Deliverable 5.2: Report on the efficiency of digital weed management solutions (version 1)

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Start date of the project: 01/05/2023   **End date of the project**: 30/04/2027
Deliverable due date: 30/04/2024   **Date of delivery**: 30/04/2024
Classification: Public
Associated Work Package(s)

WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8
☐	☐	☐	☐	☑	☐	☐	☐

Version History

Version number	Implemented by	Notes
1.0	AUA	

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Introduction

The GOOD project (aGroecOlOgy for weeDs) has established three special pilots corresponding to three Living Labs located in three European countries - Greece, France, and the Netherlands. Work package (WP) 5 of the GOOD project deals with digitalisation technologies of agroecological weed management systems. In the present document, we report on the progress on Task 5.2, "Weed management through the combination of digital tools and agroecological innovations" and on Task 5.3, "Development of Agroecological Weed Management (AWM) Toolbox". Regarding Task 5.2, three innovative and technologically advanced weed control methods such as spot sprayers, mechanical weeders and autonomous robotic weeding platforms will be evaluated in special pilots concerning their effectiveness in combating weeds in three Living Labs in winter cereal (Greece), orchard (France) and onion (the Netherlands), with focus on improving weed management while reducing the use of herbicides and to test and gather valuable information regarding the effectiveness of each of the methods applied in the context of the Special Pilots. The weed control methods to be tested will be provided by leading robotic and hardware manufacturers. The results of the assessments and the experimentation will be made available publicly, further aiming at assisting in the improvement of the efficiency of weed management in the European cultivated fields and also at reducing chemical inputs and the overall

environmental impact of weed management. Furthermore, the gathered information will be further exploited by Task 5.3, "Development of Agroecological Weed Management (AWM) Toolbox" to fine tune the Decision Support System (DSS) that will be developed in the context of the GOOD project. The AWM Toolbox is due in M36, but a first draft architecture is reported below, as several GOOD partners have started designing its features. Furthermore, in the following pages of the present document you will find the created templates that will be used for the Special Pilot periodic Reporting (SPR) in the second version of this deliverable in M18 and its subsequent updated versions in M30 and M48 of the GOOD project respectively.

Regarding Task 5.3, a digital tool, namely a decision support system (DSS), the AWM toolbox will be developed. The AWM Toolbox represents a digitally accessible decision support system (DSS) that will be integrated within the GOOD platform and made available upon user registration at no cost. Designed to streamline weed management decision-making for farmers, it will present a handy digital tool with a succinct questionnaire focused on pertinent aspects of crop cultivation and management practices. By soliciting input such as field location, main crop species, cover crops, cultivation methods, and desired outcomes, the toolbox will generate tailored recommendations aligned with agroecological weed management (AWM) practices. Drawing upon a comprehensive repository of AWM strategies developed within the framework of the GOOD project (D1.5), the toolbox will aim at automating data extraction based on predefined crop and practice parameters. Upon completion of user input, it will furnish a detailed DSS summary augmented with AWM-derived weed management recommendations. These recommendations will be complemented by insights into the anticipated environmental, economic, and social impact of each proposed strategy. Central to its functionality, the AWM Toolbox will encompass 32 AWM combinations curated for the crops under study within the context of the GOOD Living Labs. Furthermore, it will facilitate the identification of optimal temporal windows for AWM practice implementation (e.g. recommendations on the timing of cover crop sowing). In alignment with the overarching goals of the GOOD project, the AWM Toolbox will aim to serve as a pivotal tool in enhancing farmers' capacity to make informed decisions regarding weed management by giving different recommendations regarding weed management both for annual and perennial crops tested in the context of the GOOD project. Through its user-centric design and intuitive interface, it will aim to foster accessibility and comprehension among European farmers, while also contributing to the dissemination of knowledge and fostering adoption of sustainable agricultural practices by the European farmers. For the purpose of developing and fine tuning the AWM Toolbox, it will undergo several rounds of validation before being officially launched. Weed experts participating in the consortium will validate the final design and architecture of the Toolbox, while a group of experts will be responsible to provide data and knowledge from the Living Labs.

Updates of D5.2

Deliverable	Version	Due month	Reporting
D5.2	1	M12 (April 2024)	Pilot plans
D5.4	2	M18 (October 2024)	Pilot plans updates + SPR1
D5.6	3	M30 (October 2025)	Pilot plans updates + SPR2
D5.9	4	M42 (October 2026)	Pilot plans results + SPR3

Organization	AUA
Location	Domokos, Greece (GPS: 39°03'48.8"N 22°15'26.2"E)
Crop	Wheat
Aim	Two sprayers with similar spot spraying technologies will be deployed and tested in cereal fields of the Greek LL.
Description of activities	Two boom sprayers will be equipped with high-end spraying modules like section/nozzle control systems and anti-drift nozzles, coupled with an intelligent AI processing controller with cameras to discriminate weeds and cereal plants in real-time and finally perform spot spraying at plant-level. AUA and UG will use their experience and competences from existing R&D Horizon projects (i.e, OPTIMA, ROBS4CROPS, SmartDroplets) to retrofit the boom sprayer. The results from this digital weed control practice will be compared with the conventional weed management practices either of the farmers or the conventional sites of the Living Lab (reference to WP2).
Timing of activities	Rapid growth stage of weeds (when wheat is in tillering stage).
Measurements	Weed density and weed biomass at species level before application and a few weeks after to evaluate the efficacy of the practice. Distinguish between weed species and their characteristics. LCA monitoring. Weed control efficacy on species level using sensor-based technologies (NDVI) Crop density and crop growth monitoring. Grain yield and its components.
Training activities	Demo events (if possible, in combination with the demo farm events of WP2, WP3) Video content to be stored in the e-learning module. Pdf files with the results. The files will be used as guides for farmers and stakeholders.

Description of the special pilot – ONION (NETHERLANDS)

Organization	Delphy B.V.
Location	Colijnsplaat, Zeeland, The Netherlands (501°35.3650'N 3°51.1148'E)
Crop	Onions
Aim	Investigate alternative methods to deal with the reduction in the available, chemical herbicides
Description of activities	In the special pilot alternative (non-chemical) weed control methods will be used to compare with the conventional weed control method. The objects mainly consist of mechanical control, possibly in combination with chemicals, applied to the sowing row. In addition, in the organic part, weeds will only be mechanical controlled. The special pilot is divided in 4 objects. One object will be monitored by University of Gent with a drone. The drone will be exploited to capture photos of the Special Pilot field with an aim to determine the populations of weeds in it. The captured images will be further analysed in order to produce spraying recommendation maps to combat the weeds present in the field. The onions will be seeded on ridges with drip irrigation instead of conventional sprinkler on the field. Other methods aiming at reducing and combating weeds such as cultivation techniques (e.g. precise application of irrigation water through innovative techniques) and mechanical weeding techniques will also be investigated in the context of the Dutch Special Pilot.
Timing of activities	As soon as the onions are seeded, the first chemical apply will happen. Moving forward from that while keeping the Good Agricultural Practices (GAP) in mind, mechanical weeding will be applied while weeds are still in the seedling growth phase.
Measurements	Weed density, counting 3 times per plot and determination and amount per weed. Amount of plants, counting 2 times in 1m x 1,5m per plot
Training activities	Event: International Onion Day, Colijnsplaat. During this day someone will tell about the trial and the aim of the trial. Around 1500 persons will attend this event and will be divided in different groups which contains around 20 persons in 5 different rounds. PDF file with the results of the trial which can be used as information for farmers.

Description of the special pilot – APPLE/PLUM (FRANCE)

Organization	CTIFL
Location	Prigonrieux, France
Crop	Apple
Aim	Different automated equipment will be tested for weeding
Description of activities	For the 1rst year of the trials, two types of innovative and automated equipment will be tested: - A small mowing robot (Vitirover) adapted to weed perennial crops. Different weeding scenarios will be tested with different mowing frequencies and settings of the robot. - A tractor equipped with a guidance controller (with RTK GPS) to weed rows with conventional tools. The automation of the tractor may impact the weeding precision improving weeding quality and reducing tree injuries. Both solutions will be compared to conventional weed practices on different aspects: technical, agronomic and economic impacts.
Timing of activities	Mainly during the growth period of weeds (spring)
Measurements	Weed/cover height. Number of wounded trees and trees vigor Work rates Yield and fruits quality Economic impact
Training activities	Demonstration in events

Annex 1: Template for periodic Special Pilot Reporting (SPR)

SPECIAL PILOT REPORTING (SPR) SHEET

Version history table

Version	Date	Author(s)	Notes
SPR1	XX/XX/202X		

Special Pilot
Tick the box of your Special Pilot

Special pilots for Task 5.2		
Country	Code number	
Greece	GR_wheat/16	☐
Netherlands	NL_onion/12	☐
France	FR_apple-plum/21	☐

Special Pilot reporting – WHEAT (GREECE)

Special Pilot Reporting Period	☐ SPR1: M18 (October 2024) ☐ SPR2: M30 (October 2025) ☐ SPR3: M42 (October 2026) *Tick the box of the SPR*
Communication activities of the LL	*Please add (1) the communication activity name, (2) a short description, (3) who was the target audience (e.g., farmers, research communities, civil society etc.), (4) how many people you reached, (5) what was the communication channel (e.g., agricultural exhibition, social media, print materials, radio etc.), (6) what was the outcome.* *If you didn't conduct any communication activity during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Dissemination activities of the LL	*Please add (1) the dissemination activity name, (2) a short description, (3) the type of the dissemination activity (e.g., conferences, meetings, clustering activities etc.), (4) who was the target audience (e.g., farmers, research communities, civil society etc.), (5) how many people you reached, (6) why you did that with a reference to a specific project output.* *If you didn't conduct any dissemination activity during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Demonstration activities of the LL	*Please add (1) the demonstration activity name, (2) a short description, (3) the type of the dissemination activity (e.g., open field day, drone mapping etc.), (4) who was the target audience (e.g., farmers, research communities, civil society etc.), (5) how many people you reached* *If you didn't conduct any demonstration activity during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Publications	*Please add (1) the publication title, (2) a short description, (3) the type of publication (e.g.,*

	scientific publication, technical article, article in farmers' journal etc.), (4) the publisher, (5) the date (6) how many people you approximately reached *If you didn't publish anything during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Participations in regional/national events	*Please add (1) the title of the event, (2) a short description, (3) the type of the event (e.g., conference, local civil society meeting, agricultural fair etc..), (4) who was the target audience, (5) the date (6) how many people you approximately reached* *If you didn't participate in any event during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Cross-visits	*Please add (1) person who did the cross-visit, (2) the connected Living Labs, (3) a short description.* *If you didn't conduct any cross-visit during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Ethical and Data Protection	*Please refer to any ethical and data protection issues arose in the special pilots. Communicate them early with the Task leader. If there were no ethical and data protection issues during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Major field operation problems & Risks identified	*Please add (1) the identified risk, (2) proposed mitigation measures, (3) who is involved and who is the risk owner.* *If you didn't identify any risks during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Social media	*Please add (1) how many posts you did on GOOD's social media regarding your LL, (2) how many posts you did on your social media regarding your LL, (3) how many approximately reacted to the posts.* *If you didn't post anything on social media during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
Other	XXX

Special Pilot reporting – ONION (NETHERLANDS)

Special Pilot Reporting Period	☐ SPR1: M18 (October 2024) ☐ SPR2: M30 (October 2025) ☐ SPR3: M42 (October 2026) *Tick the box of the SPR*
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Other	XXX

Special Pilot reporting – APPLE/PLUM (FRANCE)

Special Pilot Reporting Period	☐ SPR1: M18 (October 2024) ☐ SPR2: M30 (October 2025) ☐ SPR3: M42 (October 2026) *Tick the box of the SPR*
Communication activities of the LL	*Please add (1) the communication activity name, (2) a short description, (3) who was the target audience (e.g., farmers, research communities, civil society etc.), (4) how many people you reached, (5) what was the communication channel (e.g., agricultural exhibition, social media, print materials, radio etc.), (6) what was the outcome.* *If you didn't conduct any communication activity during the reported SPR, please copy and paste "Not applicable for this SPR".* XXX
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