seminars on RDP and study visits), RuralLEARN (online training), and RuralCAMP (innovative territorial systems).

The project uses an internet platform. Besides the possibility to register, there is a database with the case studies, the companies involved in the project, and the work done so far.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Promoting the concepts of sustainability and innovation to new generations. Creation of a new class of more aware future researchers and entrepreneurs. |
| **Economic** | The results of the laboratories are given to enterprises, which can also assess the benefits that rural development policy can offer. |
| **Governance** | Promotion of youth entrepreneurship, professional training of teachers, and improvement of the efficiency of youth employment policies. |

# 2. LUDA.FENCEALARM: a smartphone application for monitoring electrified fences

*Fabio Lepore (UNIPI)*

This tool monitors the electrical voltage in electrified fences for the containment of farm animals. A device is connected to the metal wire of the fence and the voltage values are transmitted (via integrated SIM card) from the instrument to an application on the farmer's smartphone that receives an alarm in case of anomalies (voltage change). It can be used where GSM coverage is present, and measures the voltage values, returns graphs, and alerts the farmer of the voltage drop.

**Application scenario**

Agricultural domain: livestock and herd management on the farm.

**Digital technologies**

App for smartphone connected to a monitoring device on electrified fence.

**Socio-economic impact**

- Economic: Better management and time-saving.
- Environmental: Less use of vehicles for control, therefore lower emissions.
- Social: Increased efficiency of animal containment (reduction of damage and litigation).

**More info:**

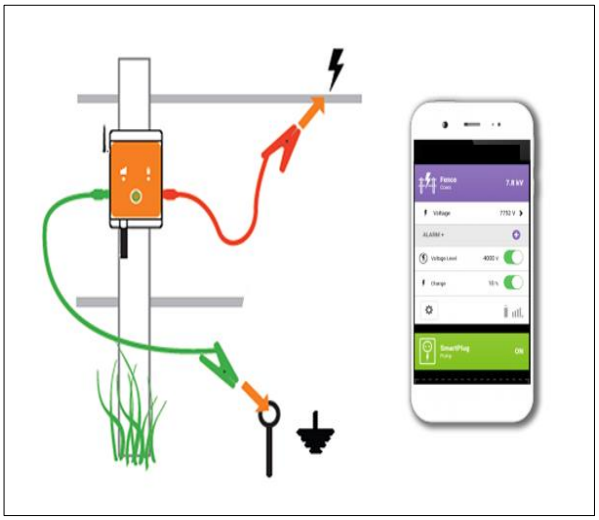
https://www.luda.farm/product/luda-fence/

The added value of this digital technology is that the system immediately alerts the farmers about the problem. In this way, they can intervene much more quickly, preventing animals from escaping or predators coming into contact with the herd or flock. Economic and management efficiency is also improved, as the risk of problems related to the malfunctioning of the fence is reduced. Maintenance becomes easier, as the farmer does not have to waste time inspecting the fence every day looking for problems that may compromise its effectiveness.

The system is easy to use and costs about €200. The farmer is alerted in case of a low battery (the battery has an autonomy of approximately 2 months and the system works with a constant 220 V or 12 V power supply) and the monitoring is continuous. The alarm system has a cost of €5 per month (the first 12 months are already included in the purchase price).

# PURPOSE OF THE TOOL

This instrument is used to automatically monitor the voltage in electrified fences. This type of fence is used to control domestic and wild animals and is equipped with metal wires in which electricity passes. For various reasons (e.g. grass growth, falling trees, rain, contact with animals), there can be a voltage drop (due to current leakage). As a result, the efficiency of the fence can be compromised. The tool, thanks to the connected app, allows the farmer to view this information directly on his or her phone. The app alerts them with a phone alarm in case of a sudden power failure and it can also provide graphs.



Source: Luda Farm

# DESCRIPTION OF THE TOOL

The application is included in the monitoring device. It can be used where there is GSM coverage, and it is available for Android, Mac, iOS, and Windows. The monitoring device is equipped with a series of elements that are connected to the fence (battery charger, cable with clamp connectors, and ground terminals). The measured voltage is transmitted from the system to the application via an integrated SIM card. The farmer can check the status of the fence remotely on his or her mobile phone at any time, and thanks to the voltage graph they can also see whether the voltage drop is due to, for example, animals or grass or rain. This allows maintenance to be carried out promptly, without wasting time and avoiding the escape of animals.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | The containment of animals is important to protect the cultivated fields of the farmer's neighbours. The advantage of this system is the timeliness with which a fault can be repaired, avoiding problems/contentious issues. |
| **Economic** | It improves the management of the farm and the pasture, through the efficient monitoring of an important farm tool (the electrified fence), allowing timely maintenance and avoiding the escape of animals, an important farm asset |

| | |
|---|---|
| **Environmental** | Through the notification, the farmer intervenes when it is necessary. They do not have to get around (in car or tractor) to check the fence every day, so emissions are avoided. |

# 3. Ritchie Beef Monitoring Unit

*Claire Hardy, Hutton*

The Ritchie Beef Monitoring Unit is a weighing crate that allows individual animal weights to be recorded automatically. This allows an average daily weight to be calculated for individual animals without handling the livestock, thereby reducing stress for both the livestock and handler. Cattle weights are recorded, along with their individual tag numbers (Electronic ID tags), each time they step into the crate to access water. The weight data for each animal is stored on the cloud. Average daily weights are calculated and made accessible for the stockman via the website or app. The use of solar panels to provide power for the unit further reduces costs and environmental impact. The unit is easy to install, relatively mobile and requires little maintenance. The website and app ensure the data is processed, so no training or new skills are required before the unit can be successfully operated.

**Application scenario**

Monitoring and logging average daily cattle weight for individual animals. Performance control and early identification of disease, nutrition and management issues

**Digital technologies**

EID tag reading, weight recording, cloud-based data management, software interface, website, mobile app

**Socio-economic impact**

- Economic: Optimal weight at slaughter, weight control improving economic returns, reduced labour costs
- Environmental: Reduced feed and bedding, early detection of potential health problems reducing administration of medicines including antimicrobials
- Social: Reduced stressful labour handling tasks, improved herd management

**More info:** https://www.ritchie-d.co.uk/product/details/211

Average daily weights for cattle allow the stockman to monitor cattle weight gain and performance. The access to data allows constant remote monitoring of intensive livestock and therefore early detection of abnormal weight changes, indicative of potential husbandry issues including disease, nutrition and management issues. Early intervention can improve general health of livestock resulting in better economic returns. Average daily individual weights can be monitored to determine when individual animals are ready for slaughter, reducing feed inputs and ensuring optimal weights are achieved.

Close monitoring of cattle weights can therefore result in achieving optimal standard weight for slaughter giving improved economic returns. In addition, the close monitoring of individual cattle weight can reduce feed and bedding requirements. This has an additional environmental benefit and results in improved sustainable cattle production.

# PURPOSE OF THE TOOL

The Ritchie Beef Monitoring Unit is a weighing crate that allows individual animal weights to be recorded automatically when the animal accesses water. As the animal returns to the water multiple weights can be recorded and an average daily weight calculated. Automatic weight recording reduces livestock handling, thereby reducing stress of the livestock and of the handler and reducing labour costs. The cattle weights are recorded along with their individual tag numbers (Electronic ID tags required), and the data is stored on the cloud each time the cattle steps into the crate to access water. Average daily weights are calculated, which are accessed by the stockman via the website or app, and these can maximise economic returns whilst reducing adverse environmental impact

Source: Ritchie

# DESCRIPTION OF THE TOOL

The Ritchie Beef Monitoring Unit reads individual EID tags and records the associated weight of individual intensively-reared livestock. The data is stored in the cloud and data management software processes the data to produce average daily weights for individual animals. The stock manager can access the individual average daily weights to ensure the optimal growth of the livestock is achieved. The management tool allows for early detective of abnormal weight gain or loss. Immediate and early preventive measures can be implemented to ensure the health of the livestock is maintained. Additional livestock handling can cause stress resulting in a drop in weight gain. The automatic weight recording reduces stress whilst allowing data to be recorded and livestock to be routinely monitored remotely. The software interface allows the unit to be used by farm owners, stock managers and unskilled livestock handlers, without additional training.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Reduced handling of livestock for a less stressful procedure for both livestock and stock handlers. Although this leads to reduced labour, for this task, additional labour is required to monitor and manage the data. Ultimately, early detection of potential husbandry problems may lead to a change in tasks rather than a drop in required labour. |
| **Economic** | Optimal individual livestock standard weight at slaughter. The ability to remotely monitor live weights will lead to better weight control, improving economic returns. Feed and bedding costs will be reduced, and husbandry costs associated with early detection of potential husbandry issues may also be reduced. |

| | |
|---|---|
| **Environmental** | Reduced feed and bedding. Optimal feeding and live weight gains will lead to less feed and bedding being required. Early detection of potential health problems could lead to reduced administration of medicines, including antimicrobials that increase resistance, and therefore less environmental impact. |

# 4. Hands Free Hectare

*Leanne Townsend, Hutton*

Hands Free Hectare (HFH) was a project of precision farming led by researchers at Harper Adams University working alongside leading company Precision Decisions Ltd., which aimed to be the first in the world to use only drones and autonomous vehicles to grow and harvest a cereal crop over a hectare of land. Whereas previous projects had only automated part of this process, HFH sought the automation of the entire system using machines to grow the first arable crop remotely, without any humans stepping into the field. It demonstrated the field-to-fork food chain in operation.

The project partners succeeded in their aim of producing and harvesting a crop (barley) through entirely automated processes. They have gone on to plant and harvest a second crop, and the project has expanded into the ongoing Hands Free Farm, a 35-hectare farm which allows the HFH team to continue to develop and improve the technologies and outcomes.

**Application scenario**

Agriculture (arable farming). Producing and harvesting a crop (barley) through entirely automated processes

**Digital technologies**

Connected and autonomous terrestrial vehicles (CAV), aerial drones (UAVs)

**Socio-economic impact**

- Economic: Reduced labour costs, better productivity
- Environmental: Precision farming reduces chemical inputs. Smaller, lighter machines reduce soil compaction
- Social: Enabling time for other tasks on the farm, improved farm management, data access

**More info:**

https://www.handsfreehectare.com/

https://www.handsfree.farm/

The technologies include connected and autonomous vehicles (CAV) and drones.

Implementing autonomous machines on the farm has the potential to be transformative for arable farms. Automation is touted as the future of farming for a number of reasons – reduced labour in rural areas, increased precision and production on the farm, decreased environmental impact and soil compaction through the use of a greater number of smaller and more precise machines. The use of automated vehicles and drones frees up time of existing staff on the farm, allowing them to turn their attention to managing data and fine tuning the automated processes. However, there is some concern that this could lead to lost jobs, and that the skills required to manage automated systems are not present in the sector, or hard to acquire. The project has made a worldwide impact, receiving attention in 85 countries, and has won multiple prestigious awards for innovation.

## PURPOSE OF THE TOOL

The purpose of the digital tools applied in the Hands Free Hectare (HFH) project is to automate the processes involved in planting, growing and harvesting arable crops on farms. Automation is argued to be the future of farming due to a number of benefits – it frees up labour on the farm to be

concentrated in other areas, it reduces the environmental impact due to a number of smaller machines taking the place of larger ones which can compact the soil, and automation can improve precision leading to reduced inputs. Hands Free Hectare aimed to harness these benefits whilst developing an automated system with optimal outputs.

# DESCRIPTION OF THE TOOL

Hands Free Hectare is a system of automated digital tools applied in arable farming. These include connected and autonomous vehicles (CAV) (e.g. a small combine harvester) and drones which improve the navigation and interaction of tractors, to complete more technically-challenging tasks. The stakeholders relevant to the project include companies developing precision farming technologies, as well as farmers considering taking up automated technologies to improve or innovate their farming practices. The project was developed due to an increasing interest in automation as the future of arable farming, and a need to develop systems which harness the benefits of automation whilst producing optimal outputs on the farm.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | The tools can reduce heavy workloads for farmers and their staff, freeing up time to work on other areas of the farm – this might include working with the data and the automated systems to understand and improve their efficiency and outputs. |
| **Economic** | The system provides reduced labour costs, and improved outputs through more precise farming practices. |
| **Environmental** | Smaller, lighter and more precise machines are able to reduce chemical inputs. They reduce environmental impact and compaction of the soil. |

# 5. Cybermoor

*Leanne Townsend, Hutton*

Cybermoor is a cooperative bringing innovative services to the local community of Alston Moor (Cumbria, United Kingdom) and the surrounding areas. It began with a community broadband project in 2003 to bring fast wired (fibre optic) broadband connectivity to the village of Alston Moor. The cooperative progressed to become a limited company providing an extended range of services to local communities (such as a community website) and went on to broaden their reach, for example in leading the development of community broadband initiatives further afield.

The mission of Cybermoor was to bring Internet connectivity to the rural community of Alston Moor and surrounding areas, which would provide residents with the tools they needed to support and grow their businesses, create new routes to employment and new jobs, and to access a range of services (educational, health, entertainment, etc.) which would bring positive social impacts.

**Application scenario**

Internet connectivity for rural community; rural development, local community and businesses

**Digital technologies**

Superfast broadband provided to Alston Moor and surrounding towns; community website

**Socio-economic impact**

- Economic: Enable local businesses through connectivity to other businesses, suppliers and local and wider markets; create local employment
- Environmental: Reduce impact of transportation and use of external inputs
- Social: Connect communities to educational, health and entertainment services; connect community to wider networks

**More info:** http://www.cybermoor.org/

Structure Cybermoor roles

http://www.cybermoor.org/images/cybermoor/cybermoor_companies_trading_relationship.pdf

Ten years later a broad range of impacts were already in evidence, including those relating to access to healthcare services, education, rural business innovation and social cohesion in the village. First generation broadband has now been upgraded to a range of superfast broadband services available to local residents, and the reach of these services has expanded to more villages in the area.

The development of community broadband in underserved rural areas brings a wide range of benefits. The case of Cybermoor shows that such initiatives can lead to job creation and economic growth, as well as social impacts ranging from healthcare accessibility to increased social cohesion at the local level.

## PURPOSE OF THE TOOL

The main purpose of the Cybermoor initiative was to bring connectivity to the village of Alston Moor and surrounding areas, which would support the community in accessing a range of innovative services. This goal was based on an understanding that the community and local businesses were at a competitive disadvantage due to not being able to access Internet-enabled services, which were

increasingly becoming part of everyday life for better-connected urban and rural areas. In particular, the aim was to provide the tools needed to support and grow the local economy, create new employment, and to enable community access to a range of services (educational, health, entertainment, transport, community services, etc.) which would bring positive social impacts.

# DESCRIPTION OF THE TOOL

The Cybermoor broadband network was developed using fibre optic technologies. The fibre infrastructure has expanded since its initial development to serve communities around Alston Moor, Nenthead and the South Tyne Valley, to Haltwhistle in the North Pennines. Cybermoor works with Quickline who supply the broadband service to residents and businesses on Alston Moor and surrounding areas. The network covers 500 properties. The technology is used by both rural businesses and local rural residents, who use it to access a range of services enabled by fast broadband, including communications services (social media, email, online video conferencing tools such as Skype and Zoom), entertainment services (Internet TV, YouTube, Netflix), online local Government, educational and e-health services, and online shopping services. The service has ensured that these rural businesses and communities are no longer left behind to suffer disadvantages associated with the urban-rural digital divide.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Increased connectivity for community members, with networks inside of, and external to, the local community. A community website resulted from the implementation of broadband connectivity – this has increased social cohesion at the local level. Residents can access a range of services which are becoming increasingly prevalent in everyday life – this increases social inclusion and reduces negative impacts of an urban-rural digital divide. |
| **Economic** | Local businesses are able to connect with innovative services, build their networks with other businesses and wider markets/customers, and innovate their own products and services. New jobs are created. In economic terms of 'added value' to the whole community, all employ predominantly local labour, who in turn spend a significant proportion of their income locally. |
| **Environmental** | Better online connectivity (e.g. online shopping, online meeting spaces) leads to reduced travel and therefore reduced emissions from vehicles. |

# 6. Automated Milking Systems (Milking Robots)

*Sylvain Quiédeville, Heidrun Moschitz, FiBL*

Automated Milking Systems (AMS) are connected agricultural robots which can assist farmers in their daily work. AMS support the implementation of a fully autonomous milking process. In addition, these systems help to monitor milk quantity and quality, and most models track cows' health.

The Milking Robots allow farmers to choose their preferred milking process and to define the timings.

An AMS can reduce the workload of agricultural workers and increase management efficiency, whilst the monitoring dashboard can be used as a decision-support tool. In practice, the AMS generates key relevant data on the milking process and also on cows' well-being in most recent models.

AMS uses a set of digital technologies, including cameras and sensors to guide, monitor and milk cows. The monitoring system helps optimise performance parameters during operation and, in some models, to detect early signs of mastitis (inflammation of breast tissue). Some models also allow, if desired, a service partner to access the automatic milking system remotely, for online diagnosis.

**Application scenario**

Enhanced milking process for optimisation of farm organisation and management

**Digital technologies**

Robotics, sensors, cameras, smartphone

**Socio-economic impact**

- Economic: milking efficiency, milking facility, performance, labour costs, investment costs
- Social: reduced workload, milk quality, reduced human-animal interactions, potentially declined farmers' skills on observation of animals
- Environmental: mastitis detection using non-chemical agents, animal welfare

**Examples of AMS models:**

GEA R9500:

https://www.youtube.com/watch?v=Si-y7xBUKLc

https://www.gea.com/en/products/milking-farming-barn/dairyrobot-automated-milking/dairyrobot-r9500-robotic-milking-system.jsp

Fullwood M2erlin :

https://www.youtube.com/watch?v=8e9twagPHKw

Lely Astronaut A5:

https://www.youtube.com/watch?v=5cWiEp10ruA

# PURPOSE OF THE TOOL

Automated Milking Systems (AMS) have primarily been developed to implement a fully autonomous milking process. The robotic system allows an operator to choose the preferred milking process and to define the timings. It welcomes cow after cow and helps farmers in managing every lactation step. The objective is not only to reduce manual work to milk cows, but also to automatically monitor milk quality and, in most recent models, cows' health.

Source: Lely; © Anoek 2012

# DESCRIPTION OF THE TOOL

Farmers can change the settings of the AMS and receive key data on the milking process and also, in most recent models, cows' health. The milking stall module works independently, day or night. Some AMS models can perform several operations in a single attachment: stimulation of the teat, teat cleaning (or pre-dipping), drying, prior stripping, milking and post-dipping. This single process is supposedly key to harvesting excellent quality milk, while maximising the efficiency of the robotic milking facility.

The monitoring system allows farmers to screen milk quantity and quality and to optimise performance parameters during operation, keeping them informed (in some models, via text messages) about deviating values. Deviating values might indicate a sign of disease. Some models allow, if desired, a service partner to access the automatic milking system remotely, for online diagnosis.

Some AMS models include a cell count sensor over which the milk continuously passes from the beginning to the end of the milking process, for the analysis and early detection of mastitis (inflammation of breast tissue). This cell count system does not require the use of chemical agents. It helps farmers to detect the disease at a very early stage, thus helping to minimise treatment time, safeguard the healing process, and ensure the continuous productivity of the healthy herd.

Finally, some AMS models include an integrated guidance system, leading cows to a range of possible gates and to an exit, as soon as they leave the box after milking. Other models are based on free cow traffic, where cows can decide themselves when to enter the system and be milked.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Reduced workload; presumably higher milk quality; reduced human-animal interactions, and potentially less time spent by farmers on observing animals, possibly leading to a decline in their observational skills |
| **Economic** | Increased milking efficiency; decreased labour costs; high investment costs |
| **Environmental** | In some AMS models, mastitis detection without chemical agents that positively affects animal welfare |

# 7. Hoeing robots

*Sylvain Quiédeville, Heidrun Moschitz, FiBL*

Hoeing robots implement autonomous mechanical weed management in vegetable crops. They can assist vegetable producers by controlling weeds through hoeing and by monitoring vegetable crops through generating key indicators. Some of these indicators are relative to the presence of weeds and the density and stage of cultivation.

By weeding and hoeing, robots help to increase profitability while respecting the environment. Weed control by such robots reduces tedious farm work and can increase economic efficiency of vegetable production.

The data collected can be used as a decision-support tool. Some hoeing robots can issue a plot report synthesising a set of relevant data.

Hoeing robots have different options for changing weeding/hoeing tools so that they can be adapted to the specific needs of different operations.

**Application scenario**

Reduced weed pressure and optimised vegetable production

**Digital technologies**

Robot, GPS, Camera, Laser, Sensors, Smartphone/Tablet

**Socio-economic impact**

- Economic: Operation efficiency, Labour costs, Investment costs
- Environmental: Reduced use of chemical pesticides, No direct polluting emissions, Low soil compaction,
- Social: Workload, Decision support, Work conditions, Silent operation, Security

**More info on the farm demo channel:**

https://www.youtube.com/channel/UCdigVLNjyy5YrAdHl5G2frA/

**Examples of robot models:**

Carré ANATIS: https://www.carre.fr/entretien-des-cultures-et-prairies/anatis/?lang=en

Naïo DINO: https://www.naio-technologies.com/en/agricultural-equipment/large-scale-vegetable-weeding-robot/

They move using a system equipped with GPS guidance and camera. Some robots also include laser technology to scan the environment around the machine. They have an electric drive allowing for four to ten working hours, depending on the model.

Hoeing robots can be fully monitored and operated via a smartphone or tablet, so that checks can be carried out continuously and important data can be recorded in real-time. Some robot models can communicate with the farmer via text messages.

# PURPOSE OF THE TOOL

Hoeing robots have been primarily developed to implement fully autonomous mechanical weed management in vegetable crops. The objective is to replace laborious manual work to control weeds and also to increase the cost-efficiency of the weeding operations. Hoeing robots work autonomously in crops by inter-row weeding, and by generating key indicators for decision-making purpose via the acquisition of various data. Some robot models create a report summarising relevant data to allow vegetable producers to better manage their crops.

Source: naio-technologies.com

# DESCRIPTION OF THE TOOL

Hoeing robots operate autonomously to mechanically control weeds between rows of vegetable crops, with different possible tools attached. At the same time, some robot models can be used as a decision support tool through processing key indicators about the presence of weeds, the density and stage of cultivation, humidity, and the soil and air temperature. Concretely, this feature allows, for example, to determine the vegetable crop development stage between two passages of the robot, making it possible to assess the effectiveness of the work carried out by the machine.

To move around the plot, hoeing robots are equipped with GPS guidance and camera, associated with a laser technology in some models. They can cover up to five hectares a day, and have a working autonomy of four to ten hours, depending on whether lead-acid or lithium batteries are used. Charging times are around three to four hours. The user can fully control and monitor the robot using a smartphone or tablet. Such robots are equipped with four directional wheels for good traction and easy movements in the field.

Different weeding tools can be attached to the robot, making it adaptable to the specific needs of different weeding operations. Sensors monitor the surroundings to ensure security while operating.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social** Reduced laborious work and overall workload at field level for farmers; improved working conditions through absence of noise; security; information and communication with passers-by (walkers) might be needed

| | |
|---|---|
| **Economic** | Higher weeding and hoeing operation efficiency; decreased labour costs; investment costs to be considered |
| **Environmental** | Reduced use of chemical pesticides (when used in conventional agriculture); no direct polluting emissions (use of electric engine); reduced soil compaction compared to machinery pulled by a tractor (robots have less weight) |

# 8. NIRwood – smart and transparent timber trading

*Clemens Rendl, SISTEMA GmbH*

| **Application scenario** |
| --- |
| Timber tree species detection for wood traceability to counter illegal logging. |
| **Digital technologies** |
| Near infrared (NIR) spectroscopy. |
| **Socio-economic impact** |
| ▪ Economic: avoidance of economic loss and financial penalties.<br>▪ Environmental: preservation and protection.<br>▪ Social: awareness creation. |
| **More info:** NIRwood |

Poor timber quality can result in problems during the manufacture of wood products, having potential negative repercussions for both traders and importers. Similarly, due to current EU legislation on forest legality, if the timber's origin is not ensured, imported timber can be retained, causing economic losses as well as financial penalties, and/or detention penalties for traders in some EU countries.

Illegally logged and traded wood represents 19% of the total wood products imported into the EU. For this reason, the European Commission approved the European Timber Regulation (EUTR), which aims at combating this problem. It applies to all wood-related products commercialised in the EU, including internal production and imports. Nowadays, timber traceability methods mainly consist of documentary control that can be easily falsified, and more rarely slow and expensive laboratory wood analyses.

A technological approach based on near infrared technology (NIR) is implemented in the NIRwood project. NIRwood aims at being an on-site system for the identification of origin and quality of wooden products, based on a NIR spectrometer analysis. NIR spectrometers can clearly identify physical, mechanical and chemical properties of wood, giving the possibility to recognise different tree species, identify the origin of woods, and realise quality assessments.

# PURPOSE OF THE TOOL

NIRwood aims to provide the timber market (producers, traders, manufacturers, transformers and environmental authorities) with a reliable, precise, quick and affordable tool to ensure that their wood products are of the type and quality they expected, avoiding fraud and illegalities. NIRwood's objective is the creation of a huge timber spectral database, which will include NIR spectra from protected tree species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) as well as most commercial species.

# DESCRIPTION OF THE TOOL

NIR technology is very useful to check the quality and origin of wooden products. With NIR spectroscopy, the absorption or transmission of light in the range of the electromagnetic spectrum in the near infrared region (780 to 2500 nm) is analysed. Depending on the physical structure and the chemical composition of the analysed material, a specific absorbance spectrum is obtained, the so-called "fingerprint" of the material. NIR spectrometry applied to timber provides information about the chemical composition and structure (moisture, lignin content, sugars, etc.), and physical and mechanical characteristics (strength, density, etc.). NIR spectrometry also allows to determine phenotypical differences in timber due to the influence of local conditions where the tree grew (soil, altitude, climate, silvicultural treatments, and others), enabling specimens to be grouped by geographical origin.

All collected data will be treated to create a mathematical algorithm that allows the identification of a certain species and its origin just by scanning its spectrum. This is called the NIRWOOD prediction model and it will be embedded in a cloud-based platform that is easy-to-access by everyone, everywhere. Its accuracy will make it possible to ascertain wood species and origin instantly just by using a portable NIR device that scans the timber on-site, avoiding economic losses caused by fraud.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Creation of awareness of illegal logging and wood from endangered tree species. |
| **Economic** | Avoidance of economic loss and financial penalties. |
| **Environmental** | Preservation of the natural environment and woodlands, protection of endangered tree species. |

# 9. Creating forest intelligence with 20tree.ai

*Clemens Rendl, SISTEMA GmbH*

| **Application scenario** |
| --- |
| Monitoring of forest status and preservation. |
| **Digital technologies** |
| Artificial intelligence, satellite imagery, neural networks and (cloud) computing power. |
| **Socio-economic impact** |
| ▪ Economic: efficient forest management.<br>▪ Environmental: forest health, sustainability.<br>▪ Social: education; urban green spaces. |
| **More info:** 20tree.ai |

Forests are essential for life on Earth and a sustainable future. The "lungs of the Earth" mitigate climate change by acting as a carbon sink. Moreover, they provide the timber for products we use every day. However, forests are under pressure. A large driver is deforestation due to agricultural expansion, replacing forests with farmland. In fact, agriculture is the biggest driver of deforestation and resources are often used unsustainably. Furthermore, climate change has a massive impact on forests in the form of severe drought, forest fires and insect pest outbreaks. There is a need for an up-to-date insight into the Earth's forests, to improve decision making by forest industry, governments and agricultural organisations, to react to these threats in an early stage and to create and apply prevention policies.

On the ground, it is barely possible to get a full understanding of the richness of resources in a forest area or predict any potential risks to the health of plants and trees. Comprehensive, manual surveying and data collection in forested areas can take months, with considerable pressure on budgets and manpower.

20tree.ai uses a combination of artificial intelligence (AI), high-quality and high-resolution optical satellite imagery and radar data, and (cloud) computing power to generate forest intelligence. Using a type of AI called machine learning, algorithms are created that can "learn" from experience. For example, in the case of deforestation, the algorithm is fed with many cases of deforested areas, and it learns what deforestation looks like. In this way, the machine learning algorithm can detect deforestation patterns and predict high risk areas. It even makes it possible to detect patterns that cannot be spotted by humans yet. The global, daily availability of satellite data combined with AI and complex data poses a potent technology for understanding natural and human induced phenomena affecting forests.

# PURPOSE OF THE TOOL

The purpose of 20tree.ai is to merge complex satellite data with artificial intelligence and computing power to turn them into actionable insights. By feeding satellite data, including high spatial and temporal resolution optical and radar data, into deep learning algorithms, highly accurate insights are created and patterns revealed, which might not be visible yet to the human eye.

Figure 9-1. Fish bone pattern style deforestation. Alongside the main road several small roads reach into the forest, an indication that more deforestation is about to happen. Imagery by DigitalGlobe.

# DESCRIPTION OF THE TOOL

The combination of artificial intelligence, satellite imagery and (cloud) computing power enables the efficient monitoring of forest health and detection of forest threats. The generated forest intelligence helps corporates, non-governmental organisations (NGOs) and policy-makers to combat deforestation and make forest management more sustainable. Regularly, new satellite data is processed, which is used to train a series of neural networks. By also using radar data, forests can be monitored independent of daytime or clouds covering the area. Cloud computing provides the resources for the training, making it possible to be completed in just a short time. The neural networks can then draw insights into forest health that are otherwise invisible to the human eye. Clients can check on specific factors of interest, including tree species, height and diameter, growth and productivity, as well as harvesting potential, allowing them to monitor those variables over time and take appropriate reactive measures, with improved impact.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Raising awareness around the need for reforestation and restoring valuable ecosystems; improvement of urban green spaces; conservation of forests. |
| **Economic** | Prediction of short and long-term impacts of investments; “Which trees to plant, when and where?” |

| | |
|---|---|
| **Environmental** | Insights into forest health and threats, like deforestation, drought, insect plagues, soil health, storm damage, and other forest disturbances. |

# 10. CO2 Revolution

*María del Mar DELGADO-SERRANO, University of Cordoba*

CO2 Revolution is a Spanish company offering a revolutionary approach to reforest big land extensions. As opposed to traditional reforestation methods, based on planting single tree species, the company uses airborne drones to spread a combination of 'intelligent seeds' (iseeds) aiming to create complete ecosystems by planting a variety of trees and plants. These services might be used to reforest burnt land after a forest fire or by companies and institutions interested in reforestation to offset their carbon footprint.

iseeds are composed of a biodegradable capsule that contains pre-germinated seeds, along with all the elements needed for their growth, including a combination of the different types of species that can create an ecosystem. The system uses advanced software and a navigation system to autonomously select the most suitable planting pattern in each piece of land.

The company can reforest large areas of land in a few hours at a significantly reduced cost (1/10 of the time and cost of planting with traditional methods), disseminate seeds in areas with difficult access, and regenerate complete ecosystems by combining different types of intelligent seeds in each area.

**Application scenario**

Reforest land using intelligent seeds, spread by drones based on advanced software and navigation systems to select the best planting pattern.

**Digital technologies**

Aerial drones, artificial intelligence, remote sensing.

**Socio-economic impact**

- Economic: Lower cost to reforest big land extension.
- Social: A potential negative impact is the loss of traditional jobs in land reforestation.
- Environmental: Reforestation of land after forest fires. Offset carbon footprint of major emitters and compensation of $CO_2$ emissions. Regeneration of entire ecosystem by combining different types of seeds. Planting in areas with difficult access.

**More info:** https://www.co2revolution.es

# PURPOSE OF THE TOOL

CO2 Revolution aims to fight climate change and desertification by offering a disruptive method to reforest land and compensate $CO_2$ emissions. The method allows for the creation of entire ecosystems proven to be self-sustainable. The company plans to plant 10 000 million trees in the next 10 years, to capture 500 million tons of $CO_2$ every year, and to do it at a reduced cost and in less time.

# DESCRIPTION OF THE TOOL

CO2 Revolution based its method on three main components: 1) a database containing all the variables influencing the creation of ecosystems and using advanced algorithms to select the most adequate for each piece of land to be reforested; 2) intelligent seeds contained in a biodegradable capsule with pre-germinated seeds along with all the elements needed for their growth; and 3) aerial drones equipped with containers to transport up to 10 000 iseeds using sophisticated software and navigation systems to select the best planting pattern in each location. In addition, different types of seeds (pasture, flowers, shrubs, trees) are combined in order create entire ecosystems. They use autochthonous species and carry out an intensive monitoring of the ecosystem evolution to make it self-sustainable in a short period of time.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | The main negative social impact is the replacing of traditional forestry jobs used to replant land and forest. |
| **Economic** | The method impressively reduced the cost of reforestation and creates the conditions to make it self-sustainable. Re-planting costs are also minimised. |
| **Environmental** | The system has important environmental impacts. It allows for the reforestation of big and small pieces of land, regenerating ecosystems by combining different types of seeds. These ecosystems offset the carbon footprint of major emitters and compensate $CO_2$ emissions. Drones can be used to plant in areas with difficult access. The use of autochthonous seeds favours adaptation to local conditions, sustainability, and minimises effects on local biodiversity. |

# 11. Wildfire Analyst

*María del Mar DELGADO-SERRANO, University of Cordoba*

Once wildfires start, fast and accurate information is essential to minimise impacts. Wildfire Analyst is a registered software that provides advanced solutions for wildland fire management. The software provides real-time analysis of wildfire behaviour and simulates the spread of wildfires. Simulations are completed in seconds, to support real-time decision-making.

Wildfire Analyst software was specifically designed to support initial fire situations, giving the Fire Chief and Incident Commander the critical early intelligence needed to support resource allocation decision-making.

The software uses predefined weather scenarios, or current and forecasted weather obtained via web services, to model fire behaviour and provide outputs within seconds. This fast performance facilitates the use of outputs in real time and allows for constant adjustment based on field observations and deployment decisions by the incident team, improving the operational response of fire crews.

**Application scenario**

Software that integrates real-time weather information with advanced modelling to simulate and calculate wildfire behaviour and provide instant information to support real-time decision-making.

**Digital technologies**

Geo-technologies and advanced analytics based on remote sensing: satellite and LiDAR.

Dashboard and mobile devices.

**Socio-economic impact**

- Economic: Quick and effective decision-supporting tools to reduce fire damage and costs.
- Environmental: High precision modelling of forest fires and forest fuels permits the quick identification of critical points and faster decision-making capacities to combat fires.
- Social: Accurate information and appropriate analysis saves lives in wildfires and increases public safety, emergency planning and risk prevention.

**More info:** https://technosylva.com/

# PURPOSE OF THE TOOL

Wildfire Analyst software supports decision-makers in emergency management, by providing real-time information on the situation and the potential evolution of wildfires. It uses advanced state-of-the-art wildfire behaviour simulation to predict the spread and potential impact of fires. This critical information is used to support the dispatching and allocation of resources.

The software is specifically designed to provide analysis capabilities for a range of situations and to be used by people with minimal knowledge of GIS data. This greatly increases usability, allowing users to concentrate on interpreting simulation outputs, and to make important decisions about how and where to deploy firefighting resources.

# DESCRIPTION OF THE TOOL

The tool integrates Geographical Information Systems (GIS), remote sensing and LiDAR data to support decision making in wildfires and emergency management. It provides simulations very quickly and repeatedly as conditions change. It is designed to be used with a laptop, tablet or mobile devices at the incident command centre, in the operations centre, or directly on scene, providing outputs in under a minute.

Wildfire Analyst provides a range of analytical outputs, available as GIS maps and charts, that empower more accurate and timely decision making.

The company also offers wildfire risk forecasts, using the Wildfire Analyst APP to generate twice a day 10+ million wildfire simulations. The application provides hourly wildfire risk forecasts for a 3-day period. This information is used to support key decision-making processes, such as preparedness, and fire crew activation and placement.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Real-time wildfire information reduces fire casualties. The tool allows users to analyse fire scenarios through a high usability. |
| **Economic** | Fast decisions and reaction capacity save time and money in wildfire fighting and reduce the enormous economic losses caused by wildfires. |
| **Environmental** | Climate change, higher temperatures and the lack of forest management have dramatically increased the severity and damage of wildfires in the last decades. |

Simulations allowing rapid and effective decision-making in both fire suppression and prevention are essential to reduce fire damage.

# 12. Aldeas Abandonadas (Abandoned Villages)

*Mª del Mar DELGADO-SERRANO, Universidad de Córdoba*

Aldeas Abandonadas is a real estate agency that offers farms, houses, hotels and villages for sale or rent in rural areas in Spain. They have been in business since 1983, and now operate from an internet portal.

| **Application scenario** |
| --- |
| Connect owner of abandoned rural houses with potential buyers. |
| **Digital technologies** |
| Online portal (web). |
| **Socio-economic impact** |
| ▪ Economic: Increase opportunities for rural economic revitalisation.<br>▪ Social: Attract new inhabitants to the rural areas. |
| **More info:** |
| https://www.aldeasabandonadas.com |

As a result of rural depopulation many buildings, and even entire villages, are abandoned. At the same time, other people are attracted by the quality of life and environmental benefits of rural areas. The website leverages these opportunities by connecting people interested in moving to these areas and people interested in selling their properties. This opens a wide spectrum of possibilities for both potential buyers and sellers, and it increases the opportunities for the revitalisation of rural areas.

The agency is specialised in the financial market, real estate and in the management of patrimonies, in villages, uninhabited towns, rural houses, and singular and unique buildings linked to farming and rural environments. These include mills, *pazos* (Galician rural houses), *masías* (Catalonian rural houses), mansions, castles, warehouses, manor houses, estates, palaces, hotels, and other properties in different rural locations in Spain.

The portal also offers different types of advanced professional services, both for buyers and sellers to facilitate the transactions and to make the whole process easier.

## PURPOSE OF THE TOOL

The tool offers a website portal hosting a database of rural buildings for sale or for rent. It acts as a marketplace to put in contact sellers and buyers, displaying a broad offer of properties in Spanish rural areas. The catalogue of properties of all types can help to attract people and businesses to rural areas with low population densities. To attract new inhabitants and economic activities to rural areas might boost population and revitalisation.

Aldeas Abandonadas

# DESCRIPTION OF THE TOOL

Aldeas Abandonadas is a website specialised in the financial market, real estate and in the management of patrimonies.

Aware of the potential for development of rural environments and communities, they bring together a wide range of offers to individuals, professionals, investors, or entrepreneurs, in search of developing activities in rural environments, contributing to their repopulation and economic revitalisation, or simply aiming to find a new way of life in rural environments.

They offer a comprehensive range of specialised services to buyers and sellers such as buyer services, seller services, general services, insurance, mortgages, consulting and legal advice, architecture advice and reforms, expert opinions and assessments or premium personal shopper services, to facilitate the interaction between those interested in the rural areas and the owners of unused buildings.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Positive social impacts result from opportunities to repopulate rural areas, by attracting new inhabitants. A negative impact might be that these new inhabitants, who often come from foreign countries, displace local inhabitants who uphold rural traditions from business or decision-making arenas. |
| **Economic** | The main economic impacts are that the attraction of new inhabitants can revitalise rural areas, creating economic opportunities, opening new business options, and creating employment and economic activity. |

# 13. Ultra High Frequency Tags For Rough Wood Surfaces

*Bacco F. Manlio, CNR, Italy*

| **Application scenario** |
| --- |
| Management, tracking/traceability, localization |
| **Digital technologies** |
| Physical tags and interfaces to visualise collected data |
| **Socio-economic impact** |
| ▪ Economic: trust and transparency in value chains<br>▪ Environmental: natural resources tracking |
| **More info:** https://sundog-rfid.com |

Radio Frequency Identification (RFID) tags are small, low-cost objects that can be attached to materials and products to identify and track them throughout their lifecycles. However, some surfaces, like rough wood, do not allow the use of classical adhesive tags. Thus specific solutions have been developed to allow easy and fast tagging of rough wood surfaces. Data from Ultra High Frequency (UHF) RFID tags can be collated using special trackers.

Each tag contains unique information about the object it is attached to, such as timber or lumber, pallets, utility poles, and railroad ties. To read the tag, an RFID reader is required, and the tag must be close to the reader (typically less than one metre), but UHF tags with high reading range can be detected at larger distances (five to seven metres).

Being able to track assets with low-cost tags provides large advantages to companies transporting or delivering materials, allowing them to know the location of each item and to have a constantly updated inventory. By positioning RFID readers in strategic points in vehicles, depots, and so on, such a process can be automated, reducing the need for human labour.

# PURPOSE OF THE TOOL

The SUNDOG® UHF RFID tags provide a reliable solution that stays fixed to rough wood surfaces, enabling real-time inventory management, fewer inventory losses, multi-tag readings, and long reading range capability. They can be left on the wood because they do not damage blades or other tools, thus they are safe to use even during processing.

# DESCRIPTION OF THE TOOL

RFID tags are low-cost objects that can be used to track goods, to locate things, and so on. Their use is widespread, and specific solutions have been developed to adapt them to difficult conditions, like rough wood surfaces (patented). Tags provide information about the object they are attached to once in the proximity of a reader; passive tags do not require a power supply (battery), thus typically exhibiting a small form factor. The use of antennas can provide high read range, but even in the case of antenna damage, close data reading is possible (tens of centimetres).

# AREAS OF SOCIO-ECONOMIC IMPACTS

The use of RFID tags, labels, and similar technology can have a profound impact on management practices in companies, by enabling them to have up-to-date information on goods (final products, raw materials, etc.) in and outside their depots. Those data can be partially exposed to customers for trust and transparency purposes, while the use of automated systems, like readers installed in strategic positions, can reduce the need for human labour. Better coordination with other actors in the value chain can be achieved, and, in the case of natural resources like wood, tracking and control activities can be fundamentally improved.

| | |
|---|---|
| **Economic** | Trust and transparency in value chain |
| **Environmental** | Natural resources tracking |

# 14. Silvismart -efficiency portal for forest operations-

*Bacco F. Manlio, CNR, Italy*

Silvismart is a cloud system able to store and analyse data collected from the field in forestry operations. Collected data can be of different types, such as those coming from machines, electronic submission procedures, performance data, available natural resources, environmental data, and so on. Thus, the dataflow is digitalised, and the forest owner is in control of his/her data. Data can be shared with other interested or involved actors.

The main rationale of such a system is to ease the management of daily operations in forestry. It will enable the collection of data into a central repository, its analysis, and the extraction of useful information for machine operators, forest owners, and forest managers.

**Application scenario**

Management, tracking/traceability, locating

**Digital technologies**

Physical tags and
interfaces to visualise collected data

**Socio-economic impact**

- Economic: trust and transparency in value chains, efficiency improvement
- Environmental: natural resources tracking
- Social: transparency and access to information on natural resources

**More info:** https://www.silvismart.eu

Analysed data can support productivity through advice on how to increase efficiency. The target is the wood supply chain, and contractors using Silvismart can link their machines with this cloud platform. Managers and owners can then be granted access, to see how and when the machines are operating, performance figures, size and distribution of trees and species in the area, personnel data, and environmental data. All this is organised into an interface showing: 'My Fleet', 'My Operations', 'My Stand' (forest), and 'My Files & Access'.

Silvismart has been developed within the TECH4EFFECT project and will be maintained by an international association once the project ends in October 2020.

# PURPOSE OF THE TOOL

Source: Silvismart.eu

The main purpose is to provide a centralised access point to relevant information for daily operations in forestry. The information is extracted from data collected in the field, and analysed to provide support and reporting tools. Efforts have been made to make Silvismart a low-cost and universal system for countries and organisations to use.

# DESCRIPTION OF THE TOOL

Silvismart is able to automatically transfer data from machines to Amazon cloud storage, interacting with different machine types. It can store and organise data, ensuring its long-term persistence. Data can be visualised and analysed to extract information useful for production reports or other custom ones, thus facilitating management and informed decisions. Furthermore, Silvismart can provide benchmarking figures to improve efficiency, suggesting measures to improve daily operations in forestry.

Access to data is tightly controlled to enforce control over data by forest owners, which they can also share them with other involved actors. The actors can be machine owners, forest owners, managers, consultants, machine operators, scientists, certification authorities, or control bodies. In this way, trust and transparency are improved, thus bringing potential economic benefits.

# AREAS OF SOCIO-ECONOMIC IMPACTS

Being able to collect data from machines and on forestry parcels where operations are conducted can improve both trust and transparency in daily operations. Data can be used to improve efficiency through benchmarking, but also to track the use of natural resources.

| | |
|---|---|
| **Social** | Trust and transparency in value chains, efficiency improvement. |
| **Economic** | Natural resources tracking. |
| **Environmental** | Transparency and access to information on natural resources. |

# 15. Tesselo

*Bacco F. Manlio, CNR, Italy*

Tesselo is a system that enhances satellite imagery through the use of artificial intelligence (AI) techniques and sectorial expertise. The aim is to tackle environmental challenges by exploiting real-time and country-wide mapping solutions in different fields, such as forestry and agriculture.

| **Application scenario** |
| --- |
| Monitoring and protection of resources and infrastructures |
| **Digital technologies** |
| Remote sensing, artificial intelligence |
| **Socio-economic impact** |
| ▪ Economic: risk assessment and customised reporting for management<br>▪ Environmental: natural resources tracking<br>▪ Social: information on natural resources |
| **More info:** https://www.tesselo.com |

For instance, tree species can be classified in a forest, growth rates can be predicted, risks of forest fires estimated, crop harvests can be monitored, and pests detected.

Through advanced monitoring capabilities, adequate responses to different challenges can be developed, and damage estimation can be performed after a disaster. This can help in insurance and certification procedures, but also in improving compliance with regulations.

The commercial service exploits satellite imagery to generate crystal-clear composite images with spatial layers covering the area of interest. Historical data can be provided up to 3 years in the past. Thus, changes can be measured, such as in land cover, tree species, infrastructure, and so on. Specialised layers of information are provided as well, able to classify and detect phenomena of interest, through the use of proprietary AI algorithms.

# PURPOSE OF THE TOOL

The main aim is to support insurance and certification procedures for companies, and to provide public entities with a verification tool for compliance with regulations. Remote imagery (from satellites, drones, LiDAR systems, and so on) is augmented through AI-powered data analysis. Alerts, reports, and monitoring capabilities represent the offered core service.

# DESCRIPTION OF THE TOOL

Tesselo exploits a large variety of raw data coming from satellites, drones, radar, multispectral imagery, and so on, to produce composite, cloud-free (13 bands technology) analysis-ready imagery. Atmospheric conditions hampering remote systems can therefore be counteracted to get usable imagery for specific business needs. Patterns can be identified through the analysis of data, as well as exposure levels, risk factors, and incremental changes. Tesselo has been supported by the European Space Agency's Business Incubation Centre (ESA BIC) programme.

# AREAS OF SOCIO-ECONOMIC IMPACTS

Data collected via remote sensing provides large-scale information to measure changes over time and to monitor in quasi real-time changes in the area under observation. Risk assessment, insurance, certification, and control procedures are facilitated, easing both monitoring and protecting activities of natural areas, such as forestry. Companies can be supported through a range of customised services.

| | |
|---|---|
| **Social** | Information on natural resources |
| **Economic** | Risk assessment and customised reporting for management |
| **Environmental** | Monitoring and protection |

# 16. La Era Rural: Revitalising rural areas through youth leadership and entrepreneurship

*Javier Sancho, Sarga*

| **Application scenario** |
| --- |
| Knowledge exchange to promote and support local economy through youth entrepreneurship and leadership |
| **Digital technologies** |
| Web interface to access services (such as e-learning), mobile app and social media |
| **Socio-economic impact** |
| ▪ Economic: Risk management prevention, resilience, marketing, cooperation<br>▪ Social: Individual skills, learning, identity, access ICT, rights autonomy and power<br>▪ Governance: Reduce administrative burdens, facilitate participation |
| **More info:** https://laerarural.es/ |

The Rural Era (La Era Rural) is a support network for youth entrepreneurship and leadership in the rural areas of Aragon, Spain.

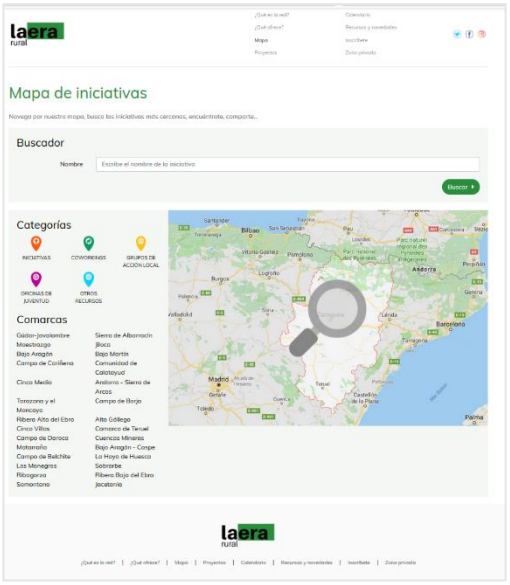
The initiative is based on an online platform that offers virtual services to businesses run by young people, as well as face-to-face actions to support and boost entrepreneurship and innovation.

The interactive website's key function is to help promote and connect the initiatives and businesses created by young people from the rural areas of Aragon. In addition, through this digital space, the initiative organises activities to enhance the capacities and skills of young entrepreneurs through networking and collaboration. In particular, the platform includes a membership area featuring a repository of information and opportunities, free e-learning and training, access to advice and support, and further assistance for the implementation of ideas and projects. The project includes a mobile application that notifies users of each publication and facilitates the uploading of information without the need for a computer.

This initiative is supported through a collaboration of 13 LEADER Local Action Groups (LAGs) within the framework of a greater territorial initiative called 'Jovenes Dinamizadores Rurales' that has been active now for more than nine years. By August 2020, the platform will feature more than 100 initiatives and 10 co-working spaces. The implementation of this digital technology has enabled a supportive community and ecosystem to be built for young entrepreneurs that is boosting dynamism, revitalising rural areas both socially and economically, and providing them with access to several services.

# PURPOSE OF THE TOOL

The Rural Era is an initiative to revitalise rural areas of Aragon, in Spain, by boosting and supporting entrepreneurship among the rural youth, and offering services to enhance skills, knowledge and networking opportunities. By joining La Era Rural the users have access to advisory, training, financing and dissemination services, as well as opportunities to launch their ideas and to start their projects.




Source: La Era Rural

# DESCRIPTION OF THE TOOL

The Rural Era is an online platform and virtual space that enhances participation and collective development. It includes a private area and offers online services to participants, and also supports face-to-face actions to boost entrepreneurship and innovation.

Being part of this online platform, users can benefit from: 1) their own fully-customisable web space; 2) their project/business being displayed on an interactive map that allows geolocation of the different initiatives and services offered; 3) access to a membership area to share information, seek support, and establish synergies and collaboration; 4) access to information and opportunities of interest; 5) access to free intensive and specialised training (training pills), and advice and support in different areas; 6) access to funding opportunities; 7) support for communication, dissemination and branding; 8) networking and shared learning; 9) access to collaboration opportunities and service provision; 10) 'Rural on-tour' inspirational visits to companies, initiatives or ventures, both inside and outside the Aragon region; 11) internships in companies, enterprises, or initiatives to learn through practice; 12) an e-learning and training platform; and 13) a marketplace where they can sell products and/or services.

The project includes a mobile application that notifies users of each publication and facilitates the uploading of information to the platform without using a computer.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social** Boosted capacity, knowledge and skills of young people to help them create their own business in a rural area through improved access to ICT.

| | |
|---|---|
| **Economic** | Supported more than 100 businesses set-up by young people. |
| **Governance** | Reduced administrative burden of operationalising entrepreneurship. |

# 17. APADRINA UN OLIVO

*Javier Sancho, Sarga*

| Application scenario |
| --- |
| Creating local economic activity around a sponsorship system for project that support the maintenance of life in the rural environment |
| **Digital technologies** |
| Website with fundraising functionalities, mobile application |
| **Socio-economic impact** |
| ▪ Economic: added value for ecological production system, sustainable tourism, incomes, marketing, resilience, responsibility, food quality<br>▪ Environmental: clime, carbon emissions, foot print, soil, traditional sustainable management practices<br>▪ Social: rural employment, inclusion, autonomy, power, custody of territory |
| More info: www.apadrinaunolivo.org |

*Apadrina un olivo* (Sponsor an olive tree) is an initiative that arises from a local NGO's in a rural area of Aragon (Spain), which consists in allowing people to sponsor a centennial olive tree, through a donation of 50€. The mobile application "My olive tree" allows the small donor to follow the tree's evolution and to be in contact with the farmer.

The technologies used in the project, the website and the mobile application, have been fundamental to achieve the implementation of the project and the large repercussion in the media and social media.

The website provides the project's information; sustainable tourism options based on olive trees and includes fundraising functionalities for individual sponsorship or for companies following CSR model.

The free app "My olive tree" allows monitoring the sponsored olive tree. Each olive tree is labelled with a QR code. Every time farmers perform some work in the olive tree, they can scan the code and the sponsor receives a notification on their mobile device with the corresponding image. The updates sent directly by the farmer can be shared with friends.

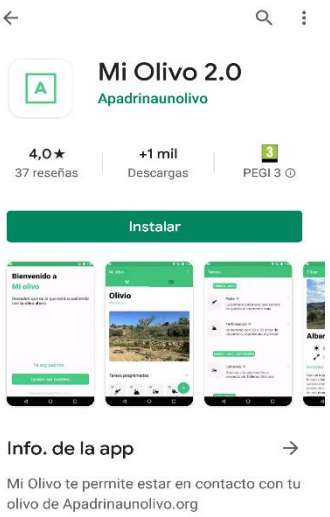
The app has a "Town section" where the small donor can learn more about the needs of the area, see in photos the farm where the olive tree is and write direct messages to the farmer. It is possible to sponsor new trees from the application itself.

## PURPOSE OF THE TOOL

Apadrina un Olivo (Sponsor an olive tree) is an initiative that arises in the village of Oliete (rural area of Aragon, Spain), and that aims to resist against depopulation and the abandonment of traditional olive oil production. A local NGO's, formed by young entrepreneurs, devised the project from a sustainable, digital and environmental point of view.

Apadrina un Olivo seeks through a website, mobile app and presence in social networks to promote a sponsorship system to preserve a traditional agricultural activity such as the olive grove and oil production.

# DESCRIPTION OF THE TOOL




The initiative consists in sponsoring an olive tree, through a donation of 50€ and the possibility of knowing the tree evolution and being in contact with the farmer thanks to an APP and a QR code in each tree.

The website provides the project's information; a blog including articles on olive trees and sustainable tourism (stars gazing or ornithology). In addition, the web has fundraising functionaliti es and several sponsorship models (individual, for companies following CSR model, specific or annual payments and also the possibility of giving it away).

The sponsor receives 2 litres of organic oil from every sponsored olive tree and can visit them when he/she wants.

Source: Apadrina un olivo

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Recovery of a traditional sustainable management practice, reduce depopulation, autonomy, power and internalization of the project. They work with people with different capacities and in social exclusion. This initiative has managed to avoid the closure of the school in the town of Oliete, has been declared of national interest. |
| **Economic** | Added value for ecological production system, sustainable tourism, incomes, marketing, resilience, responsibility, food quality. This initiative has created 10 jobs, more than 5000 sponsors distributed in more than 25 countries and 18000 visits to the project based in Oliete (365 inhabitants). Recently, Apadrina un Olivo has restored a house (given by the Ebro Hydrographic Confederation) to promote tourism in Oliete. Thorough the project has been created an oil mill for the production of oil. |
| **Environmental** | Climate, carbon emissions, soil, traditional sustainable management practices |

# 18. The Digital transformation of 'Lormes'

*Enrique Nieto, AEIDL*

| **Application scenario** |
| --- |
| Smart Villages: services for a digital ecosystem supporting/promoting local economy |
| **Digital technologies** |
| Web, fast internet connectivity, sensors, with support of Digital Hubs and Fab-Lab |
| **Socio-economic impact** |
| ▪ Economic: Business and village development<br>▪ Environmental: Efficient resource management<br>▪ Social: Digital capacities, social inclusion |
| **More info:** https://bit.ly/2WmgJ52 |

Lormes is a village (1 300 residents) located in the Morvan area, in the county of Nièvre, Burgundy (France). It is a good example of a digital transformation pathway for small villages, and the timescale and steps that are required to become a 'player' in a wider digital ecosystem.

Lormes began its digital and social journey with a groundbreaking district-level digital policy to foster the economic and social potential that ICT and the internet could bring to remote rural areas. This was followed by investments in the digital capacities of the population in 2003. With enhanced digital capacities, the creation of a 'Rural Hub' enabled Lormes to maximise the potential of local skills by providing office spaces, Fab-Lab, fibre-optic connection, etc. The success of the Rural Hub triggered other complementary initiatives, such as the enhancement of the broadband network in the village, and the creation of a 'competence centre' for the business, public and community sectors to deliver training and mediation services on behalf of the county and regional government. Several ICT projects, companies and services emerged in the territory as a result of these initiatives.

Every village is at a different point in their digital transformation path, but they can all get inspired by the process carried out in Lormes. Digitalisation at village level goes beyond the technology deployed, it also relies on the support provided to achieve digital and social transformation.

# PURPOSE OF THE TOOLS

The combination of a series of different ICT tools has enabled the small village of Lormes to transition from a digitally-excluded territory to a digital player with an enabling digital ecosystem built around the needs of its population.

Source : http://paysnivernaismorvan.com

# DESCRIPTION OF THE TOOLS

Starting with the development of a common vision, the village as a whole was able to move from a stage of 'digital exclusion' to become a key digital player for the territory. Lormes set up the first 'Digital Mission' association in 2003, to provide digital inclusion and education support services to the community and initiated the 'Digital passport for every one' programme.

In 2007-2008, Lormes created the Rural Hub. This provides eight offices with connections to the high-speed broadband network (FTTH fibre-optic 100 Mb), technical support, meeting rooms, videoconferencing facilities, loan of equipment, VoIP telephones, a network server, and expansion of digital inclusion and mediation services. By 2016, the first rural FTTH pilot was conducted in Burgundy, together with a community consultation to prioritise new digital services to accompany the deployment of FTTH. The expansion of Rural Hub and the launch of the 'Villages of the Future' process focused on wider community-led social and economic regeneration. In 2017, the Rural Hub or 'Mission' started to act as a competence centre for the business, public and community sectors by delivering training and mediation services on behalf of the county and regional government through two agreements. Lormes Rural Hub has inspired others to follow a similar digital transformation pathway.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social** Enhanced the digital capacity and skills of village inhabitants; strengthened the social dynamic and capital of the village to work collectively on their development.

| | |
|---|---|
| **Economic** | Created an enabling digital infrastructure and ecosystem for the emergence of digital initiatives and projects for the private and public sectors. |
| **Environmental** | Triggered projects related to management of natural and public resources. |

# 19. Smart remote management of public services – ZWIT Project

*Blanca Casares, AEIDL*

ZWIT project proposes the Smart Management Network as a tool to build Smart Villages and transit to the

green and digital economy. The Smart Management Network creates an innovative framework focused on sustainable territorial development, with a business model based on connectivity and the smart management of infrastructures.

| **Application scenario** |
| --- |
| Provide connectivity to rural areas that creates innovative and intelligent ecosystem to build Smart Villages and facilitates sustainable development |
| Digital technologies<br>Multi-device: remote sensing, local sensing, web-based platform for data analytic, geo-location, mobile app |
| **Socio-economic impact**<br>▪ Social: Digital capacities, inclusion, empowered local municipalities<br>▪ Economic: growth supported by digitisation, sustainability, cost-efficient, integrated infrastructures and communication networks<br>▪ Environmental: resources and energy efficient, sustainability of public services |
| **More info:** https://zwitproject.es/<br>https://enrd.ec.europa.eu/sites/enrd/files/tg6_smart-villages_zwit-project.pdf |

The ZWIT project integrates technology in street lighting infrastructure that allows a more efficient use of public services. Its Smart Management Network is a double-layer network, with a Wi-Fi backbone, to provide high-bandwidth services, such as Wi-Fi zones with free internet access in public spaces in rural areas. The Wi-Fi network is connected to sectoral data sub-networks dedicated to the efficient management of public infrastructures such as lighting, water, waste, etc. The Wi-Fi backbone forms a kind of "ring" that covers the entire municipal territory, and accesses the internet through a single municipal access point. This network allows the implementation of specific projects around it that can attract further investments, in relation for instance to video assistance for the elderly, smart nature trails, or a better management of public services (light, water, waste, etc.).

## PURPOSE OF THE TOOL

The Smart Management Network provides quality internet connectivity for the development of Smart Villages. It is a multifunctional and multi-device tool that enables data transmitted from sensor networks to be used for the remote management of public infrastructures (lighting, water, urban waste, transport, etc.). This is possible through a large telecommunications network at municipal level. The Network allows municipalities to offer new services to citizens, such as free internet Wi-Fi access,

tools for the elderly's social health care using remote video support, e-health, e-learning, tourism and local business promotion, etc.

This Smart Network is implemented in Los Corrales de Buelna (a village in the north of Spain) which has already changed its lighting system and installed devices that allow the remote management of services. The region optimises the provision of public services by upgrading existing infrastructure (public lighting) with sensors and internet connection that can boost entrepreneurship and investment in the area.

# DESCRIPTION OF THE TOOLS

ZWIT Smart Management Network is an open, multi-purpose, multilayer (fibre-optics, Wi-Fi, ZigBee), municipal/regional communication network. The tool integrates multiple devices that include remote sensing, local sensing, web-based platform for data analysis, and geo-location and mobile applications.

The tool obtains and manages all kinds of data from the users/sensors that are connected to the Smart Management Networks. The frequency of data is controlled by the system and the treatment of confidential data is based on the laws of each country. The data can be used for verifying the operation of the water, energy or lighting networks, and for knowing the needs of a territory to be able to generate entrepreneurship scenarios that help deliver services to citizens.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Boosted local participation of stakeholders of the territory and empowered local municipalities. Enabling the emergence of social projects (e.g. remote assistance for the elderly). |
| **Economic** | Catalysed development of the territory in a more sustainable and smart way. Generated a Smart Villages business model that guarantees the sustainable provision of public services and the transition to a green and digital economy. Municipalities saved costs by not using GPRS/3G/4G and can potentially obtain additional revenues by giving third parties access to the Smart Management Network. |
| **Environmental** | Enhanced the efficient use of public resources and services. |

# 20. Cadastre of Latvian land reclamation systems

*Inga Berzina, Union "Farmers Parliament", Latvia*

Land Reclamation Cadastre is an up-to-date, systematic, digital unified information database of all land reclamation systems in the territory of Latvia.

In Latvia, about 90% of agricultural land suffers from excessive moisture due to excessive precipitation. Water discharge and drainage systems for soil wetness regulation measures have been constructed on two-thirds of agricultural land. This includes 37 000 ha of flood-endangered land where Latvia's polder system ensures the safety of people and the conditions necessary for economic activities. Safe use and maintenance of the water management systems and other infrastructures are vital to the national economy, such as roads, railways and airports.

The Cadastre database shows the status of each drainage system and the information that is registered there. The system contains textual and spatial data on the systems built so far on the agricultural land. The information regarding drainage systems in state forest lands is currently uploading on the database. In contrast, there is almost no information archived regarding private forest and state road ditches. The information system is managed by the State limited liability company "Real Properties of the Ministry of Agriculture, Republic of Latvia" (ZMNĪ).

**Application scenario**

Digital unified information database of all land reclamation systems in the territory of Latvia for sustainable management and use of natural resources

**Digital technologies**

Web GIS applications with spatial and textual data (Esri ArcGIS)

**Socio-economic impact**

Social: Publicly available database that favors transparency, better governance, improved information exchange, enhanced data access

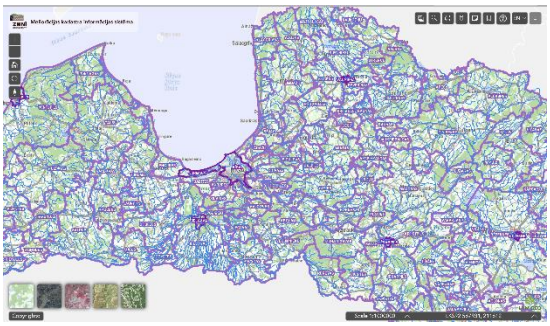
Economic: positive effects on productivity, better resource efficiency, improved use and maintenance of National infrastructures, facilitated land tenure and land use

Environmental: Sustainable use of land and nature resources

**More info:** https://www.melioracija.lv/?lang=EN

https://www.zm.gov.lv/en/lauku-attistiba/statiskas-lapas/amelioration?nid=1173#jump

# PURPOSE OF THE TOOL



The tool is developed for sustainable management and use of natural resources. It ensures the construction, operation, management and maintenance of the water regime necessary for the safety and well-being of the population, infrastructure development, as well as rational drainage systems.

The land reclamation measures, which are owned or legally possessed by the state, local governments and other natural and legal persons, regardless of the ownership and status of its property, shall be registered in the Land Reclamation Cadastre information system.

It is crucial to implement land reclamation measures and to support a productive, economically beneficial use of land and nature resources, to create a safe living environment for people and to ensure the necessary water regime for economic activities. The measures can be either newly-built systems or restored existing ones.

# DESCRIPTION OF THE TOOL

Land Reclamation Cadastre contains:

1) textual data, which includes information regarding the quantitative and qualitative condition of the water management system (including engineering solutions and information regarding the technical condition), the status of the system, documentation of technical regulations, and hydrometeorology data;

2) spatial data, which includes cadastral plans and maps in analogue and digital form, showing watercourses, water drainage systems, water drainage catchment basins and land boundaries, water management system structures and devices and hydrometric items with their enhanced designations, as well as land unit boundaries and cadastral designations.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Publicly available database that favors transparency, better governance, better governance, improved information exchange, enhanced data access |
| **Economic** | Positive effects on productivity, better resource efficiency, improved use and maintenance of National infrastructures, facilitated land tenure and land use |
| **Governance** | State operated, interactions between other sectors, publicly available and accessible |

# 21. AgroPlatforma - FOR SELLING and BUYING GRAIN IN THE INTERNET ENVIRONMENT

*Inga Berzina, Union "Farmers Parliament", Latvia*

AgroPlatforma is the first Internet grain trading platform in Latvia, the Baltics and Europe. It has been developed in Latvia where, with its functionality and capabilities, it represents a new approach to working in the agricultural sector.

On AgroPlatforma, deals in grain can be done faster, more profitably and efficiently with real-time information. The developers of this digital solution anticipate that the tool will increase the total turnover of the industry by up to 15%, as well as give a positive impact to the industry as a whole.

The platform allows the agricultural sector to implement the opportunities provided by digital technologies both in the form of e-commerce tools, and in communication and digital socialisation.

**Application scenario**

Online commerce of grain in an enlarged context; real-time evidence-based decision making for grain trading

**Digital technologies**

Web application; online platform, data sharing among actors

**Socio-economic impact**

- Social: information accessibility, traceability, transparency, trust
- Economic: improved efficiency, marketing, individual position in the market, competitiveness

**More info:**

www.agroplatforma.lv

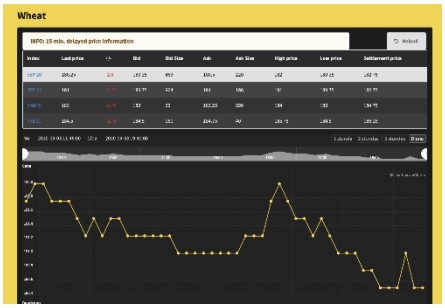
https://www.facebook.com/pages/category/Internet-Company/SIA-AgroPlatforma-365452543969962/

https://www.youtube.com/watch?v=zirgJKlnTc4

The price of grain, and the world price exchanges, determines the published price indices, which are used in determining the prices in grain transactions. AgroPlatforma represents a connection not only between the farmer and the grain buyer, but also with the stock exchange. The involvement of both sellers and buyers in transactions on this platform reduces the direct costs of grain procurement and increases the speed and efficiency of pricing processes. The transactions become more transparent, more reliable and thus more beneficial for both farmers and grain buyers.

The solution complements official national statistics, as all transaction data are stored in databases.

# PURPOSE OF THE TOOL




The goal of AgroPlatforma is to enable farmers to sell their grain product at the best possible price, as well as to do it quickly, safely and effectively. The platform is developed to improve communication and transparency between farmers and the grain buyers, with a key connection to the stock exchange. In addition, AgroPlatforma is the first innovative digital solution for agricultural companies to ensure a fair and effective approach to grain trade.

# DESCRIPTION OF THE TOOL

On AgroPlatforma, the Seller can register as a company, farm or individual person and do transactions with a Rural Support Service (RSS) number. The Seller is the owner of the areas, for which it receives area payments. The Buyer, only a company, whose main activity is the purchase, processing and/or marketing of agricultural products, has the necessary resources to complete transactions. Before concluding the Service Agreement, both the Buyer and the Seller are asked by AgroPlatforma to provide information, in order to verify compliance with these requirements. Moreover, making an offer takes only a few minutes and gives the opportunity to specify the conditions for the transaction. The stock market data is available in real-time within the working hours of the stock exchange.

AgroPlatforma provides both market players (farmers and grain buyers) with additional services which allows them to be more confident in decision-making processes, including a stock market notification service, grain market reports, and podcasts with agriculture experts and/or market players.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Data sharing and information accessibility, traceability, transparency, trust between the engaged actors |
| **Economic** | Real-time evidence-based decision making and management. Improved efficiency, Marketing, individual position in the market, competitiveness. |

# 22. APOLLON: monitoring air quality

*Livia Ortolani, Marco Venturini, Giulia Petitta, AMIGO*

APOLLON is a software platform that implements and deploys new methods and innovation tools for environmental quality monitoring, with particular reference to air quality. Through a sensor network installed on the ground, APOLLON also assesses acoustic pollution and ultraviolet radiation (UV rays).

The approach consists of the distribution of a capillary low-cost network sensor, the use of Artificial Intelligence (AI) algorithms to provide forecasts, and the involvement of both citizens and institutions.

The platform handles multiple and heterogeneous data sources available in the territory, using semantic technologies, IoT, big data, weather and atmospheric forecasting models, and geographic information. Implementing all these data sources together gives the model the capacity to compute final data aggregations at a very high resolution, much higher than existing satellite models. Data sources are represented by:

- Fixed and mobile sensors data stream (IoT sensors for environmental monitoring, placed on public transport or in fixed control units)
- Weather and Atmospheric forecasting models (e.g. WRF weather model and CAMS model by ECMWF)
- Mobile devices (GPRS data, smartphone data, noise data)
- Open Data (data related to environment monitoring provided by public institutions, like public transport remote control, traffic, public transport routes and data from no-vehicle streets)
- Social Media Feeds (users' interactions).

**Application scenario**

Environmental quality monitoring, with particular reference to air, noise pollution and ultraviolet radiation (UV rays) in rural and urban contexts

**Digital technologies**

Satellite data, software platform, Artificial Intelligence, IoT, semantic technologies

**Socio-economic impact**

- Economic: Improving air quality driven DSS, responsibility
- Environmental: Control and mitigate air pollution, climate, air quality
- Social: Increasing awareness of air quality, health, information, security

**More info:** https://apollon-project.it

A visual dashboard displays simple and easy-to-use maps, graphs and textual reports. The tool will help citizens and institutions to increase their awareness and make better decisions.

## PURPOSE OF THE TOOL

APOLLON is aimed at the implementation and testing of innovative tools and methods for monitoring and predicting air quality parameters. The aim is to find relationships between air pollutants and anthropomorphic behaviours (e.g. traffic), weather conditions and land characteristics. It also implements a short-term forecasting model to predict air quality evolution. Prevention of air and noise pollution is related to the data available for the public administration to evaluate the specific risk in their area of reference. The direct involvement of citizens has the goal of improving their awareness on the specific issue. The tool will find relationships between all available data sources, and extract

new realistic information to create real-time scenarios. This will enable citizens and companies to be informed about both real-time pollution conditions and short/mid-term forecasting.

The monitoring network will consist of a software platform able to correlate the flow of information collected by the sensors with other information sources, through the use of semantic technologies and tools for the management and analysis of geo-referenced data.

# DESCRIPTION OF THE TOOL

The tool uses a citizen science approach. Data collected by citizens are integrated with other sources such as sensors (IoT, mobile and fixed) and public control units. The outcome is a visualisation platform based on a web application. Results and infographics are shown through a web dashboard, using simple and easy-to-use maps, graphs and textual reports. Machine learning and big data infrastructures are the digital technologies used to achieve this goal. This tool has multiple end-users: citizens, companies and public institutions. The online dashboard will help citizens and institutions to make better decisions.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Citizens increase their awareness of the real value of information on air and noise pollution. Contribution to encouraging citizens to adopt good practices concerning the reduction of air and noise pollution. Improved health and security. |
| **Economic** | Improved management and decision-making for companies, which are directly affected by air and noise pollution. Providing competent administration with IT tools, allowing them to adopt proper measures for the protection of citizens' health. |
| **Environmental** | Greater awareness of public administrations of the risk of air and noise pollution at local level when considering specific measures. Improved air quality. |

# 23. AGRICOLUS DSS

*Marco Venturini, Livia Ortolani, Giulia Petitta, AMIGO*

Agricolus is a Decision Support System (DSS) which collects, analyses and interprets data from forecast models, crop scouting and remote sensing. It provides farmers with information to help prevent and fight the main diseases of olives, tobacco, vineyards, vine, corn and other crops. This DSS pursues various objectives: 1) prevent plant disease, 2) support decisions on the distribution of sanitary products, and 3) gather and compare data related to productivity, treatments and infections of fields and crops.

Agricolus is a cloud platform accessible from both web and mobile devices. It operates as a monitoring tool providing meteo-climatic data and innovative forecast models of the spread of phytopathologies on crops at plot and farm level. The forecast models provide precise information suggesting the best time to apply treatment and also on which specific part of the area.

**Application scenario**

Provide farmers with data for optimising pest treatments management and recognition of diseases in crops

**Digital technologies**

Cloud platform, IoT sensors, forecast models, web, mobile devices

**Socio-economic impact**

- Economic: input saving, productivity and profitability, improve quality production
- Environmental: decrease in the use of phytosanitary products, prevent the spread of crop diseases
- Social: alternative channels to social networks for knowledge exchange

**More info:**

https://www.agricolus.com/agricolusdss/

A combination of technologies collect data. Internet of Things (IoT) sensors gather data from soil and leaves and send information to the platform about specific parameters. For example, meteo-climatic sensors provide data on precipitations, humidity, wind direction and speed, and temperature. The weather forecast systems provide data on single fields. An advanced data storage and management system collects and archives data on possible presence of phytopathology.

All those data are combined in provisional models to provide valuable information on the risk of plant disease in advance, to allow farmers to take decisions on what actions to undertake on their crops. The accuracy of the model and the specific localisation system enable a quick intervention in the field, leading to increased productivity and profitability.

## PURPOSE OF THE TOOL

Agricolus is a Decision Support System (DSS) tool for agriculture. The main purpose is to provide farmers with information in advance on the risk of phytopathology spread. This monitoring tool has two further objectives: to provide information on the use of sanitary products, and to collect data on

the effects of phytosanitary products in plots and on farms. While the first purpose is directed to the farmers, the second and third aims are also of interest of companies selling phytosanitary products, enabling them to conduct an analysis of the effectiveness of their products and to promote the optimal use of the treatments. The issue of data property and open data is relevant in such tools and should be considered to guarantee farmers' rights.

# DESCRIPTION OF THE TOOL

The tool utilises sensors (IoT and meteo-climatic) to collect data and "feed" forecast models. The digital technology can improve the precision of data collected, but it cannot improve the accuracy of the forecast model, which depends on the main assumptions used to build the model. Results on those Decision Support Systems are given in probability terms. The main users of single field data are farmers or technical advisors. However, the combination of data from different fields can be of interest both for public administrations that regulate farms and evaluate the environmental impact of chemicals and pests, and for private companies producing chemicals to consider the efficiency of their products.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Increased knowledge and less dependency on technical advisors. |
| **Economic** | Reduction in the cost of inputs for large-scale farms with high chemicals consumption. |
| | Limiting loss in production due to plant diseases. |
| | Increasing effectiveness of phytosanitary products on specific plant diseases. |
| | Higher quality of products. |
| **Environmental** | Reduction in the use of phytosanitary products to fight plant diseases, depending on the accuracy of the forecast model. |
| | Increase in the capacity of environmental monitoring for public administrations. |

# 24. GroenMonitor: Measuring and tracking the development of green spaces

*Lurissa den Dulk, Wageningen Research*

The GreenMonitor (GroenMonitor) is a satellite monitoring system that generates a "green index" in the form of a number between 0 and 1. This number indicates how much biomass is present in a given area. Tracking the development of biomass provides an overall picture of the progression of a growing season, as well as the influence of weather, pests, plant diseases and human activity on the land area.

**Application scenario**

Satellite monitoring of vegetation.

**Digital technologies**

Website to access satellite data.

**Socio-economic impact**

- Economic: information driving response to drought, floods, pests and diseases.
- Environmental: measurements of biomass and nature development during a season.
- Social: information to support coordinated actions.

**More info:** http://www.groenmonitor.nl/

The website for the GreenMonitor does not provide data analysis or specific recommendations to users. Rather, it gives users data (green indices) that can be used in a multitude of ways to inform actions and responses. While this lack of a specific data product may be confusing for some, it also allows for flexible implementation that could be combined with other technologies to act as a digital game changer. It is easy to see how this product could be useful for farmers to better infer when to plant which crops and where, for insurance companies to calculate the damage done by a disease or pest, and for conservationists to monitor development of green spaces in a nature area.

# PURPOSE OF THE TOOL

The GreenMonitor is intended to share information with farmers and ecologists about biomass developments. This 'green index' calculated by GreenMonitor for a given land parcel is freely available via the website, where there is a video explanation of the tool (in Dutch). This information does not include specific recommendations for different land parcels. Rather, it informs users as they make any number of decisions. Applications are many. For example, the tool could allow users to work with their neighbours to coordinate a response to pest infestations like processionary caterpillars, to diversify crops and increase yields, or to set up partnerships between ecologists and farmers that benefit conservation areas without threatening crops.

# DESCRIPTION OF THE TOOL

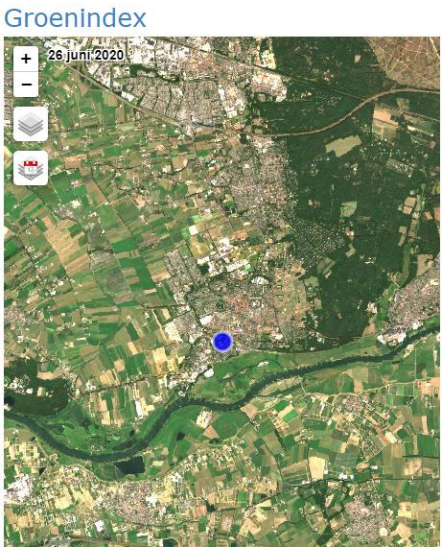



Photo credits: GroenMonitor

The GreenMonitor uses information from satellites which take pictures of the Earth's surface on cloudless days. The satellites have a 6-metre resolution. These satellite images are cross-referenced with a database of the uses of each parcel of land (e.g. grasslands, forest land, crops, and urban areas). Each parcel of land is then given a number between 0 and 1 called a green index. Just like temperature can be measured with degrees Celsius, the biomass of a land parcel can be measured with the 'green index' (*groenindex*), otherwise known as a *Normalised Difference Vegetation Index* (NDVI), which is the ratio between the reflections of red and near-infrared light. The index is then used to compare different parcels of land, or to compare the same parcel of land from one month or year to the next. The index can show when crops were harvested, the impact of drought and speed of recovery, or the progression of diseases killing off biomass. This information is valuable to farmers and ecologists alike. Though the direct implications of the tool itself are small, combining this information with other sources could have a multitude of applications. The website already gives the example of the data being combined with the movements of fauna to track damage done by some pests. The availability and flexibility of the data make it a potential digital game changer.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Access to information for informed coordinated action. |
| **Economic** | Calculation of damage trends caused by climate change-related events. |
| **Environmental** | Conservationists track changes in land use and movement of fauna. |

# 25. Sparter: Robotic selective harvesting of white asparagus

*Lurissa den Dulk, Wageningen University and Research*

SPARTER is a selective harvesting tool for white asparagus. Selective harvesting means picking that part of the crop which is sufficiently large or ripe without harvesting (or damaging) those plants which are not ripe enough or too small, so that these can be picked at a later time.

Finding sufficient workers to harvest the asparagus is still the biggest challenge facing asparagus growers. The goal of this tool is to reduce the need for manual labour and increase the quality of harvested white asparagus.

The tool uses an underground detection method to determine when a crop is ready and to harvest accordingly. This method of underground detection can reduce harvesting costs by 50%. It also improves crop yields, making them both more predictable over time and more profitable, by targeting fertilisation and irrigation.

**Application scenario**

Selective detection and harvesting of white asparagus.

**Digital technologies**

Sensors to gather data. Robotics to harvest. A platform for storing and analysing data.

**Socio-economic impact**

- Economic: predictable yields, improved crop quality and quantity.
- Environmental: lower use of water and fertiliser.
- Social: field labourers no longer needed for selective harvesting.

**More info:**

https://www.cerescon.com/EN/sparter

# PURPOSE OF THE TOOL

SPARTER is designed to perform selective harvesting of white asparagus. Through its underground detection method, the tool also provides information that can improve crop quality by avoiding discolouration and open heads. Harvesting capacity triples when compared to methods that use above-ground detection. This is due to a decreased chance of underground damage as compared to hand-picking and restoration of the sand bed after harvesting. Labour costs are reduced significantly, because the tool can work both day and night.

SPARTER (Photo credits: Cerescon)

# DESCRIPTION OF THE TOOL

The SPARTER tool uses earth skis to skim along rows of asparagus and uses sensors to detect asparagus in the ground. The sensors can move through the soil at various depths, allowing the tool to determine the size of the spear without damage. The harvesting robot receives the coordinates from the detection module and moves to pick the spear from the top of the bed down. The spears are transferred to a receptacle and the sand bed is covered again to prevent future damage to spears. The tool does not require light to "see" the spears, so it is able to work both day and night.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | No need for hand-picking by labourers. |
| **Economic** | Improved crop predictability and increased yields over time. More A class products. |
| **Environmental** | Water and fertiliser can be micro-targeted, thereby reducing consumption and application overall. |

# 26. Phytophthora Lite: Reducing infection with better information

*Lurissa den Dulk, Wageningen University and Research*

PHYTOPHTHORA LITE is a software application used in the Netherlands that takes users' local and regional weather and makes predictions about the chance of a given crop becoming infected with phytophthora. The application provides information for both treated and untreated crops. Predictions on the chance of infection are rated as 'low', 'medium', or 'high' and are shown for a period of 3 days: the day before, the present day, and the following day.

**Application scenario**

Advice for avoiding phytophthora infection on smartphone.

**Digital technologies**

GPS and weather data; big data.

**Socio-economic impact**

- Economic: decreased financial risk.
- Environmental: plant health.

**More info:** http://agroapps.nl/apps/dacom-phytophthora-lite/

This information allows users to predict when the best time to water, treat or harvest their crops may be in order to prevent or reduce phytophthora infection. This information allows for better decision-making, which could potentially lead to a reduction in plant protection treatments and improve the efficiency of use of farming resources like water, providing improved plant health for both the crop and the surrounding environment. This would also lead to a significant reduction in economic costs related to the purchase of plant protection products and the costs associated with personnel, machinery and equipment.

# PURPOSE OF THE TOOL

PHYTOPHTHORA LITE allows users to make informed decisions about when and how to treat their crops in order to avoid phytophthora, a fungus-like pathogen that damages or destroys crops, leading to poor plant health and financial loss.

# DESCRIPTION OF THE TOOL

Users allow the application to access their location data. The application connects to weather services and cross-references weather with known rates and types of phytophthora infections in a given crop. The application can then offer advice to users about when to treat a crop, as well as a model for comparison: the risk of infection the day before, in the present day, and in the following day.

Users are able to input data on their crops, treatments, and the progress of phytophthora. This additional data allows the algorithm to improve its predictions.

Photo credits: AgroApps

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Economic** | Enabled better decision-making in crop treatment thereby minimising financial loss. |
| **Environmental** | Improved crop health and improved decision making about using treatments may allow for a reduced use of treatments overall. |

# 27. CowVision: An insightful overview of users' agricultural chains

*Lurissa den Dulk, Wageningen University and Research*

CowVision is an online application platform that provides an overview of a cow farmer's business and opportunities for improvement. CowVision is the successor to the Comru desktop package. The software is available in 30 locations worldwide.

The CowVision platform comprises five applications (all designed by Agrovision) that work together to provide a detailed overview of a users' cow farm. These applications look at five elements: (1) animal management (pedigree, offspring, inseminations, milk production figures, links with system of the government, dairy companies, animal health service), (2) feed (rations and feed calculations/doses), (3) minerals (phosphate monitor and government regulations), (4) soil and crops (fertilization production and plan) and (5) financial aspects of the business (current balance per kilo of milk, drawing up a liquidity budget and submitting the VAT return).

The integration of data from these five applications allows consultants to provide targeted advice to users looking to improve their efficiency or quality. While the integrated applications allow a farmer clear insight into their business, the five applications can be purchased individually. Therefore, if a farmer only wants insight on feed calculation, he/she will purchase the Optifeed app rather than the entire CowVision suite. However, that means that some functionality is lost without the integration of other data points. This encourages users of an individual application to transfer all their data to one platform if they want comprehensive insights. The users have online access to their management programme on various devices, at any time. All data is stored on well-secured central servers, which reduces the administrative pressure for the dairy farmer.

**Application scenario**

Analysis, monitoring, and benchmarking for farms to assist in decision-making and to optimise cow farmer's business operations.

**Digital technologies**

Software application platform; big data; data analytics; mobile app

**Socio-economic impact**

- Social: access to information about entire agricultural chain; better management
- Economic: eases burden of financial management; insights can lead to cost-savings, efficiency and quality
- Environmental: phosphate monitoring; fertilization plan

**More info:** https://www.agrovision.com/

# PURPOSE OF THE TOOL

AgroVision is a company offering suites of software applications that help users track, analyse and manage their agricultural business. Farmers and agribusinesses deal with huge amounts of data, multiple links in their supply and production chains, and must ensure they are complying with a government's rules and regulations. Keeping track of this information is time-consuming and can limit a business's ability to grow. The integration of these factors into AgroVision's software applications, such as CowVision, allows users to manage their business using data that is more accurate and available much faster than if they were trying to manage alone. Users can implement targeted measures to tweak aspects of the business for maximum efficiency and profit.

Photo by Jakob Cotton on Unsplash

# DESCRIPTION OF THE TOOL

CowVision is software designed by AgroVision for dairy farms. Its programme features animal management, feed, mineral legislation, soil and crop, and financial applications. It combines all management units together in one online programme.

The CowVision tool can be installed on multiple devices. The applications are particularly useful on mobile devices where users can input data as they work in the field. While applications can be used separately, they provide the most complete overview when integrated on the CowVision platform. For example, the Dairy Monitor application which connects farm advisors and dairy farmers works better when it is integrated with the Optifeed application which provides detailed feed ration information directly from production companies. Consultants are able to offer insights based not only on an individual user's business, but can also compare data points to larger data sets and offer suggestions based on best practices.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social** Better access to information, better decision-making in farming and agribusiness, resulting in better management

| | |
|---|---|
| **Economic** | Stimulate users (both on the farm and for those advising on farm improvements) onto a single platform that unifies decision-making processes, reducing the burden of financial management; provide insights that can lead to cost-savings, efficiency and quality |
| **Environmental** | Improved phosphate monitoring and support to develop a fertilization plan |

# 28. BeeKing: digital apiary management

*Sandra Šūmane, Baltic Studies Centre*

BeeKing is a digital note-taking and work planning mobile application aimed at improving the efficiency of apiary management for beekeepers. The tool allows the recording of a beekeeper's observations and actions at the apiary, with the help of voice recognition technology on a smartphone and near-field communication (NFC) sensors attached to hives. The users can consult and organise the registered data, and interact with other beekeepers on the internet support platform.

**Application scenario**

Effective apiary management and informed decision making to ensure the wellbeing and production of bee colonies in hives

**Digital technologies**

Mobile application, speech recognition and near-field communication (NFC) sensors to register information, cloud storage, online forum for users' support and networking

**Socio-economic impact**

- Economic: work organisation, planning, efficient management, tracking data optimisation
- Environmental: saving resources, for example chemicals for mite treatment due to improved monitoring, bees' welfare
- Social: beekeepers' networking and mutual learning

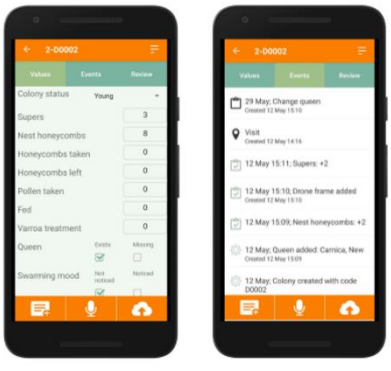
**More info:** https://beeking.eu/en

The tool helps beekeepers improve their work efficiency. It enables more accurate and systematised monitoring of apiaries, as it substitutes for manual note-taking which can be time-consuming, inconvenient and incomplete. This digital beekeeping assistant records the status of colonies and queen bees, keeps notes on Varroa mite treatments, records the amount of collected honey and pollen, and other information.

Therefore, it also serves as a decision-making support tool: the beekeepers can learn from their observations and make better-informed decisions on the basis of a more thorough and systematic overview of the situation and interventions made in their apiaries.

The forum for beekeepers' networking aims to facilitate their knowledge exchange, mutual learning and co-working.

## PURPOSE OF THE TOOL




Source: www.beeking.eu

The mobile application BeeKing was developed to support beekeepers' work at their apiaries. Beekeeping requires regular monitoring of bee colonies in hives to ensure their wellbeing and production with timely and appropriate interventions. The application eases note-taking of observations and actions made in an apiary and at each hive, as it replaces manual writing by data recording with voice and NFC sensors.

# DESCRIPTION OF THE TOOL

The hand-free tool allows beekeepers to record notes of their observations and actions on a smartphone while working in an apiary. The beekeeper's speech is automatically transcribed into text that is stored on the cloud for further processing and use. Registration of the performed activities at each hive can be done also with the help of near-field communication sensors attached to the hives. The data are accessible on an internet portal where the beekeeper can have an overview of all the interventions and observations made in the apiary and each hive. The next tasks can be planned and scheduled on the app accordingly. The internet portal also includes an open forum for user support and networking: registered app users can share their experiences and knowledge with their peers.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Enable beekeepers' networking and mutual learning, create a community. |
| **Economic** | Improved monitoring, work planning and decision-making in apiaries that allows to increase work efficiency and reduce costs. |
| **Environmental** | Saving resources due to improved monitoring, improved honeybee welfare. |

# 29. Interactive platform for a smart dairy farmer

*Mikelis Grivins, Baltic Studies Centre*

Relations between dairy producers and processors have been one of the problematic areas in the dairy sector. The major factors causing discontent are the price, the quantity and the quality of the milk. In this context, one of the largest milk processors in Latvia, Food Union, has developed an interactive digital platform for dairy farmers "Smart Dairy Farmer". The platform is aimed at supporting the farmers supplying the processor with milk and with data of their milk suppliers that could be used to support on-farm decision making, increase traceability of milk and to improve the transparency of the farmers-processors relations.

**Application scenario**

Logging and analysing data on milk to efficiently plan farm resources and operations. Real-time evidence-based decision making

**Digital technologies**

Data sharing, mobile app, online platform

**Socio-economic impact**

- Economic: improved efficiency, clearer relationships between links in the dairy production supply chain, market optimisation
- Environmental: improved production forecast avoids excessive resource use and reduces waste
- Social: traceability, transparency, better production management

**More info:** https://foodunion.com/news/food-union-creates-digital-tool-for-latvian-farmers

The platform allows a farmer to monitor several farms' performance indicators at any selected time-frame. Firstly, it provides a farmer with a way to monitor the sale price for the milk they have supplied and to compare this indicator with global average milk prices. It also provides data regarding the quality of the milk sold (such as protein content, milk fat and other macronutrients). The Food Union refreshes the data used in the platform two to three times a month. Thus, although it is not entirely real-time monitoring, it still provides a clear illustration of the dairy trade dynamics allowing farmers to plan their resources more effectively.

The tool is developed using Microsoft Power BI analytics platform, which is available for free to iOS and Android users. It is available to the suppliers of the processor.

## PURPOSE OF THE TOOL

The platform is developed to improve communication and transparency between farmers and the processor of the dairy industry. The interactive platform also helps farmers to improve the efficiency of their farms and the quality of milk they supply to the processor. In addition, it also helps to improve the traceability of the milk. It does so by sharing data available to the processor with farmers.

At the same time, it also sets a new standard for dairy business management. The platform is available only to the suppliers of the processor, and it is believed that in the long-term it will also help to strengthen loyal and trustful relations between the two actors of the supply chain.

# DESCRIPTION OF THE TOOL

The tool is based on the Microsoft Power BI analytics platform, which is available for free to iOS and Android users. It combines aggregated data and the farm-level data on milk supplies available to the processor.

The key features of the new platform offer farmers, who have developed long-term cooperation with Food Union, the opportunity to see and analyse, for any particular cooperation period, data such as the quantity of milk sold and the quality of its components, including milk fat and protein content. Farmers can also keep track of financial data with the help of the tool, including data on payment amounts the farmer has received and the total amount of milk sold, as well as his or her average milk price and how it compares with the average market price.

The platform offers the data to a farmer in a visual way, allowing them to monitor their performance. This data is used mainly to support on-farm decision making and to improve the quality of the produced milk.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Improved traceability, transparency, and better production management. Data sharing improves trust and loyalty between the engaged actors. |
| **Economic** | Real-time evidence-based decision making and management that should result in more efficient farming. Clearer relationships between links in the dairy production supply chain and market optimisation. |
| **Environmental** | Improved production forecasting means more efficient use of resources, which reduces waste. |

# 30. OSIPPPIT - Web farmer's market

*Ena Ban, Kristijan Jelakovic, Ministry of Agriculture*

OSIPPPIT is a free web application that aims to help farmers use digital tools to sell locally-produced products to a large number of consumers in the area of Istria County, Croatia.

The application is an online market and an interactive map. The users are small farmers, members of farm associations, and consumers of agricultural products: households, restaurants, educational centres, hospitals, tourist establishments and other public institutions.

The application enables buyers to search for home-made products and locate them on a map. The buyer can browse the product offer in four different ways: by product group, product type, keyword or production area/location. The producers can present their products, increase their visibility, and help consumers make online orders by choosing delivery and payment methods. The app also provides direct online communication between the farmer and the consumer, along with destination guidelines for tourists.

**Application scenario**

Promoting small farmers' products and connecting farmers with local consumers, online market

**Digital technologies**

Web-browser, online platform, interactive map application

**Socio-economic impact**

- Economic: Organisation, independence, market conditions and standards, position in value chain, profitability, added value
- Environmental: proximity sales, high-value and quality products, low input production systems
- Social: connection between farmers and end-consumers, food sovereignty

**More info:** https://www.trznica-trg.eu/en

The platform was developed through the project "Organisation of the system of direct sales of agricultural products using Internet technology" (OSIPPPIT) financed by the operational Programme Slovenia-Croatia 2007-2013 under the European Regional Development Fund (ERDF). The partners were the Institute of Agriculture and Tourism of Porec, the City of Vodnjan, the Faculty of Agriculture and Life Sciences at the University of Maribor, the Science and Research Centre of Koper, farm associations and the private sector (ICT Company).

# PURPOSE OF THE APPLICATION

The web application is a market for home-made agricultural products. It aims to promote opportunities and methods for selling local agricultural products, direct insight into production technology, and the purchase of fresh and quality agricultural products in the local area of Istria County.

The global market for agricultural products is saturated with cheap products, from often insufficiently differentiated industrial production systems, whose main goal is to maximise profits, often at the expense of quality. Such trends mostly affect small and medium-sized agricultural holdings that do not have the technology to produce in quantity or be as competitive when reaching the consumer.

Given the importance that small and medium-sized farms have for the management and sustainable development of rural areas, and in preserving their sociological, ecological and cultural role, it is clear that one of the most important tasks of agricultural policy, especially in the Mediterranean, is to find new opportunities and sources of income for these farms.

# DESCRIPTION OF THE TOOL

OSIPPPIT is a free web application, to which all farms that are certified in the Farm Register have the right to sign up. Through it, small and medium-sized farms can sell their own agricultural products, and connect to consumers directly. The application requires accurate data to be entered as a prerequisite for successful communication between producers and buyers in the process of ordering and purchasing products.

The local agricultural products offered must comply with all legal regulations governing the production and trade of that agricultural product, and each producer must independently comply with the legal regulations and conditions to place the products on the market. The developer and owner of the application do not have any responsibility in this regard.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Better communication between small and medium-sized agricultural holdings and end- customers, greater food sovereignty and purchasing decision capacity, contributes to avoiding local depopulation. |
| **Economic** | Strengthen position of small and medium-sized agricultural holdings in the value chain. |
| **Environmental** | Less impact due to proximity sales, high-value and quality products and a low input production system. |

# 31. #DONESIDOMA – Virtual Marketplace

*Ena Ban, Kristijan Jelakovic, Ministry of Agriculture*

#DONESIDOMA is a virtual marketplace that connects agricultural producers, family farms, companies and customers.

The online platform has been established to help the local economy, but also citizens to more easily access food produced by local farmers in the context of COVID-19.

Given the new situation caused by the coronavirus pandemic, with restrictions on certain activities and movements, citizens are limited in performing daily activities, including buying food. To provide a solution, the City of Rovinj (Croatia) together with the farm association Agrorovinj launched an online platform to connect producers of food and other products with end-customers in the city of Rovinj called "Tastes of the field - I sapori dei campi".

The virtual marketplace allows an easier and quicker view of the current offer of agricultural products in the area, and enables customers to get to know the farms that offer local home-made products. It represents an opportunity to establish direct contact with producers, and to purchase seasonal agricultural foods, olive oils, wines and other products, and in a very simple way to get fresh and healthy food.

Entering data on offers on the platform is free for producers, and the method of buying and paying for products is the responsibility of sellers and customers.

**Application scenario**

Online marketplace to promote farmers' local products and connect producers with consumers

**Digital technologies**

Webpage, online shop (e-commerce), mobile app

**Socio-economic impact**

- Economic: assistance to local economy, improve position of local producers in the value chain
- Environmental: low input systems, high-value and quality products, resource efficiency
- Social: identity, local consumption, food sovereignty, rural population

**More info:** https://www.donesidoma.com/

## PURPOSE OF THE APPLICATION

#DONESIDOMA is a virtual marketplace to connect producers of food, and other products, with end-customers. In the context of the coronavirus pandemic, with restrictions on certain activities and movements, citizens are limited in their daily activities, including buying food. The City of Rovinj (Croatia), together with the farm association Agrorovinj, has launched this online platform, which enables the sale of products of local agricultural producers from the area.

Through this virtual marketplace, it is possible to easily and quickly view the current offer of fresh and local agricultural products in Rovinj and its surrounding area, meet the farmers that offer their products, and through direct contact make purchases of products.

# DESCRIPTION OF THE TOOL

#DONESIDOMA is an online shop that allows e-commerce from a webpage. All farms in the Register of Agricultural Holdings have the right to register on the online platform. Producers offering agricultural product must be located in the City of Rovinj and have computer and mobile phone devices with internet access.

Displaying products and services on the platform is free for all farmers. It helps local producers and companies by finding alternative channels for digital advertising and promotion of local products and services.

The method of delivery, as well as payment for purchased products, is directly agreed by the buyer and sellers.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Better communication between agricultural holdings and buyers in the process of ordering and purchasing local products. Enhanced local identity, local consumption, food sovereignty and prevention of rural depopulation. |
| **Economic** | Supporting the local economy and selling food produced on farms located in a specific area. |
| **Environmental** | Support to low-input systems, high-value and quality products and proximity products and services, and improved resource efficiency. |

# 32. LEŚNIK+: a new application for Forest Management in Poland

*Paulina Tobiasz-Lis, UniLodz*

Lesnik+ is a newly-developed forest management software application, based on the Android system, which enhances timber recording in forestry management practices. Implemented by State Forests in Poland in September 2019, as part of a strategic project on mobile technologies, it replaced the former "Leśnik" based on Windows Mobile.

Basing the new application on the Android system made it possible to switch it to smartphones, to fulfil the application's full potential. Leśnik+ is a big and integrated system of five, formerly separate, applications used by State Forests in Poland. The greatest benefits are related to the new data transfer functionality and the map module, which enable better communication, data coordination and management within the Information System of State Forests in Poland (SILP).

The application supports forest professionals by providing an overview of forest areas, in performing the necessary documentation, and in planning forest cultivation. Leśnik+ offers a field mapping service, general inventory management, and a full timber turnover documentation function. All data can be conveniently recorded from the office or from the forest.

Over each year, mobile forestry devices record a turnover of over 40 million $m^3$ of wood with a value of approximately EUR 2 billion, which proves the importance of mobile technologies in Polish forestry.

**Application scenario**

Software for enhanced timber recording in forestry management practices

**Digital technologies**

Mobile application, software, desktop application, WebGIS

**Socio-economic impact**

- Economic: organisation, financial autonomy, value chain transparency, work efficiency
- Environmental: management of natural resources in forestry, protection
- Social: access to information, education

**More info:**

https://www.lasy.gov.pl/pl/wideo/telewizja-lasow-panstwowych/wideo/lesnik-najnowszy-sprzet-i-aplikacja-dla-kazdego-lesniczego-i-podlesniczego

## PURPOSE OF THE TOOL

Leśnik+ is a software application developed by State Forests in Poland for more efficient recording of timber turnover and the work of contractors, but also for issuing timber legality certificates in non-state forests. The first version of this mobile application was released in 1997, alongside the development of an integrated and uniform Information System of the State Forests in Poland (SILP). Since 2007, the second generation of devices was based on the Windows Mobile system. However, as Microsoft announced the end of support for this platform in 2020, in 2014 State Forests started to work on the implementation of new Android-based technologies, including Leśnik+.

# DESCRIPTION OF THE TOOL

Leśnik+ is a forest management software application that has three main improvements compared to its previous version. Firstly, it integrates the functionality of five mobile applications, for timber turnover, data transfers, measuring trees intended for felling, planning works of outside contractors, and mapping services, which were used separately before 2019. Secondly, data transfer is easier and faster, partly because it runs inside the application and not within separate tools. Lastly, is the integration of a basic system with a map module, which, apart from visualising and filtering map layers, is important when adding data and documents, after locating in-field positions via GPS.

Leśnik+ has been implemented by almost 4 000 registrants. However, eventually the system will operate on approximately 10 000 devices used by forest workers all over Poland. The system is also available for educational purposes in forestry schools and universities which train the staff of State Forests in Poland.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Optimised human resources and enabling better access to information on forest management. The system is available to forestry schools and universities training new State Forests staff. |
| **Economic** | Advanced timber management, enhanced efficiency of in-field operations, full coordination with other elements of the system (previously separate applications), upgraded quality of the former mobile application used since 1997. |
| **Environmental** | Improved management of natural resources in forestry – Leśnik+ informs about restrictions related to nature protection (notes about zones of strict protection, Natura 2000 sites, protected species, priority habitats, etc.). |

# 33. SatAgro - crops satellite monitoring

*Karolina Dmochowska-Dudek, UniLodz*

SatAgro is a system that was developed by a Polish start-up with EU funds in 2015. This innovative technology processes and integrates satellite data used in farming to monitor the state of crops and individual fields. The system sends data in an easy-to-understand format that helps to increase agricultural efficiency and helps to reduce a farm's environmental footprint.

| **Application scenario** |
| --- |
| The use of remote sensing and satellite data in farming to improve farm management and performance efficiency |
| **Digital technologies** |
| Remote sensing, GPS, application maps, sensors, IoT, app |
| **Socio-economic impact** |
| ▪ Economic: resource efficiency, optimised farm management, maximise land's potential, productivity<br>▪ Environmental: Soil protection, reduce environmental footprint of farming<br>▪ Social: Improved data accessibility, information, empowering social capital, prediction, surveillance |
| **More info:** https://www.satagro.pl |

SatAgro makes use of satellite imagery from NASA, the European Space Agency and private satellite operators. A desktop application allows farmers to monitor productivity of cultivated land and analyse historical data (including meteorological data and indices, soil maps and vegetation maps) on an ongoing basis.

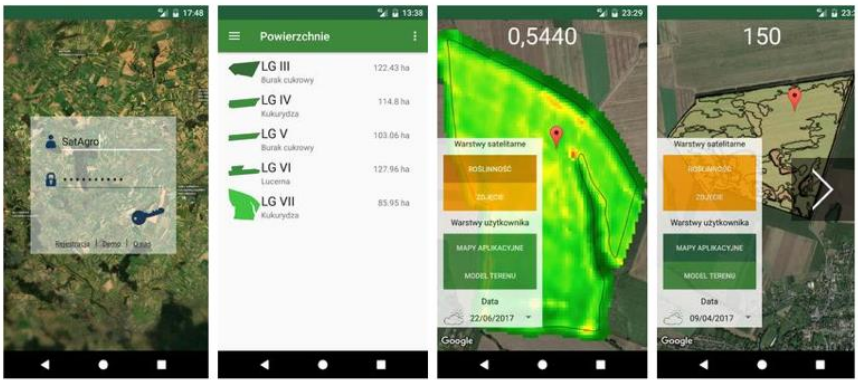
The SatAgro system offers different services, such as crop monitoring, event and treatment logging, alarms when variable values are exceeded, data export to other applications, historical data from previous seasons through maps, geolocation, weather forecasts, soil sampling support, and consulting to help users interpret data and optimise crop yields and production inputs.

With the Android SatAgro app, users can monitor crops' development in near real-time, observe the effects of weather events and agronomic treatments, and use historical data to improve decision-making. It allows optimised agrochemical (fertiliser and plant protection products) doses, which also minimises environmental impact. Custom-built variable-rate prescription maps enable farmers to sow, fertilise and spray with unprecedented precision. Automated alarms warn about sudden changes in crop condition and weather. The application is free for farms of up to 50 hectares. SatAgro's crop monitoring application is currently in use in 20 European countries, as well as in the United States and a few African countries, and it covers more than 20 000 fields.

# PURPOSE OF THE TOOL

SatAgro aims to make satellite data accessible to all. It develops processing chains for a variety of satellites, transforms and processes the data as it becomes available, and delivers the resulting images, cropped to individual user's needs. SatAgro uses innovative solutions to improve decision-making and increase agricultural efficiency, but also to reduce environmental footprint. SatAgro allows knowledge exchange (i.e. experts can collaborate with farmers to develop new solutions). A Professional and Premium Packages technical support and agronomy advice is included.

# DESCRIPTION OF THE TOOL




Source: SatAgro

Basic SatAgro components consists of few functionalities. The Dashboard displays basic information along with a schedule of upcoming satellite fly-overs. The Explorer (the most important part of the SatAgro app) lets the farmer browse data acquired by satellites as well as other data integrated with the account, such as digital terrain models and soil quality maps. It is also possible to inspect time series of key variables (e.g. weather data – received from public and private, web-enabled weather stations) on the charts. With the Android SatAgro app, users can compare what they see on satellite imagery with the actual situation in the field and easily find problem spots with the phone's GPS. SatAgro app also helps with applying fertiliser based on satellite imagery and planning soil sampling. SatAgro system offers compatibility: individually collected satellite and weather data can be exported for use outside the app, and the precision treatments created in SatAgro can be wirelessly sent straight to the tractor in the field.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Enhanced human work; better access to information. The system is available for all users - free for farms up to 50 hectares. |
| **Economic** | Enhanced efficiency of in-field operations and evidence-based decision-making and management. |

| | |
|---|---|
| **Environmental** | Protection of the environment, thanks to reductions in the use of fertiliser and plant protection products. Using the app helps cut fertiliser use by up to 30%. |

# 34. iFARMING: livestock integrated farm management systems

*Daniel van der Velden, Lies Debruyne - EV-ILVO*

The iFarming system developed by Fancom is a tool or management system used worldwide. In Belgium several farmers are using (parts of) this system to manage their farms in new ways and improve their farm management.

iFarming is developed with a focus on intensive livestock production, such as poultry or pigs. The Ifarming tools is used to automate barn management, such as ventilation, feeding and herd management, integrating them into one farm management system.

This enables farmers to increase productivity, while improving housing conditions.

With the increasing number of intensive livestock operations, coupled to societal demands on sustainability and pollution, it is increasingly important to reach maximum efficiency in livestock farming. Systems like iFarming, allow farmers to reach these goals more consistently with a reduction in labour demand, while potentially also reducing costs. The technology is developed with intensive livestock farming in mind. This means larger and more intensive operations will likely benefit the most from this technology.

**Application scenario**

Smart farming for livestock. Herd management using climate control and feeding data.

**Digital technologies**

Integrated sensor and network technology, fusion of data streams for real-time information.

**Socio-economic impact**

- Social: farmer wellbeing, skills; access, information
- Economic: increase income, optimise value chain, improve food quality, enhance resource efficiency; market concentration
- Environmental: animal wellbeing and welfare

**More info:** https://www.fancom.nl/smart-farming

# PURPOSE OF THE TOOL

The purpose of the iFarming tool is to automate and integrate intensive livestock farming. The management system's software collects the data and integrates it on a platform which the farmer can access. This allows farmers to increase the size of their operations with a reduced labour cost, as well as improving livestock management, both increasing productivity and reducing the incidence of diseases or other problems.

# DESCRIPTION OF THE TOOL

iFarming provides a comprehensive barn management system that automatically collates and analyses data on climate control and automated feeding, and continuously monitors animal behaviour. It allows farmers to optimise both their livestock management and their labour needs. This technology is particularly suitable for the intensive livestock farming sector since it responds to the needs of farmers with large operations in terms of reaching sustainability and animal welfare goals. Smaller farms, or farmers with less intensive operations, will most likely not gain a benefit from this technology.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Farmers benefit from workforce optimisation, which can also improve their wellbeing. The tool also requires farmers to have increased knowledge of digital systems and management systems, changing the skillset farmers need. |
| **Economic** | For individual farmers, iFarming can lead to increased income, by reducing management costs and making more efficient use of resources such as water. The increased intensification of agriculture both enables, and requires, the automation of livestock management. This intensification impacts the value chain and market concentration, which is important to consider in assessing this technology. |
| **Environmental** | There is potential for improving the health and wellbeing of animals in intensive livestock production. Sophisticated livestock management systems like iFarming enhance the farmer's capacity to respond quickly and adequately to avoid diseases and other problems in livestock. |

# 35. Farmcafe: an online meeting space for Flemish farmers

*Daniel van der Velden, Lies Debruyne - EV-ILVO*

FarmCafe is a tool in use since 2015 which aims to provide an online platform for farmers to connect with other farmers, advisors and experts, so they can develop ideas together.

This digital platform provides inspiration to professional farmers in Flanders and provides the space to post questions, read articles and develop business ideas and innovative plans. The goal of this platform is to develop new digital ways for farmers to receive information and support from a team of experts, which allows farmers to gain a clear view of their agricultural businesses. Farmers can turn to this community to find information on the challenges of today and tomorrow facing agriculture, such as new regulations, farm succession, and economic and technological developments.

**Application scenario**

Digital meeting space for farmers and advisors for knowledge exchange

**Digital technologies**

web interface, digital online platform

**Socio-economic impact**

- Economic: Favours the creation of organisations and networks, enhancing, cooperation and marketing of farm products. Social: Acquisition of skills and learning by farmers. Improved access to relevant information and experiences, Social capital through participation.

**More info:** https://www.farmcafe.be/

With the decrease in the farming population in Belgium, coupled to the challenges in farm succession, there is a demand for online services like FarmCafe. At the same time, there are cuts to advisory services resulting in less time available for traditional advisory work. Here, FarmCafe is a useful tool in support of the more traditional services of agricultural advice. Recently, the Covid-19 lockdowns and reduced in-person meetings have also shown the importance of new (digital) forms of communication, between farmers and advisors. Tools like FarmCafe can support this move towards digital forms of advice.

## PURPOSE OF THE TOOL

The purpose of FarmCafe is to provide an online meeting space for Flemish professional farmers. Through this online tool, farmers can develop their networks, get into contact with advisors and experts, and develop new ideas for their farms. The goal is to allow farmers a space with a low barrierto-entry, which they can use to obtain new information, experiences and ideas from other people in farming. FarmCafe also has tools where farmers can develop their plans in collaboration. The tool is developed by traditional knowledge providers, ensuring quality and confidence in the advice received.

# DESCRIPTION OF THE TOOL

FarmCafe is a digital platform that promotes the inclusion of many different types of farmers, while improving the access of farmers to information, skills and learning. Through this platform, farmers can strengthen their business plans and their farm management.

The online platform is an easily accessible tool (only requiring an internet connection), consisting of a website in a secure environment. Farmers retain ownership over the data and information that they add to the website.

Farmers can sign up for free and access most of the information directly. Private spaces can also be created, where farmers in Flanders can develop their ideas with a more select group of advisors and peers. Getting into contact with people outside of the traditional social groups can also increase innovativeness and lead to new and creative business ideas. At the same time, this tool answers the need for a new form of advisory services and can alleviate the impacts of cuts to traditional farmer advisory and extension programmes. Online meeting spaces do not fully replace the in-person meetings, but can be an important addition to more traditional services.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social**

The FarmCafe platform stimulates peer-to-peer learning by farmers. Farmers can use the new knowledge and skills to improve their farm management.

Through this platform the access to relevant information and experiences by farmers is improved. The tool allows farmers the connection with advisors and a team of experts and the development of innovative plans.

**Economic**

It is foreseen that the tool will favour cooperation among farmers, and a better positioning of the farms through improved and more innovative business plans.

# 36. CAPSAT: Using satellite data to use in CAP compliance control

*Daniel van der Velden, Lies Debruyne - EV-ILVO*

The CAPSAT initiative aims to provide the farmer with a tool for sending data to the government using geotagged pictures. This tool, proposed by the Flemish government and currently under development, is meant to help controlling support of the Common Agricultural Policy (CAP). Presently, the controls represent a heavy administrative burden on both farmers and governments. Ideally, the CAPSAT tool is intended to support the compliance to the CAP objectives.

**Application scenario**

Farm data reporting for auditing in CAP payments using satellite data to monitor compliance.

**Digital technologies**

Satellite imagery, smartphone app, online platform

**Socio-economic impact**

- Social: access and provision of data, bureaucratic and administrative burden, regulatory knowledge, autonomy, responsibility, privacy and transparency.
- Economic: public resources intended to CAP's control, strengthened control/surveillance system.
- Environmental: land and resources management and risk management prevention.

**More info:**

https://www.innovatieveoverheidsopdrachten.be/en/node/6098

This is achieved through a smartphone application where farmers can send evidence of their conformity to CAP. Geotagged pictures at farm level can be uploaded by farmers as evidence of compliance to EU regulations linked to CAP. The benefit for the public administration is a reduced need for auditors in the field. At the same time, the tool is also intended to show an augmented visualisation of the farmers' fields, displaying the CAP requirements to the farmer. This allows the farmer to visualize the complex regulation, reducing the learning curve for farmers in following this regulation.

Challenges remain in ensuring that the system works correctly, and privacy can be an issue. It might also be seen as an increase in government control of farmers.

# PURPOSE OF THE TOOL

The purpose of this tool is to monitor farm management and field changes that need to comply with standards and obligations of CAP enhanced conditionality. Up to this point this has been done through spot-checks, where a percentage of individuals receiving CAP support income are randomly selected for a field control visit to ensure that the farmer respects a set of basic rules. This tool is meant to reduce both the administrative burden on farmers and to allow public administration to monitor that criteria and requirements for the associated payments to beneficiaries are complied. For the government, this tool will automate part of the auditing process and increase the efficiency of this process. The tool is also intended to lead to a fairer system, since all farmers are monitored in the same manner and the random and limited control is no longer used.

# DESCRIPTION OF THE TOOL

The CAPSAT tool is a satellite imaging technology complemented with a smartphone app for use by farmers. It is currently in development, and follows a trend in Europe to use satellite data in the monitoring of CAP compliance. In the Flemish case, the CAPSAT initiative is focused on providing the farmer with a tool or app to provide data to the government using geotagged pictures. This tool will support the current monitoring system and improve compliance to the CAP. Additionally it provides a tool to visualise information to farmers using augmented pictures and augmented reality. This would be a way in which complex regulation can be visualised for the farmer, allowing them to understand this regulation while reducing the learning curve for farmers, and the time and effort needed to understand this.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | This tool has a high social impact potential due to its envisioned monitoring capacities. Increased surveillance plays into aspects of access and provision of data, bureaucratic and administrative burden, regulatory knowledge, autonomy, responsibility, privacy and transparency, which might impact feelings of autonomy and responsibility by farmers. |
| **Economic** | Reduction of resources allocated to spot checks, changing and complementing the way compliance is enforced. Strengthened control/surveillance system that will help to support the compliance to the CAP objectives. |
| **Environmental** | By improving compliance to CAP regulation, this tool impacts the (pro-active) land and resources management of environmental risks. |

# 37. The use of RFID to monitor pig health, productivity and wellbeing

*Daniel van der Velden, Lies Debruyne - EV-ILVO*

The use of Radio Frequency Identification (RFID) to track pigs' feeding behaviour is a tool that shows promise in linking feeding information with the health and welfare of animals in intensive pig farming facilities. The ICT tool is still in the prototype development stage in Belgium. Similar tools have been developed for other livestock, such as Connecterra for dairy cows.

The use of RFID tags in monitoring allows collected data on the feeding behaviour of individual pigs to be used to track changes and detect health problems like lameness or an infection. The analysis of parameters, such as number and the duration of feedings, and a sudden change in behaviour, can be a symptom of an underlying health issue. For herd health, it is also important to track diseases or environment-related issues at an early stage.

**Application scenario**

Monitoring intensive livestock's health and performance through RFID sensors and tags. Herd management

**Digital technologies**

RFID (Radio Frequency Identification), information management systems and decision-support systems.

**Socio-economic impact**

- Social: decision-making and farm management skills, access to information, control, surveillance and transparency.
- Economic: performance, traceability, productivity and responsibility.
- Environmental: animal husbandry, health and well-being; risk management and prevention; reduced use of antimicrobial treatments.

**More info:**

https://www.ilvo.vlaanderen.be/language/en-US/NL/Pers-en-media/Alle-media/articleType/ArticleView/articleId/2779/Sensoren-kunnen-gezondheid-en-welzijn-varkens-monitoren.aspx

In the case of the pig consuming less feed, this can also lead to reduced productivity. The system will help farmers to run the most efficient pig farm and to diagnose issues and find solutions.

Since pig farmers in Flanders often manage large herds (>1 500 pigs on average) it is becoming more difficult to track the health of individual pigs. For this reason, the use of this type of tool is gaining in importance.

## PURPOSE OF THE TOOL

The purpose of this tool is to track individual pigs in new ways, and link feeding information with the health and welfare of pigs in intensive livestock facilities. Farms are getting bigger, with increased herd sizes per farm and with less personnel, so it is becoming more difficult to monitor the health of all pigs in a barn. One possible solution is to develop new tools to track the health of pigs on farms. This

technology, using RFID, enables farmers to follow the behaviour of individual pigs and track their movements and feeding behaviour. Specialised software is used to analyse this information and to notify the farmer when a pig shows signs of sickness. This would improve the health of pigs, reduce the severity of sickness, and allow the farmer more time to focus on other tasks on the farm.

# DESCRIPTION OF THE TOOL

The tool is still in a prototyping phase, with researchers working to improve it. The tool uses an electronic tag (RFID) attached to the pig, which activates a sensor when the pig goes to the feeding station. This enables the software to automatically validate feeding parameters in fattening pigs that use RFID feeding troughs.

The tool tracks this information and hence provides an early-warning system triggered by poor performance and health. In other words, through the pigs' behaviour, the software can notice issues with the health of individual pigs. Farmers on intensive livestock operations can use this technology to predict welfare-related issues and to improve the health of their herd. Especially on bigger farms, this is important because the tracking of individual pigs is no longer possible for the farmer. With the intensification of pig farming, this will become more important in the future. At the same time, it allows farmers to focus their attention on other important aspects of farm management.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Societal expectations for pig wellbeing and livestock management can be met using this technology. Improved detection of disease might also improve public health through the reduction of zoonotic disease. Better decision-making and farm management skills, access to information by farmers, control, surveillance and transparency. More time available for other farm activities. |
| **Economic** | Improved farm management, prevent economic losses and reduced labour costs; potential to improve yields and production efficiency and reduce inputs by preventing diseases. The reduction of labour needed on farming can also be seen as a negative impact, as it might lead to unemployment of farm labourers. |
| **Environmental** | Potential for reduced use of medicine and antibiotics through the early detection of disease; improved animal husbandry, health and wellbeing; prevention of environmental risk. |

# 38. Intelligent biomass analyser (IBA)

*Jouni Kaipainen, University of Jyväskylä (JYU)*

Intelligent biomass analyser (IBA) can quickly determine the key characteristics of biomass. This will allow the sorting of biomasses, for example, into quality groups or types, and the determination of moisture content. By using the electrical impedance spectroscopy (EIS) technique, it is possible to obtain information from a relevant volume of biomass, and not only from its surface (as near infrared/infrared (NIR/IR) techniques do). The IBA product is still a prototype, but it has many promising applications relating to renewable resources.

By combining EIS technique with a robot and artificial intelligence (AI), the process will be both quicker and more accurate. An automated sampling solution replaces time-consuming and expensive manual laboratory work. Digitalised quality data serves the supply chain in real-time.

In forestry, EIS probes are usually installed in the moving stream of wood chips. The IBA process helps to control logistics and storage. If the wood chips are of high quality, they are used in pulp and by the paper industry. If there is a lot of bark, the chips still produce heat and power.

Fast testing and analysing helps to overcome the information market failures that hinder the sustainable transition into a circular bio-economy.

Continuous development of the IBA system is an example of a good working university-industry link. Puumit Ltd, a spin-off from the University of Eastern Finland (UEF), is the main developer of the IBA. It has created a consortium to take the IBA product to the next level by integrating robotics in the system.

EU DG-Regio supports IBA, as the development project is part of a High Impact Action programme (EU In My Region). East and North Finland (ENF) encourages RDI actors and firms to cooperate trans-regionally. The integrated ENF area increases knowledge cooperation between partner regions but ENF can also distort knowledge trade due to its borders.

**Application scenario**

Non-destructive classification of biomass into different quality groups

**Digital technologies**

Artificial intelligence (AI), EIS sensing, robotics

**Socio-economic impact**

- Economic: Intelligent biomass analyser (IBA) can lead to better valorisation of circular bio-economy side-streams. In forestry, this includes wood chips, tree bark, and sawdust
- Environmental: Using more renewable resources from forests (like wood chips and forest residuals) for heat and power production leads to substitution of imports
- Social: Small-scale forestry firms remain in remote rural areas if they can automate analysing forestry side streams

**More info:** https://elmoenf.eu/wp-content/uploads/tiitta_elmo-1112-2019.pdf

## PURPOSE OF THE TOOL

Many biomasses are wasted because there is uncertainty about their attributes. In rural areas there are usually no laboratories nearby, so a fully automated analysing system would help remote heat and power producers to optimise their input mix of different forest residuals.

The intelligent biomass analyser (IBA) reveals the key characteristics of biomass: quality, type and moisture content. It aims to help sort biomasses like wood chips into different quality groups (without breaking the study objects). In addition, the tool will provide quality data to the whole supply chain in real-time. The outcome will be better valorisation of the circular bio-economy side-streams.

The IBA product is still a prototype but it has many promising applications in renewable resources and could be used to control logistics and storage. IBA systems need in-site testing and investigations of the main industrial challenges with different types of end-users.

# DESCRIPTION OF THE TOOL

The tool obtains information from a relevant volume of biomass using the electrical impedance spectroscopy (EIS) technique. The IBA process combines the EIS technique with robotics and artificial intelligence (AI). It includes investigations of combining IBA sensors with commercial industrial robots.

The variety of solid bio-based raw materials makes testing important due to the economic significance. Wood chips are utilised as a raw material for many bio-refining industrial processes. High quality wood chips are used for pulp production. If the properties are known beforehand, the processes may be improved, for example by adjusting the amount of chemicals. Large amount of resins or bark may cause problems in bio-refining processes.

The sample's division according to its properties, at an early stage of processing in forest industries, increases the efficiency of wood processing and use.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Strengthened cooperation on many levels. Universities will work with SMEs and energy firms. Regions will cooperate more as the RDI actors and firms can be from different regions in the ENF collaboration area. |
| **Economic** | Quality control in factories. IBA is a substitute for laboratory work but employment in rural areas will likely rise. Automated systems can help remote areas to create more income from their renewable resources. |
| **Environmental** | Taking renewable resources and side streams from forestry and agriculture into use usually lessens the amount of nutrients in rural areas. Optimising the moisture content and other characteristics of wood chip batches early in the process will save energy and materials. |

# 39. Biomass Atlas

*Jouni Kaipainen, University of Jyväskylä*

Biomass Atlas is an open service that collects location data about biomass under a single user interface. The online service promotes the use of renewable resources. The informational problems are usually the reason why firms do not adopt circular systems. In practice, it is very difficult to find out who could offer the right kind of renewable materials with volumes that are sufficient for commercial use.

The map user interface is easy to use and allows users to see, analyse and report on biomass from forestry, agriculture, and biodegradable waste from rural communities and industry. There are approximately 300 map layers of different biomass types or land use categories in the map user interface.

Making the classifications and updating the data following prescribed rules is not easy. The one-stop service makes the processing and analysis of data easier.

The Biomass Atlas service enables users to calculate the amount of biomass in a given geographical area, as well as examining the opportunities to utilise the biomass and restrictions on its use. The information can be used for planning, to invest in a new production plant that can use biomass as an input. Users can also look for new raw materials (like wood, bark, sawdust, dry twigs) for an existing processing plant that now uses peat.

The service is developed by the Natural Resources Institute Finland together with the Finnish Environment Institute, Tapio, the University of Eastern Finland and the University of Vaasa, and with funding from the Finnish Ministry of Agriculture and Forestry.

**Application scenario**

Geographic information on biomasses from waste from rural communities and industry. Planning investments and raw material procurement, support for environmental and energy policies

**Digital technologies**

Online platform, thematic maps and data, decision support system

**Socio-economic impact**

- Economic: Lowering transaction costs in recyclables market, creating markets for wastes
- Environmental: Enhancing circular economy, fostering the use of manure
- Social: Locational data helps connecting producers and users of different types of biomass, transparency and traceability

**More info:** https://www.luke.fi/biomassa-atlas/en/

# PURPOSE OF THE TOOL

Biomass Atlas is an online service that collects location data about biomass under a single user interface. The free online service is open and can be used, for example, for planning investments and raw material procurement, as well as to support environmental and energy policies. The service enables users to calculate the amount of biomass in a given geographical area, as well as examining the opportunities to utilise the biomass and restrictions on its use.

Biomass Atlas contains information about the volumes and locations of almost 200 different types of biomass. This is useful information to support decision-making regarding investments and policies. In addition, it also helps bank managers who want to check quickly if the business plan for a new biorefinery is feasible in their region. It also helps when considering where to place process waste from a new production line.

# DESCRIPTION OF THE TOOL

Biomass Atlas combines agricultural, forestry and rural domains. The multi-source nature of the information means that the platform gives a balanced and research-based view of the biomass situation in Finland. In the agricultural domain, field area data comes from the statistics of the Agency for Rural Affairs (Mavi). Information about forest resources is obtained from the National Forest Inventory. In the rural domain, biodegradable waste regulation helps with the data collection. Enterprises having an environmental permit for their operations are obligated to report annually on waste data to environmental authorities. Biomass Atlas also includes calculated amounts of biodegradable municipal waste.

In the map application, one can select the area freely or use preselected (administrative) areas. One can ask what the value of nutrient production in the area is, or the distribution of the relevant biomass in the area. Users can also choose a specific location and search for relevant biomass over a distance of 100 kilometres from that location. The distance option is useful, as the transportation of low-value biomass over long distances is not economically viable.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Improved decision making at municipal, regional and national level. Planning green investment is easier if all stakeholders have access to the same basic information. |
| **Economic** | The online service helps raw material procurement. Actors find quickly relevant side streams and raw materials. Platform creates new markets in regions where |

| | |
|---|---|
| | there were no trading places. Maps make it easy to find out if there are nearby producers who could join into value chains. |
| **Environmental** | Promoting the use of renewable resources, support for environmental and energy policies. |

# 40. TREEMETRICS – THE INTERNET OF TREE

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Treemetrics is a software company founded in 2005 to develop a new technology to replace traditional forestry methods with a more sustainable, innovative and dynamic one.

The Forest HQ technology facilitates interventions in three domains through three modules: manage, measure, and harvest. By using satellite technology, mobile application and artificial intelligence (AI) to store data collected in a unique platform and provide advices for a more precise and efficient forestry management, it optimises the value of wood production and improves the preservation of the environment and natural resources.

The Irish state forestry company, Coillte, as an example, approached Treemetrics six years ago to develop harvest monitoring solutions which would help to overcome their difficulties of timber production. Treemetrics provided them with extensive training and support for all staff and developed a solution to integrate Forest HQ with their existing software and systems. The harvest module has helped Coillte to improve harvest monitoring efficiency by over 30%, reduce losses, help driver performance and improve their safety, and automate some tasks. With the same objective, Treemetrics has also worked with the Irish Farmers' Association, the Forestry Company, and the Romanian timber harvesting company Silvador.

"I believe it's going to be an absolute game changer, it's going to revolutionise how Coillte carries out it's harvesting operations."

- Mark Carlin, Coillte

| |
|---|
| **Application scenario** |
| Forest Management and Information System (FMIS) |
| **Digital technologies** |
| Mobile applications, artificial intelligence, satellite imagery and communications technology, aerial drones, LiDAR, GIS |
| **Socio-economic impact** |
| ▪ Economic: harvest operation efficiency, better log yield, reduced costs, improve the profits of the forest industry<br>▪ Environmental: environmentally-sensitive ecosystems protection<br>▪ Social: improved forest management, ecosystem services, worker safety |
| **More info:** http://www.treemetrics.com/ |

# PURPOSE OF THE TOOL

FOREST HQ
TREEMETRICS

Forest HQ is a digital solution embodied in a cloud-based management platform that offers the possibility of centralising all the data collected from the different devices used in forestry, which communicate together in real-time over multiple locations. This technology makes forest management simpler and more precise, thanks to digital data capture and integrated systems delivering intelligent data mining in control operations, advanced analytics, operation monitoring, and log yield improvement. This tool was co-created with foresters (owners and managers), consultants and organisations across the world, in order to preserve the environment and ensure sustainable use of natural resources. The objective of its two founders was to replace traditional forestry methods with a new one, which utilises recent technological advances to improve the forestry industry's benefits and protect environmentally-sensitive ecosystems.

# DESCRIPTION OF THE TOOL

Source: TreeMetrics

Forest HQ combines mobile applications, remote sensing, intelligent data mining and satellite communications technologies into a sophisticated software system to deliver accurate forest appraisals and live harvest control. Forest HQ is divided into three modules: **manage** to efficiently plan and control the operation from one central platform which integrates all the LiDAR, drone, satellite imagery and GIS data collected; **measure** to provide greater efficiency and precision for inventory planning, data collection, analysis and reporting; and **harvest** to monitor harvest operations and wood flow in real-time over multiple locations to improve log yield and profits, reduce costs and improve customer service.

# AREAS OF SOCIO-ECONOMIC IMPACTS (BENEFITS AND CHALLENGES)

| | |
|---|---|
| **Social** | Good forest management protects ecosystem services. |
| **Economic** | Improve management and decision-making, enhance harvest operation efficiency, develop a better tools interoperability and interconnectivity to improve log yield and profits, reduce costs and improve customer service. |
| **Environmental** | Preserve environment and ensure sustainable use of natural resources through precision forestry and a better efficiency of harvesting operations. |

# 41. XAG drones – xplanet® agricultural uas

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| **Application scenario** |
| --- |
| Agricultural Unmanned Aerial System (UAS) for chemical treatments (precision techniques) |
| **Digital technologies** |
| Satellite, 3D mapping, 4D imaging radar, mobile applications, unmanned aerial system, artificial intelligence (AI), cloud, camera |
| **Socio-economic impact** |
| ▪ Economic: Costs saving for more profitability, increase yield<br>▪ Environmental: impact reduction on resources, small ecological footprint<br>▪ Social: food safety, public health and farmers' quality of life |
| **More info:** https://www.xa.com/en |

The XAG Company was founded in 2007, to research, develop and implement agricultural technology. It is today one of the world's leading manufacturers of unmanned aerial system. It has established partnerships with many influential international enterprises to provide farmers with the best local solutions, ranging from plant protection and crop monitoring to farm management.

Combining smart agriculture solutions, integrating drones, artificial intelligence and cloud, XAG creates and provides solutions that are tailored to every user's personal needs: 1) XMission works for 3D mapping, 2) XStation provides digital field maps and 3D models, 3) XAI cloud and edge recognises boundaries, obstacles, plant location, disease, and 4) XPlanet provides agricultural drones for the optimum smart agriculture solution.

XPlanet agricultural UAS is the latest drone designed and marketed by XAG. It is crafted in an independent way, to carry out the operations previously programmed by the farmer.

Based on data captured from RGB/MultiSpectrum Camera and the recognition result from XAG AI engine, the mobile application Prescription Map will be automatically generated to guide XAG XPlanet for spraying or spreading. XAG has introduced its technology into rural areas, where it has already empowered 6.37 million farmers with smart agriculture solutions.

# PURPOSE OF THE TOOL

The XAG XPlanet Agricultural UAS is a high-performance aerial system designed to provide farmers with an optimal smart agriculture solution. Thanks to cartography and a 4D imaging radar, this tool optimises seeding, crop spraying and granular spreading. In this respect, cost and time are saving for farmers, while more sustainability and safety is also generated.

Source: XAG

The basic principle is to provide the right quantity of material in the right place. Crafted into an ultimate balance between precision, efficiency, cost and safety, compared to a manual approach of agriculture, a large ground-based machinery or a manned aircraft, the XPlanet Agricultural UAS offers higher precision, all-terrain autonomous operations, a better efficiency and more flexible operations.

# DESCRIPTION OF THE TOOL

Source: XAG

The XAG XPlanet drone provides three different operation modes adaptable to multiple terrain types (e.g. plain, mountain, hill, terrace or plateau): standard mode, spot mode and customised mode. Farmers, through 3D high-definition maps, can capture a full picture of a landscape from every angle, to select the ideal mode that suits their needs. The drone can sense the slope of land to optimise the flight path and ensure safe, smooth operation, even on complex landforms.

All settings and operations can be controlled from a smartphone through a unique mobile application. Indeed, based on data captured from the camera and the recognition result from XAG artificial intelligence engine, the prescription map will be automatically generated to guide the drone for seeding, spraying or spreading. Targeted parcels, spraying parameters and appropriate operational flight path are also set through the XAG Agri App. Support over-the-air (cloud) is provided to store data collected and one operator can control up to five drones simultaneously.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Preserve food security and public health, better working conditions for farmers. |
| **Economic** | Costs saving by reduction of inputs and nutrient consumption (chemicals, pesticides, fertilizers, etc.). More profitability, potentially higher yield and income. |
| **Environmental** | Reduced effect on water quality due to chemical reduction. The main challenge is to leave the smallest ecological footprint. |

# 42. Innoseta - Innovative spraying equipment training and advising

*Christos Marinos-Kouris, ATHENA RC*

INNOSETA (Innovative Spraying Equipment Training Advising) is a project funded by Horizon 2020, which has developed a freely accessible repository of innovative spraying technology, training material, projects and papers tailored to the needs of the spraying community.

This project supports the transfer of knowledge to practice in the field of application and management of phytosanitary products and, thus, improve the efficiency of agriculture.

The lack of functional Agricultural Knowledge and Innovation Systems (AKIS), as well as innovation platforms regarding spraying technologies, results in gaps known to the actors concerned, but not currently bridged. In the research framework of INNOSETA, extension and advisory services play an intermediate role in negotiating with other actors to create a relevant AKIS network.

More specifically the project's approach includes:

i) Creating an inventory of spraying equipment and technologies, training materials and advisory tools from available research results and commercial applications

ii) Assessing the SETA (Spraying Equipment Training and Advising) end-users' needs and interests, and identifying factors influencing adaptation, while also taking into account regional specificities

iii) Facilitating interactive multi-actor collaborations, especially international network of researchers and farmers

iv) Creating an on-line platform for the assessment of SETA materials and allow crowdsourcing of grassroots-level ideas and needs.

**Application scenario**

Innovative practices for spraying equipment, training and advising

**Digital technologies**

data sharing and repository services, online platform

**Socio-economic impact**

- Economic: provide material for better economic assessment of investment and practices
- Environmental: widespread adoption of environmentally-sustainable farming/industrial practices, pest and phytosanitary management and application
- Social: connecting stakeholders, learning, transparency, compliance

**More info:** https://platform.innoseta.eu/

# PURPOSE OF THE TOOL

The aim of the INNOSETA project is to set-up a thematic network on innovative spraying equipment, and advising and training practices, designed for the seamless exchange of knowledge among researchers, farming communities and industries. This network will connect research and commercial solutions with newly identified needs and innovative ideas, aiming to bridge the gaps between research, innovation and real needs in this area. Furthermore, the INNOSETA project opts to assess end-users' interests and needs and identify the factors that influence a farmer's practices regarding the adoption of innovative spraying technologies.

The project promotes the exchange of new ideas and information between industry, university and research centres and the agricultural community. Thus, existing scientific and commercial solutions can be widely disseminated and applied, with respect to the identified needs of the sector.

# DESCRIPTION OF THE TOOL

The INNOSETA platform is a freely accessible repository of innovative spraying technology, training material, projects and papers tailored to the needs of farmers. The tool aims to be a one-stop shop for all information on spraying innovations. Each record provides relevant information on the SETA such as a short abstract, links to more information and related websites, field of application, and type of sprayer/operation/technology. Filters allow users to fine-tune the search results on crop systems, but also on applications and sprayer types or on the effects of the innovation or on keyword selection and language. To date, over 800 records are included in the platform and the content is growing each day. The content of the INNOSETA Platform varies among industry products, training material, information on projects relevant to SETA, and scientific articles. It is available in all eight project languages.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Guidance to the platform users to comply with regulations, support farmer's work in acquiring recognition from the interested communities, provide training on innovative equipment, provision of communication linkages among practitioners and individuals with advisory capacity. |
| **Economic** | Help users in foreseeing profit benefits, assessing the long-term benefits of technological equipment investments, access to cost-benefit analysis tailored to their needs, increase the effectiveness of Plant Protection Product (PPP) applications. |

| | |
|---|---|
| **Environmental** | Indirect benefits coming from the user's adoption of less environmentally stressful practices and better use of resources. |

# 43. Farm Machine interop

*Christos Marinos-Kouris, ATHENA RC*

Farm Machine Interoperability is an application developed under the Internet of Food and Farm 2020 (IoF2020) project, funded through Horizon 2020. It strives to facilitate efficient machine-to-machine communication and data sharing between farm equipment and management information systems. Moreover, its design will stimulate future developments in agricultural machinery communication. In particular, it will enable further progress in communication standards between vehicles and platform for seamless data transfer, and for cross-communication between various models and brands of farming machinery.

In this sense, Farm Machine Interoperability contributes to the development of precision agriculture, by making information transfer easier and by helping farmers to access more data services and ultimately harness their potential. Furthermore, this smart application contributes to the overall sustainability of farming activity, since the improved use of machinery decreases energy consumption and enables the more efficient use of resources.

More specifically, Farm Machine Interoperability aims to implement real-time communications between farming management information systems (FMIS) cloud solutions and equipment manufacturers, test harvest logistics applications compliant with interoperable solutions, and share technical solutions with the standards development organisations for agricultural machinery.

The platform works by applying communication standards, such as ADAPT and NGSI-LD, for effective offline and cloud communication between farm and machine, and vice versa. Unified data models facilitate easy data transfer and conversion. Service providers can add value to data based on a single API.

# PURPOSE OF THE TOOL

Farm Machine Interoperability creates a framework for farmers to connect their work equipment through one interoperable and integrated system, regardless of the type and vendor of the equipment. This tool strives to address the challenge of unifying different, vendor specific, digital standards to make farming devices work together in the digital space. By bridging the interoperability gap for farming machinery, it will not only facilitate the adoption of new Internet of Things (IoT) technologies and boost their uptake in the European market, but it will also allow more efficient smart farming methods to be implemented. These smart methods will subsequently lead to better outcomes in terms of gross production, net income and optimal use of resources.

The specific goals are to increase interoperability of agricultural machinery by optimising digital communication standards; demonstrate the benefits of agricultural machinery interoperability; and demonstrate the economic impact of data valorisation from optimised IoT technologies.

# DESCRIPTION OF THE TOOL

Farm Machine Interoperability is designed to enable the exchange of data between field machinery and farm management information systems for supporting crossover pilot machine communication. The tool is based on ADAPT and NGSI-LD communication standards for easy data transfer and conversion, enabling cloud and offline communication among farming fields and machinery. Still, the low maturity level of available standards remains as the main challenge, since presently there are no real usable solutions that enable real-time communication from the standardisation organisations involved in agricultural machinery. Therefore, this use case is focused on finding universal frameworks and to modify them in a way that will be applicable for interoperating farming machinery. In this regard, the developers of this tool aim to perform a proof of concept and liaise with the most prominent API developers to speed up the development of data standards in the agricultural sector.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social**

- Faster IoT uptake +15% in farming communities

**Economic**

- Yield +10%
- Gross margin +5%
- Cost-benefit of IoT (e.g. soil fertility) +10%
- Yield in compaction-sensitive areas +16%
- Fuel consumption -10%
- Machinery sales +15%
- End-user costs of IoT +5%

**Environmental**

- Estimated improvements in farming efficiency +15-20%
- Crop produced/input resources ratio +15%
- Reduced pollutant/greenhouse gas emissions

# 44. SQAPP

*Christos Marinos-Kouris, ATHENA RC*

Soil Quality Mobile Application (SQAPP) is an interactive tool designed inside the remit of the EU Horizon 2020-funded ISQAPER project. It aims at offering an easy-to-use tool that brings global soil data into the decision-making sphere of land users and other interested individuals. This application is being developed, tested and validated by scientists, practitioners, farmers, policymakers and agricultural service providers. It will provide an innovative soil quality assessment method for different pedo-climatic zones, integrating soil science with agricultural and land management practices. The soil quality indicators used are being modified and tested by farmers for farmers in Europe and China. The application can be tailored to provide farmers and other decision makers with science-based, easy-to-apply and cost-effective solutions.

Finally, through the use of SQAPP it is intended to upscale the results gathered, to examine the consequences of widespread implementation of land management practices and provide recommendations for integrating and promoting soil quality and sustainable land management into policy. In addition to the detailed research results, a number of key messages are provided for a range of stakeholders including farmers, advisors, policymakers and researchers.

**Application scenario**

Soil quality assessment for risk assessment and quality checks. Informed decision making for sustainable land use

**Digital technologies**

Machine Vision systems, Satellites, Geographic Information System (GIS), mobile application

**Socio-economic impact**

- Economic: improvement of food product value and farming field value
- Environmental: contributing to ecosystem resilience and sustainable farming practices, resource efficiency and environmental performance, and reduced impact on soil
- Social: wider adoption of sustainable management practices and recommendations for sustainable land use

**More info:** https://www.isqaper-project.eu/downloads/soil-quality-app-sqapp

# PURPOSE OF THE TOOL

The Soil Quality Mobile Application (SQAPP) is designed with the purpose of setting a new standard in soil quality assessment. It is an interactive tool for in-field soil quality assessment. This application is made for mobile devices for use anywhere in the world, and it provides location-specific soil quality information and sustainable land use management options. The provision of reliable data and knowledge, through the application, will help land users to evaluate the soil in their fields and to make well-informed decisions about its use. In this sense, it will facilitate access to information regarding alternative land use practices and support farmers in improving their land management.

# DESCRIPTION OF THE TOOL

Soil Quality Mobile Application (SQAPP) provides available soil quality information for any location in the world, simply by the user selecting a location from a map. The selected area's soil information and properties are consequently shown to the user, supplemented with indicated possibilities for adapting the soil to the users' needs. The application calculates the soil quality relative to the average soil quality among areas with similar soil and climatic conditions (i.e. same pedo-climatic zones). Depending on the selected location, as well as soil properties, the application will also give an overview of possible soil threats that are classified based on general scientifically-based threshold values. The overview contains a summary of the overall threat level and highlights the most significant parameters as well as recommendations in order to safeguard the soil quality and avert threat risk.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Widespread adoption of sustainable land management practices, facilitates access to data, greater knowledge of the farm and decision-making. |
| **Economic** | Improvement of soil quality and food production leads to higher net worth of the farm and the retail prices of the goods produced. |
| **Environmental** | Improved ecosystem resilience. |
| | Providing detailed information on the environmental footprint of farming activities. |
| | Providing recommendations for sustainable land use and widespread adoption of sustainable land practices. |

# 45. WAZIUP Fish Farming MVP

*Christos Marinos-Kouris, ATHENA RC*

WAZIUP Fish Farming MVP is an output from the WAZIUP project, an EU-Africa project developing Internet of Things (IoT) technologies. WAZIUP adopts a do-it-yourself approach and provides a number of IoT and hardware components, accompanied by their respective tutorials. This helps local communities create low-cost solutions to problems they face in their daily activities.

The fish farming Minimum Viable Product (MVP) is developed to measure the water quality of fish ponds. It consists of a product with a minimum of features designed to cover the basic needs of the end-users, and aimed at gathering valuable feedback from early adopters that can be used for future product development. The Fish Farming MVP of WAZIUP incorporates core features defined at the early stages of the project and is formed of a buoy device that allows users to measure pond water quality in real-time. Currently, Fish Farming MVP is being piloted in 7 fish ponds in four different African countries.

The measures taken by the device are temperature, dissolved oxygen, and the acidity of the water. The device is capable of giving real-time readings about relevant information for fish ponds and communicate this data via LoRa. The device is powered by a solar panel with a battery.

By utilising the WAZIUP Fish Farming MVP, users are able to manage their fish farm input, farming schedule and regular tasks, manage costs and output product, and have access to a visualisation template with customisable options accompanied by advanced analytic applications. Finally, the tool provides the option for additional development of the user's own applications and information panels according to their needs.

**Application scenario**

Decision Support Tool to monitor the water quality in fish ponds through sensing the pH level of the water, dissolved oxygen, and temperature. Reminders on fish feeding and harvest time

**Digital technologies**

IoT, remote sensing, machine vision systems, dashboard and mobile application

**Socio-economic impact**

- Economic: low-cost solutions, optimisation of farming tasks, opportunities for further development and exploitation of the tool
- Environmental: safeguarding environmental water quality standards in fish farms
- Social: low-cost, wide coverage and DIY approach, tool that allows unique opportunities for social inclusion and innovation

**More info:**

https://www.waziup.io/documentation/usecases/water/

# PURPOSE OF THE TOOL

The goal of this prototype tool is to develop an IoT device for fish farming. The device is capable of giving real-time information for fish ponds, such as pH level of the water, dissolved oxygen and temperature, and to provide timely reminders on fish feeding and harvest time. The data collected are transferred through a LoRa network, and consequently sent in the form of notifications to the user's devices connected to the network. Finally, the use cases and reference examples coming from WAZIUP Fish Farm MVP will be used to locally transfer know-how and serve as training material for interested individuals. This will ensure local people acquire the skills to further develop the tool.

# DESCRIPTION OF THE TOOL

The main component of the WAZIUP Fish Farming MVP is the back-end, which consists of a number of sub-components, each delivering a set of features. The external world talks to the back-end through the WAZIUP API (application programming interface). The back end is run as a collection of containers on a "container service". The WAZIUP dashboard and mobile application are parts of the WAZIUP front-end. They fetch data from the WAZIUP back-end and display it to the user. User applications also communicate with the back-end through its API. The fish farming application presents sensor data to farmers, for pH, temperature, and dissolved oxygen. The device is powered by a solar panel battery and the final product is placed in a lightweight box, which protects the sensors and battery. On the hardware front, the tool contains Arduino microprocessors, a Raspberry Pi, and Semtech LoRa to enable low-cost and efficient data transfer.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Creation of reliable solutions to bring a cutting-edge computing concept to the gateway level in a context where internet connectivity and computing infrastructures are not a given, providing young people in African communities the opportunity to develop IoT technology. |
| **Economic** | Low power consumption, low cost of deploying services, further development and exploitation of IoT solutions, increase fish feeding efficiency, increase production yield. |
| **Environmental** | Preservation of local aquaculture, ecosystem resilience, ensure health and growth of fish species. |

# 46. TRACE - fostering tree monitoring technologies to support climate adaptation and mitigation

*Arianna di Paola (CMCC), Monia Santini (CMCC), Riccardo Valentini (CMCC)*
*Antonio Brunori (PEFC Italy)*

TRACE is a project that aims to foster tree monitoring technologies for forest resources to support climate adaptation and mitigation through enhanced forest management and certification practices.

The project implements a small-scale monitoring network to trial the use of innovative Internet of Things (IoT) technologies to continuously monitor tree growth and health. There is a strong connection between tree ecosystems and climate. Climate change impacts on a forest's ability to absorb carbon, and on biodiversity and habitat degradation.

The TreeTalker tool collects reliable data that informs forest owners' management decisions and the forest certification process. The outcome is an improved resilience of fragile ecosystems.

TreeTalker is an innovative and low-cost device that is attached to selected trees within the forest. Sensors in the device measure various eco-physiological/biological parameters, such as water transport within the tree, water content of the stem, diameter growth, and the quality/quantity of the tree foliage.

**Application scenario**

Forestry Information and Management System (FMIS) for tree parameters (growth, water exchanges, health) for enhanced management and certification practices

**Digital technologies**

Sensors, connectivity to automatically deliver data, cloud-based platform for storing and analysing data, application to access and visualise data

**Socio-economic impact**

- Economic: organisation, autonomy, less time-consuming, less financial risk, resilience; value chain transparency
- Environmental: ecosystem services, biodiversity and plant health
- Social: access to information

**More info:** https://www.pefc.org/what-we-do/our-collective-impact/our-projects/fostering-tree-monitoring-technologies-to-support-climate-adaptation-and-mitigation

# PURPOSE OF THE TOOL

Source: PEFC

TRACE is an initiative to monitor the physiological parameters of trees by using IoT technologies in a local network setting. PEFC sustainable forest management certification relies on dedicated, and often time-consuming, field measurements of several biotic and abiotic indicators. The continuous measurement of vegetated ecosystems' ability to store carbon and be resilient to environmental changes is possible through an increased density of observations of tree health, growth and water exchange. Enhanced access to this information enables forest owners to act faster and to adapt their forest management practices in response to any changes within their forest. It also enables certification bodies to carry out their verification tasks more efficiently, thereby improving the certification process.

# DESCRIPTION OF THE TOOL

The project sets up a small-scale monitoring network within 160 hectares of privately-owned forest in the Umbria region of central Italy. It relies on the latest-generation of IoT technologies, including an online platform for the acquisition, transmission, processing and storage of data. TreeTalker is an innovative and low-cost device, which is attached with its sensors to selected trees within the forest. It measures various eco-physiological/biological parameters, such as water transport within the tree, water content of the stem, diameter growth, and the quality/quantity of tree foliage. The sensors transmit the data to the cloud-based platform, to be processed and correlated with environmental data to provide information about the growth and health status of trees. Specific algorithms enable a near real-time processing of, and access to, information. The Italian PEFC-certified forest is one of the 150 forest sites that can be studied through CMCC solutions, to build a "worldwide tree network" distributed across the most vulnerable and representative forests of the world, from boreal to temperate and tropical regions.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social** | Improved access to information on the state of forests.

| | |
|---|---|
| **Economic** | Better decision-making in forest management and certification based on fast and reliable information, resulting in improved resilience and transparency of value chains. |
| **Environmental** | Enhanced environmental services to society (healthier landscapes, biodiversity, etc.) and strengthened status and resilience of forests. |

# 47. FRESH LIFE – Demonstrating Remote Sensing integration in sustainable forest management

*Gherardo Chirici, Università degli Studi di Firenze / Accademia Italiana di Scienze Forestali*

| **Application scenario** |
| --- |
| Data fusion among field-collected forest inventory data and remote sensing information to quantify sustainable forest management (SFM) and support precision forestry |
| **Digital technologies** |
| Unmanned Aerial Vehicles (UAVs), GIS, remote sensing |
| **Socio-economic impact** |
| ▪ Economic: less expensive data collection, less time-consuming methods, resources mapping, transparency of value chains, certification<br>▪ Environmental: sustainable forest management, resilience of forests<br>▪ Social: forest data, management decisions |
| **More info:** https://freshlifeproject.net/ |

Climate change is a challenge that significantly impacts the functioning of forest ecosystems and the services they provide. The complex nature of climate change increases the uncertainty in predicting future forest ecosystem dynamics and requires an adaptive management approach. Forest managers need monitoring and analysis tools to assess the condition of forest resources and their capacity to supply ecosystem services.

Geographic information systems (GIS) and remote sensing are useful tools to quantify sustainable forest management (SFM) indicators to support local decisions. SFM is widely recognised as a key objective of forestry policy and practices.

The FRESh LIFE – Demonstrating Remote Sensing Integration in Sustainable Forest Management (LIFE14 ENV/IT/000414) project demonstrated innovative methods to integrate forest inventory data collected in the field with remote sensing information, to estimate selected SFM indicators at local scale. Within the project, high-resolution data were collected at three sites in central Italy using drones equipped with light detection and ranging (LiDAR) and optical sensors. Automated and semi-automated mapping methods were then used to spatially characterise the variables used to assess forest physiognomy and conditions at the scale of the forest management unit.

# PURPOSE OF THE TOOL

The FRESh LIFE project demonstrated that remote sensing, using drones equipped with multispectral sensors, can be used to develop a forest information system based on multiple indicator maps. This was shown to be a less expensive and less time consuming method for acquiring forest data than traditional approaches based only on field observations.

Information generated through these new techniques can help in improving forest management decisions. The information is also useful in helping to achieve sustainable forest management targets and forest certifications in the framework of precision forestry.

The applicability of the methodologies at a wider scale and the integration with European Forest Data infrastructures is possible.

# DESCRIPTION OF THE TOOL

Under the coordination of the Italian Academy of Forest Sciences, the FRESh LIFE project aimed at integrating forest inventory data (collected in the field) with remotely sensed information (collected through multiplatform instruments) to spatially estimate a number of forest variables.

Data were used to implement a Forest Information System (FIS) in order to support local sustainable forest management actions. Three demonstration sites in Italy were involved. In Ricine (Tuscany Region), the growing stock data and other variables were integrated in the FIS to support the implementation of the new forest plan. In Caprarola (Lazio Region), the FIS was used for a multi-criteria analysis between alternative uses of the local forest area. Lastly, in Bosco Pennataro (Molise Region) the FIS was adopted to discuss and take decisions about forest harvesting and other forest-related activities.

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Estimation of SFM indicators faster than current data collection systems. |
| **Economic** | Decision-making in forest management and certification based on fast and reliable information, resulting in an improved transparency of value chains. |
| **Environmental** | Enhanced environmental services to improve the health status and resilience of forests. |

# 48. DorfFunk – The Region's Communication Centre

*Matthias Berg, Fraunhofer*

DorfFunk (*VillageRadio*) is a smartphone application intended to serve as a rural area's communication centre. The app features various functionalities around the principle of enabling communicative exchange among local and village communities.

| **Application scenario** |
| --- |
| Communicative exchange and information to support local sense of community |
| **Digital technologies** |
| Mobile application with social media functionalities for local digital communication |
| **Socio-economic impact** |
| ▪ Economic: facilitates the local market<br>▪ Social: cohesion, identity, inclusion, participation and access to information. Improved governance and participation |
| **More info:** www.dorf.app |

The mobile application holds up to seven channels, offering various forms of interaction within a local area: "Gossip" allows for everyday talk with public text messages and pictures on local issues, observations or questions. The channels "Seek" and "Offer" resemble a local market square and are intended for the non-commercial exchange of goods and services. Various "groups" can be requested and facilitate public as well as private spaces for communication on special topics, while "Tell us" opens up a direct link to the local administration. In addition, the two channels "News" and "Events" offer the latest information on what is going on locally as well as regionally. Users can post comments on all these channels and contact each other through private messages.

DorfFunk was developed in the context of the project "Digitale Dörfer" (*Digital Villages*) in Rhineland-Palatinate, Germany, by the Fraunhofer Institute for Experimental Software Engineering IESE. It enables digital communication and local interaction in given rural communities, to support identification with the region and a local sense of belonging. It aims to support aspects of rural life such as neighbourly help and networks of mutual exchange. Furthermore, it offers a platform that brings together various actors who are vital for rural life – citizens, clubs and associations, members of church congregations, volunteers, public administration and local policymakers.

# PURPOSE OF THE TOOL

DorfFunk is a communication tool that aims to bring together a region's population and strengthen rural communities. It expands various forms of everyday talk into the digital sphere, such as gossip, bartering or personal support. Additionally, DorfFunk offers the latest local information on various topics such as politics, events and other issues of community life. The app promotes local and regional exchange, supports existing networks of clubs, associations or initiatives, intensifies the connection between citizens and public administration, and helps to organise volunteer work as well as community life in general.

Image Source: Fraunhofer IESE

# DESCRIPTION OF THE TOOL

DorfFunk is one of several software tools developed in the project "Digitale Dörfer" (*Digital Villages*) that cover services of general interest, such as local supply, delivery logistics, administrative services and communication. All these tools are interconnected through the "Digital Villages Platform", which handles centralised data, user and account management. The app has been developed according to the real-life needs of rural communities following a co-creation approach. Starting off in three test municipalities in Rhineland Palatinate, DorfFunk is now available in eight federal states in Germany with more than 50 000 registered users.

DorfFunk runs on Android and iOS smartphones. It is free of charge to users; however, it needs to be activated by the municipal administration. Due to the limited financial capacities of rural municipalities, a small monthly fee has to be paid. As a location-based service, DorfFunk asks users to register in their home municipality and to set a geographic range for information and communication to be received.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social** Supports social cohesion, local identity and inclusion through communicative exchange, grants access to relevant information by various actors. Strengthens the connection of the community. Improved governance, participation in rural community life and exchange with the local public administration.

| | |
|---|---|
| **Economic** | Facilitates local market. |

# 49. Integreat - an app to help new immigrants

*Christof Schroth, Fraunhofer*

Integreat is a smartphone app that provides important local information from public administrations of a municipality to newly arrived immigrants. The platform was originally developed in the context of the "migration crisis" in 2015 for German public administrations, but in recent years Integreat has been making its way to other European countries. With the app, local public authorities and administration can provide information in multiple languages to break down language barriers. Thus, Integreat helps to ease communication between the local public administration and newcomers from various cultural and language backgrounds. Furthermore, Integreat is designed independent of the migration context and offers support to overseas professionals, as well as to refugees and asylum seekers.

Integration can be a complex process associated with various challenges. The obvious ones are language and cultural barriers. Apart from that, Integreat also offers practical services such as information on registration issues outside the public administration's opening hours. Hence, Integreat is highly adaptable to local needs.

Another reason why this app was created is to help to address the shortage of skilled workers in some companies. Integreat provides a platform to search for new staff, but also for interested workers to find a job. New immigrants can get easier access to the labour market through the information related to "Work and apprenticeship training". A further benefit of the app is providing addresses or opening hours, which may change frequently. Instead of re-issuing brochures following such changes, information can be updated easily in the app.

**Application scenario**

Information and orientation provision by local public administration for citizens of a community, especially newcomers

**Digital technologies**

Digital computer/smartphone app that works online and offline

**Socio-economic impact**

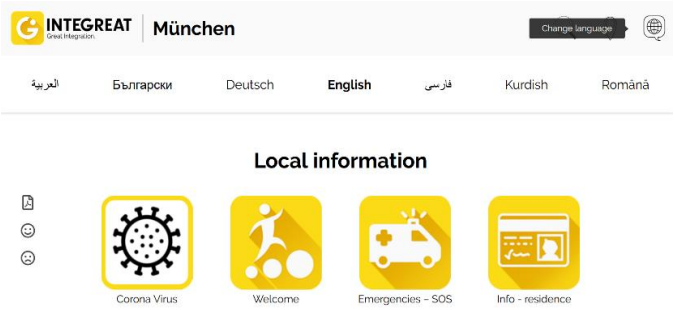
- Economic: labour market improved, equal opportunities
- Social: access to information; individuals' well-being, digital integration, cohesion, improved governance

**More info:** https://integreat-app.de/en/ (English), https://integreat-app.de/idee-wirkung/ (German)

The mobile guide is offline and in an open source that works on cell phones and PCs. Integreat was developed (and is still maintained) by a non-profit organisation called "Tür an Tür – Digital factory gGmbH" in cooperation with researchers from the Technical University of Munich (TU München).

# PURPOSE OF THE TOOL

The Integreat app was developed to provide all the necessary information in multiple languages to help in the orientation of immigrants who experience the challenge of integration and lack of information. Thus, integration becomes easier and people do not get lost in their new society. Also, there is typically no internet available when people move into a new flat, while asylum seekers' hostels might have no Wi-Fi. Therefore, the app was developed to work offline.




Snapshot of Integreat (https://integreat.app/muenchen/en)

Since 2018, the development of the app has been extended to other European countries facing similar migration issues.

# DESCRIPTION OF THE TOOL

Integreat is an open-source multilingual smartphone app that also works offline. Basically, the local public administration provides information for new immigrants, like addresses, opening hours or available language courses. The information can be grouped and represented by symbols. Usually, all information is provided in multiple languages. The choice of the information and languages provided depends on the local public administration. New information can be added quickly, for example, updates about the local COVID-19 situation.

The information provided differs for every community, meaning it must be downloaded separately for each individual city.

For example, the information can be grouped into categories such as:
1) COVID-19; 2) Welcome-First Steps; 3) Emergencies - SOS; 4) Info - residence; 5) German language; 6) Education and training; 7) Work, apprenticeship training; 8) Health; 9) Children, adolescents, family; 10) Offers for women and girls; 11) Culture, leisure, sport.

The app can be downloaded free of charge for Android, Apple and Windows devices..

# AREAS OF SOCIO-ECONOMIC IMPACTS

| | |
|---|---|
| **Social** | Cohesion and easy information access for new migrants to help them integrate into society. In terms of governance, it helps the local public administration to provide necessary information to citizens. |
| **Economic** | Helps companies find professional staff from other countries, equal opportunities. |

# 50. Aurea4rural: Augmented reality for rural tourism

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Aurea4rural is a EU project co-funded by the Erasmus programme to promote the use of augmented reality (AR) in rural tourism. It exploits a platform that brings together business associations and training institutions, with the aim of involving students and professionals in the dissemination of digital culture in this context. The aim is to enhance tourists' and visitors' experiences.

The project involves several participants. There are associations of enterprises representing the rural tourism sector and associations of entities operating in the digital learning sector. The consortium also includes a rural business school and two institutions specializing in augmented reality: an ICT developer and a higher education entity.

**Application scenario**

Rural domain: promotion of rural tourism and education of operators

**Digital technologies**

Web platform, mobile app, augmented reality

**Socio-economic impact**

- Economic:
- Individuals – responsibility, skills; learning; Access – information, resources; Social capital- inclusion, participation, trust.
- Social:
- Individuals – responsibility, skills; learning; Access – information, resources; Social capital- inclusion, participation, trust.

**More info:** http://www.aurea4rural.eu

The project uses a rich web platform (reports and documents on digital tools and rural tourism), educational contents, and an e-learning section for online courses. There is also a mobile application with interactive AR-based content that can be updated and enriched by students and operators involved in the project.

The main added value of this system is the use of an integrated approach: promotion of digital technologies, and training for operators in rural tourism. Moreover, the project is oriented toward a specific group of people: the actors involved in rural tourism. This makes it a reference point for the provision of information for people who share the same interests. The information is very detailed and it allows users to learn the principles linking opportunities offered by digital technology (with particular attention to AR) to rural tourism.

# PURPOSE OF THE TOOL

This instrument aims at promoting the use of ICT in rural tourism. The main objective is to create innovative AR applications using a digital platform for rural tourism, and also to provide training content for people working in this sector (managers of public parks, hotels, restaurants, companies offering leisure activities). This project also aims at strengthening cooperation among enterprises, professional organizations, and institutions to promote vocational education and training for students and actors involved in this sector, with particular attention on digital skills.

# DESCRIPTION OF THE TOOL

The tool is based on a rich web platform, where several reports and documents related to the use of technologies in rural tourism are hosted and open for consultation by everyone. There is also a virtual space that can be used by registered users to promote rural tourism and to inform tourists and visitors (operators and students can help to increase content by entering data and creating new points of interest); this information will be integrated into an AR application for smartphones. Users can see historical and cultural places, but also activities targeted for tourists. When users are close to points of interests (e.g. a fountain or a historical building), they can point the phone camera to them and read descriptions (e.g. when it was built, its history). Lots of educational resources are available to students and tour operators to learn how to use those digital tools. The learning procedure is based on real cases to understand how the tool can be used and what advantages AR can provide.

Another key instrument is an e-learning platform that allows students to follow courses with exercises and online videos, with the possibility to obtain certificates of attendance.

# AREAS OF SOCIO-ECONOMIC IMPACTS

**Social**

Individuals – responsibility, skills; learning;

Access – information, resources;

Social capital - inclusion, participation, trust.

| | |
|---|---|
| **Economic** | Organizations – cooperation, Incomes, Marketing;<br>Value chain – Trust;<br>Markets – Stability. |

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