Practice Abstracts Batch 1

Deliverable 5.4

WP 5. Dissemination, exploitation and communication

Project title
D4AgEcol – Digitalisation for AgroEcology

Grant agreement: 101060759
From 1st September 2022 to 31st August 2025

Prepared by: CETRI
18/04/2024

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No.101060759 **Disclaimer:** The sole responsibility for any error or omissions lies with the editor. The content does not necessarily reflect the opinion of the European Commission. The European Commission is also not responsible for any use that may be made of the information contained herein.

Deliverable Factsheet

Deliverable no.	Deliverable D5.4: Practice Abstracts Batch 1
Responsible partner	CETRI
Author	Ioannis Aviziotis
WP no. and title	5: Dissemination, Exploitation and Communication
Task no. and title	T5.2: Dissemination and communication tools design and development
Version	1
Version Date	18/04/2024
Approved by	Andreas Meyer-Aurich (ATB)
Version history	

Dissemination level	
X	PU = Public
	SEN = Sensitive
	EU classified = EU-Restricted, EU-Confidential, EU-Secret

Partners' short names

ATB – LEIBNIZ INSTITUTE OF AGRICULTURAL ENGINEERING AND BIOECONOMY E.V.

CETRI – CENTER FOR TECHNOLOGY RESEARCH & INNOVATION LTD

ZALF – LEIBNIZ CENTRE FOR AGRICULTURAL LANDSCAPE RESEARCH

AUA – AGRICULTURAL UNIVERSITY OF ATHENS

UCPH – UNIVERSITY OF COPENHAGEN

BOKU – UNIVERSITY OF NATURAL RESOURCES AND LIFE SCIENCES

LfL – BAVARIAN STATE RESEARCH CENTER FOR AGRICULTURE

PESSL – PESSL INSTRUMENTS GMBH

DLG – GERMAN AGRICULTURAL SOCIETY

LUKE – NATURAL RESOURCES INSTITUTE FINLAND

UNAC – UNIAO DA FLORESTA MEDITERRANICA

HAU – HARPER ADAMS UNIVERSITY

Abbreviations

AECM	Agri-environmental climate measures
D&C	Dissemination and Communication
PAs	Practice Abstracts
RTK-GNSS	Real time kinematic position- global navigation satellite system

Publishable summary

A practice abstract (PA) is a short summary, in understandable language, that describes the main information/recommendation/practice that can be used by the end-users in their daily practice. This compilation of practice abstracts aims to highlight agroecology and digital innovations that demonstrate ways to improve the digitalisation of agroecology and, at the same time, the efficacy and the affordability of digital solutions in agroecological systems.

In the framework of D4AgEcol project, fourteen (14) PAs will be produced in the EIP Agri format. These practice abstracts will be produced and grouped in two sets, respectively reported in two deliverables:

• D5.4 Practice abstracts batch 1, due at Month 18, containing six (6) PAs;

• D5.10 Practice abstracts batch 2, due at Month 36, containing eight (8) PAs.

Per each practice abstract, two versions have been created:

- One version to be used for the EIP-AGRI website (without pictures);
- One more detailed version, published into the D4AgEcol website (with illustrative pictures).

The first six (6) PAs will be published in the D4AgEcol public website (see Annex 1) under Communication and Dissemination/Practice abstracts (https://d4agecol.eu/practice-abstracts) using a specific template designed by CETRI. Relevant posts will be done on project social media accounts (Twitter, Facebook and LinkedIn). The first six (6) PAs will be also sent for publication to the EIP AGRI website (https://ec.europa.eu/eip/agriculture/en) along with the relevant project information. The following PAs are elaborated in D5.4:

Table 1. Practice Abstracts of D5.4

PA	Title	Partner
PA01	Weed mapping on cereal crop fields (‘Thistle tool’)	UCPH
PA02	Virtual Fencing technology	HAU
PA03	Automated Robots in Sugar Beet Farming	LfL
PA04	Sensor-based health management in cattle farming	ATB
PA05	Unmanned-aerial-vehicle-based green fertiliser mapping	LUKE
PA06	Online tool for agri-environmental-climate measures	ZALF

Table 2. Main Task of deliverable 5.4

WP5 - Dissemination – Exploitation – Communication
Task 5.2: The D&C tools include the D4AgEcol website, the project brochure (leaflet), publications in international journals, conferences and workshops, the project newsletter, dissemination to the public by means of publicity online and at local media (e.g., interviews in local newspapers or TV shows), contacts with industrial stakeholders through existing links of the partners with such organisations, strong presence in social media (Facebook, LinkedIn, Twitter, Instagram) and visits to schools. A YouTube account will be created for short interviews of the project partners and project news. Printed dissemination material will be kept to a minimum, preferring online alternatives adopting a “Green-paperless approach”. A video series related to pilot activities and farm stakeholders will be developed combining partners, agriculture, and specialized media influencers. The content of the digital inventory (Task 1.1) will be ready to be used in the EUFarmBook project (7 years duration), which aims to store and present results of multi-actor projects. A dedicated API will be designed and developed for this purpose. AUA, responsible for the digital repository, is also core partner of EUFarmBook, which ensures the smooth transfer of data. In addition, the resulting innovative knowledge and easy accessible end-user material from this project will feed into the EIP- AGRI (The agricultural European Innovation Partnership) website for broad dissemination to practitioners. End-user material will be produced in the form of a number of summaries for practitioners in the EIP common format ("practice abstracts"). The project details will also be submitted to the platform with the first deliverable submission. A full package of practice abstracts for a total number of 14 will be produced by the project, containing all the outcomes/ recommendations, which are ready for practice.

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1 Introduction

The European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) was launched in 2012 to contribute to the European Union's strategy "Europe 2020" for smart, sustainable and inclusive growth. This strategy sets the strengthening of research and innovation as one of its five objectives and supports a new interactive approach to innovation: European Innovation Partnerships.

The resulting innovative knowledge and easily accessible digitalization technologies, when applicable for technologies that are market-ready, from this project will be fed into the EIP-AGRI website for broad dissemination. The investigated digitalization technologies contain an important number of summaries for practitioners in the EIP common format ("Practice Abstracts"), including the characteristics of the project (e.g. contact details of partners, etc.).

All European Union's Horizon Europe 2021 multi-actor projects and thematic networks, as well as all EIP-AGRI[1] Operational Groups, "use this common format to provide farmers, foresters, advisers, practitioners, or whoever is interested with short and concise practical information. The use of the EIP-AGRI common format facilitates not only the exchange of knowledge, but also the contact between potential partners in innovation projects. It contributes to building up a unique repository of practical knowledge across the EU via the EIP-AGRI project database, which supports the dissemination of results of all interactive innovation projects".

A full package of practice abstracts will be produced by D4AgEcol project, containing all the outcomes/recommendations which are ready for practice. A Practice Abstract (PA) is a short summary of around 1000-1500 characters (word count - no spaces) which describes the main information/recommendation/practice that can serve agroecology practitioners in their daily practice. Guidance and templates for these PAs are available on the EIP-AGRI web site. A total target number of fourteen (14) PAs is foreseen for the project. Six (6) are delivered in this first batch of D5.4.

[1] https://ec.europa.eu/eip/agriculture/en/content/eip-agri-common-format.html

2 Description of Practice Abstracts

2.1 PA01: Weed mapping on cereal crop fields ('Thistle tool')

Thistle Tool uses drone images to identify root weeds like thistles and from that creates an allocation map that can be used for spot spraying in the field.

By using the Thistle Tool, farmers can reduce the use of plant protection products for pre-harvest weed control by up to 90%. High-resolution images taken with a drone are necessary for this task, as the Thistle Tool identifies weeds by exploiting the colour difference between crop and weed before harvest and it is currently not possible to solve this task with satellite images.

Thistle tool is used to minimise the use of pesticides on grain crop fields (i.e., Glyphosate). The use of a drone mounted camera allows the user to map the patches of weed in a field. Then, the weedmap enables a precision application of pesticides, avoiding spraying pesticides in the areas where they are not necessary. The pesticide amount can be decreased significantly if the invasive weed is found only in small patches on the field while the application is limited if the weed infests most of the field.

The weed map is georeferenced, and it can be also used to guide a self-driven robot. The self-driving precision sprayer can be fed with the data and weed map produced by the drone and the entire process automatised with a high level of precision.

In synthesis, the proper 'thistle tool' is a weed mapping tool, but it is only the first part of the whole precision application system (mapping and precision spraying).

The tool is being commercialised for the past 2-3 years (although the number of adopters is unknown and it is still being developed at the University of Copenhagen to serve a broader scope (i.e., the imaging system has the potential for monitoring other aspects of the crop).

2.2 PA02: Virtual Fencing Technology

The first concept of using audible cues emitted by a collar-mounted device worn by an animal appeared about 50 years ago, but it was initially only used on companion animals as reported by Golinski *et al.,* 2023 (Virtual fencing technology for cattle management in the pasture feeding system – A review). Peck's Invisible Fence manufactured the first virtual control devices for domestic livestock in the US in 1987.

Virtual fencing is used in different cattle and sheep rotational grazing systems for precision pasture management. These systems may include: dairy, store, and finishing cattle; ewe and store lambs; as well as lowland or upland, intensive or extensive, low- or high-maintenance grazing systems. Virtual fencing works similarly to conventional electric fencing, but without relying on physical barriers. Rather, fences are digitally created with the help of a mobile application or other software. The animals experience virtual fences by means of an audio cue and potentially an electric shock administered via a collar worn around their neck, as described by DEFRA (Opinion on the welfare implications of using virtual fencing systems to contain, move and monitor livestock).

DEFRA's Animal Welfare Committee reported that there were 140+ virtual fencing users in the UK at the time of data collection (DEFRA, 20222). This figure might underestimate the current adoption level in the UK as, according to workshop participants, the technology is spreading quickly. Globally, there are four main virtual fencing system manufacturers, namely: Nofence (Norway), eShepherd (Australia), Vence (US), and Halter (New Zealand).

2.3 PA03: Automated Robots in Sugar Beet Farming

Sowing and mechanical weeding robots are a subclass of field robots (autonomous agricultural vehicles working on the field). They are built and used for mechanical weed control. The robots usually travel along predefined tracks. A distinction can be made between inter-row hoeing and intra-row hoeing. Intra-row hoeing is more complex than inter-row hoeing. Camera systems with pattern recognition algorithms can be used to distinguish between crops and weeds. However, there are also systems that sow and store the position of the seed to selectively hoe around it based on an RTK-GNSS signal (satellite positioning system with enhanced accuracy).

In recent years, weeding robots have become somewhat common in (organic) horticulture and have spread to agricultural row crop production, both of which require high manual labor input for weed control and generate significant value. Examples include horticultural crops such as lettuce or onions or organic sugar beet cultivation in arable farming. Field robots have only been on the market for a few years. One of these commercially available robots is the Farmdroid FD20, which autonomously sows fine seeds (e.g., sugar beet, rapeseed) and then performs inter- and intra-row hoeing for weed control. A special state funding program for farmers in Bavaria to invest in field robots since 2021 has resulted in more than 60 of these field robots being used, primarily in organic sugar beet production.

2.4 PA04: Sensor-based Health Management in Cattle Farming

The smaXtec bolus technology is a herd and health management system. A bolus is inserted into the cow's reticulum. This, measures and sends various values to a station in the barn. AIs and algorithms determine the cow's health status and send reports and recommendations for action back to the farmer. The data and recommendations for action, e.g. push-up notifications for fever events, can be accessed via app or computer.

The system provides information about:

- Health (febrile illnesses such as mastitis, metritis, respiratory illnesses or other infections or
  metabolic illnesses such as ketosis and milk fever)
- Drinking, eating behavior and activity in general
- Heat and calving (fertility, twin calves)

The first sensor was developed in 2006, from which smaXtec emerged as a research project in 2009. The commercial marketing of the system began in 2016. In the last four years, more and more international markets have been opened up (e.g. Great Britain, USA, Australia).

2.5 PA05: Unmanned-Aerial-Vehicle-based Green Fertiliser Mapping

Green fertilizer mapping aims at defining the amount of nitrogen fixation by legume plants in in-field scale. The technology is based on the automation-assisted drone imaging (RGB) from low altitude (5 m) covering the whole field, as well as on an image of the entire field from higher altitude. The image of entire field was used for biomass estimation and the low-altitude images to define the growing density of legume plants. The growing density of legume plants is determined utilizing AI assisted recognition of the number of flowers per drone image. The amount of fixed nitrogen in a growing site is based on mathematical models per legume plant type. The model parameters include the amount of yield and its legume plant fractions. To validate the biomass estimation some growth samples are measured as ground reference.

The technology is provided as a service for farmers, where the role of a farmer is to take a leased drone to the target field and to monitor the safety during the mission. Everything else in the service takes place automatically. The service concept was put together in response to a need that has arisen for the application of green fertilizing in precision farming. The service combines several well-known technologies in a new way for the described application. The service is not available in the markets yet.

2.6 PA06: Online Tool for Agri-Environmental-Climate Measures

The NatApp is an information and documentation application, with which farmers can get informed about agri-environmental climate measures (AECM) and other contract-based nature conservation measures and document them. The idea for the NatApp dates to 15 years ago at ZALF, when the need for one single platform offering a wide overview of all available measures was becoming more and more evident. Its development included 3 versions of the NatApp, until finally Flynet joined the project at ZALF and started developing the application. The NatApp's main applications are (1) its use as an information tool, and (2) its use as a web-based and app-based documentation tool. On one hand, it can be used as a condensed platform to get information about all European, German, and regional/local measures that farmers can choose to implement. On the other hand, famers can use the application to allocate the measures, plan them, and document their execution through photos, GPS-tracks etc. as documentation. Currently, the NatApp is not on the market yet, and links with other digital technologies and systems need to be implemented for it to work. However, it holds great potentials since the need for a platform that collects information about available measures (that are otherwise scattered and not easy to find) is still high among farmers, as some surveys show.

ANNEX 1 – Practice Abstracts uploaded on D4agecol Website

Practice Abstract No. 1

D4AgEcol
DIGITALISATION FOR AGROECOLOGY

eip-agri
AGRICULTURE & INNOVATION

Weed mapping on cereal crop fields ('Thistle tool')

Thistle Tool uses drone images to identify root weeds like thistles and from that creates an allocation map that can be used for spot spraying in the field. By using the Thistle Tool, farmers can reduce the use of plant protection products for pre-harvest weed control by up to 90%. High-resolution images taken with a drone are necessary for this task, as the Thistle Tool identifies weeds by exploiting the colour difference between crop and weed before harvest and it is currently not possible to solve

this task with satellite images. Thistle tool is used to minimise the use of pesticides on grain crop fields (i.e., Glyphosate). The use of a drone mounted camera allows the user to map the patches of weed in a field. Then, the weedmap enables a precision application of pesticides, avoiding spraying pesticides in the areas where they are not necessary. The pesticide amount can be decreased significantly if the invasive weed is found only in small patches on the field while the application is limited if the weed infests most of the field. The weed map is georeferenced, and it can be also used to guide a self-driven robot. The self-driving precision sprayer can be fed with the data and weed map produced by the drone and the entire process automatised with a high level of precision. In synthesis, the proper 'thistle tool' is a weed mapping tool, but it is only the first part of the whole precision application system (mapping and precision spraying). The tool is being commercialised for the past 2-3 years (although the number of adopters is unknown and it is still being developed at the University of Copenhagen to serve a broader scope (i.e., the imaging system has the potential for monitoring other aspects of the crop).

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[1] P. Golinski, P. Sobolewska, B. Stefanska, B. and Golinska, *Agriculture*, 13, **2023**, 91:1-14.

[2] Department for Environment, Food & Rural Affairs (DEFRA). 2022. *Opinion on the welfare implications of using virtual fencing systems to contain, move and monitor livestock*. UK Government. Available online.

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Unmanned-Aerial-Vehicle-based Green Fertiliser Mapping

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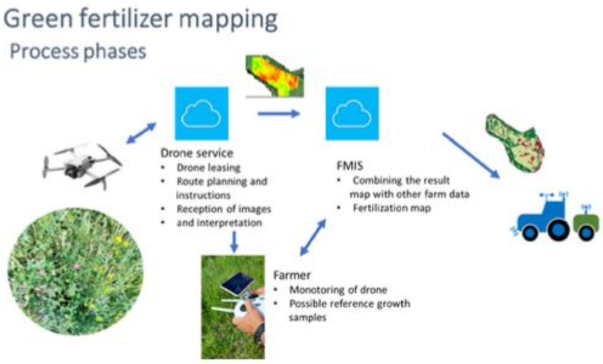

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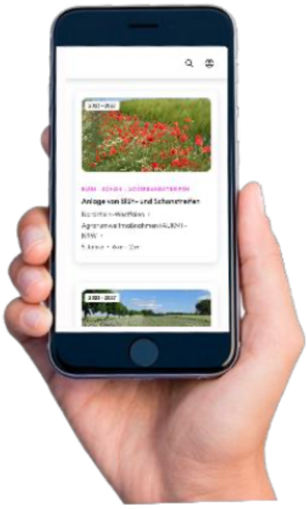
Online Tool for Agri-Environmental-Climate Measures



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