# WeLASER

Eco-innovative weeding with laser

## Sustainable Weed Management in Agriculture with Laser-Based Autonomous Tools

# D1.1 – Multi-actor involvement plan and activities (I)


Funded by the Horizon 2020 programme of the European Union

[This page intentionally left blank]

**Acknowledgment**

WeLASER is a project funded by the Horizon 2020 Research and Innovation Programme of the European Union under the call “Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bio-economy” and the topic “Integrated health approaches and alternatives to pesticide use.”

(H2020-SFS-04-2019-2020)

Grant agreement N. 101000256



| | |
|---|---|
| Deliverable number | D1.1 |
| Work-package Task | WP1 |
| Work-package leader | IETU |
| Deliverable type * | Report |
| Dissemination level** | Public |
| Status –Version | V1 |
| Contractual delivery date | September 30, 2021 |
| Actual delivery date | September 30, 2021 |
| Star date/end date of the project | October 1, 2020 / September 30, 2023 |
| Author(s) | Janusz Krupanek, Beata Michaliszyn (IETU), Pablo Gonzalez de Santos, (CSIC) Alvaro Areta (COAG), Kaat Verplanken, Duc Tran (UGENT), Karsten Scholle (FUT) |
| Contributor(s) | CSIC, LZH, FUT, UCPH, AGC, COAG, UNIBO, IETU, UGENT, VDBP |
| Approved by | Pablo Gonzalez-de-Santos |

* Report; Prototype; Demonstrator; Other.

**Public; Restricted to other programme participants (including the Commission Services); Restricted to a group specified by the consortium (including the Commission Services); Confidential, only for members of the consortium (including the Commission Services).

[This page intentionally left blank]

## EXECUTIVE SUMMARY

Deliverable D1.1-“Multi-actor involvement plan and activities (I)” is the first document intended as report of the annual activities regarding the involvement and management of the Multi actors in the WeLASER project. It covers the period M1 – M12 (October 2020- September 2021). The report provides overview of the activities carried out in workpackage 1 including the following tasks:

- Identification, involvement, coordination and knowledge exchange with stakeholders and other entities
- Scientific and technical continuous assessment – value chain follow-up
- Economic assessment and risk management in farms
- Health and environmental issues
- Social aspects concerning the adoption of novel techniques

In the reported period, the stakeholders were identified and involved in project activities. They represent various interest groups including farmers, NGOs, policy makers, research and industry. Two stakeholder events were organised in the on-line format due to COVID-19 situation. The aim of the first event was to stimulate involvement and to include stakeholders in the decision loop regarding the definition of WeLASER system characteristics. The second event was dedicated to safety issues, legal aspects and infrastructural requirements for efficient operations of the system. Both events brought valuable input for designing of the invention and its future introduction to the market. Stakeholders’ interaction was accompanied with communication of project activities by issuing Practice Abstracts and dissemination activities.

In the first period, the tasks related to evaluation of the project from scientific-technical, financial-marketing and sustainability perspective were launched. The scientific-technical progress of the project is satisfactory and gives positive prospects for market introduction of the final design of the system. It is also positively evaluated by the Stakeholders.

In the reported period, the economic and sustainability assessments were planned with basic information on the WeLASER invention gathered and evaluated and methodologies of assessment for socio-economic studies and Life Cycle Assessment work out. In this respect, stakeholder events brought valuable opinions regarding the sustainability of the invention from a practical perspective.

[This page intentionally left blank]

# TABLEOF CONTENTS

[This page intentionally left blank]

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AGC: | Agreenculture |
| AGRI: | Agricultural (manager) |
| CATI | Computer Assisted Telephone Interviewing |
| CBA | Cost benefit analysis |
| COAG: | Coordinator of Farmer Organizations and Livestock Rural Initiative of Spain |
| CSIC: | Spanish National Research Council |
| DoA: | Description of the Action (A part of the Grant Agreement) |
| FGI | Focus group interviews |
| FUT: | Futonics |
| GDPR: | General Data Protection Regulation |
| IETU: | Institute for Ecology of Industrial Areas |
| ICP | Informed Consent Process |
| LCA | Life Cycle Assessment |
| LZH: | Laser Zentrum Hannover |
| M1 – M36: | Month within the period of project development |
| PESTEL | Political (P), Economic (E), Social (S), Technological (T), Environmental (E), and Legal (L). |
| S-LCA | Social Life Cycle Assessment |
| UCPH: | University of Copenhagen |
| UGENT: | Ghent University |
| UNIBO: | University of Bologna |
| VDBP: | Van den Borne Projecten |
| WP: | Work Package |

[This page intentionally left blank]

# 1. PURPOSE OF THE DOCUMENT

Deliverable D1.1 is the first document intended as report of the annual activities regarding the involvement and management of the Multi actors in the WeLASER project. There are planned three deliverables D1.1, D1.2, D1.3 – "Multi-actor involvement plan and activities (I), (II), (III)"; to be delivered in months: 12, 24 and 36 of the project duration. The reports have to contain the identification, involvement, coordination and knowledge exchange with stakeholders and other entities and the assessment of the scientific, technical, social, economic, health and environmental issues. D1.2 will update D1.1 and D1.3 will update D1.2.

# 2. INTRODUCTION

WeLASER project's Workpackage 1 (WP1) – "Open-ended multi-actor networking and activities: from initial specifications to exploitation" executes, a multi-level approach to the innovative technology development/assessment. It has to be realised from October 2020 to September 2023 by all partners: IETU, CSIC, FUT, LZH, UCPH, AGC, COAG, UNIBO, UGENT, VDBP. This is an interdisciplinary and multidimensional approach to deal with multiple effects in different domains, forecasting system behaviour and technology evolution, uncertainties and risks. The approach includes environmental considerations in terms of resources and emissions, risks, economic/financial concerns and socio-cultural considerations. To achieve the objectives, the execution of the following tasks in the WP1 has been planned:

- TASK 1.1 – "Identification, involvement, coordination and knowledge exchange with stakeholders and other entities" led by COAG with involvement of all participants. Period: M1 – M36. This task focuses on
  - (i) identifying groups of stakeholders and entities all over Europe,
  - (ii) making a plan for better understanding how to engage with them and efficiently exchange knowledge,
  - (iii) involving and coordinating them in the development of the weeding system,
  - (iv) attracting potential end-users, and
  - (v) identifying the most appropriate ways and means for the inclusion of hi-tech systems in farms.
- TASK 1.2 – "Scientific and technical continuous assessment – Value chain follow-up" led by CSIC with involvement of all participants in months M5 to M36. This task is devoted to monitoring all the aspects included in the value chain presented, not only regarding scientific-technical and evaluation issues, but also monitoring those topics related to financial opportunities to deploy the system in the market as well as related marketing activities
- TASK 1.3 – "Economic assessment and risk management in farms" led by UGENT with participation of all participants in the period: M5 – 36. For the need of economic assessment, the

models for the investment profitability assessment (on the level of individual farmer and entrepreneur) and development of cost benefit analysis (CBA) will be performed. The analysis will include identification and evaluation of investment and operational costs (life cycle perspective) with evaluation of economic benefits to farmers. Opportunities for innovative economic models like machine sharing/leasing/lending will be considered

- TASK 1.4 – "Health and environmental issues" led by IETU with participation of all partners in the period: M5 – M36. Regarding health and environmental issues, the innovative technology will be assessed through the Life Cycle Assessment (LCA) methodology based on the ISO 14040:2009 standard. The main objective will be to consider all the aspects, direct and indirect, that could potentially affect the health and environment associated with new technology.
- TASK 1.5 – "Social aspects concerning the adoption of novel techniques" led by IETU with participation of all partners in the period: M5 – M36. The Social Life Cycle Assessment (S-LCA) is intended to assess the social and socio-economic aspects of innovative product and their potential positive and negative impacts along with its life cycle encompassing manufacturing; distribution; use; re-use; maintenance; recycling; and final disposal.

In this workpackage, apart from D1.1, D1.2, D1.3 – "Multi-actor involvement plan and activities", deliverable D1.4 – "Final project assessment" in month M36 will be prepared. This document will report the final evaluation of the project carried out by the consortium and the project officers. A document describing the evaluation of the project (equipment and activities) made by the consortium and the EC representatives.

# 3. MULTI-ACTOR STRATEGY- WELASER APPROACH

## 3.1. Description of Multi – Actor strategy plan

WeLASER is a Multi-actor project in which end users and multipliers of research results such as farmers and farmers' groups, advisers, enterprises and others, are closely cooperating throughout the whole research project period.

The identification and involvement of stakeholders in WeLASER are key aspects because (i) the project intends to offer a practical system and the knowledge and recommendations from practitioners are critical for developing useful equipment and (ii) stakeholders can provide understandings of circumstantial factors not covered by the project consortium (societal disputes, gender and cultural local aspects, etc.) that are critical for the exploitation of the equipment. Thus, WeLASER focuses on the identification and involvement of stakeholders as follows:

1. **Identification** – The identification of stakeholders is carried out along the duration of the project with quick identification of key stakeholders done in the first month of the project development with their participation in the design phase. It was planned that all the WeLASER partners collaborate during the first months in the identification of potential stakeholders comprising the following sectors:

- Governments: Regional and local governments, EU policy-makers.

- Institutions: Research, high education and standard institutions.

- Businesses: Industry (manufacturers, users), investors, etc.

- Civil society: NGOs, general public, etc.

**2. Involvement** – Stakeholder involvement consists of both **engagement** and **management**:

**a) Engagement** – This first part of the involvement of stakeholders consists of establishing relationships. Stakeholders would be more valuable if they keep on participating in the project from beginning to end. The engagement plan offers incentives to keep their interest in participating in the project. Those incentives are as follows:

- Access to information: The knowledge generated in WeLASER will be accessible to stakeholders.

- Personal or institutional interest in being joined to the project.

- Networking: WeLASER will offer several opportunities for stakeholders to meet face-to-face with other collaborators and establish new partnerships.

Early stakeholder engagement is essential for the project development; therefore, a WeLASER Stakeholder Event was held in November 2020.

**b) Management** – This second part of the involvement of stakeholders consists of managing the processes of including the stakeholders in the project activities that will be based on (i) Reciprocal communication, (ii) Consensus building and (iii) Co-design.

WeLASER identification and involvement of stakeholders are summarised in the following **Multi-actor involvement procedure**, which is sketched in Fig. 3.1.

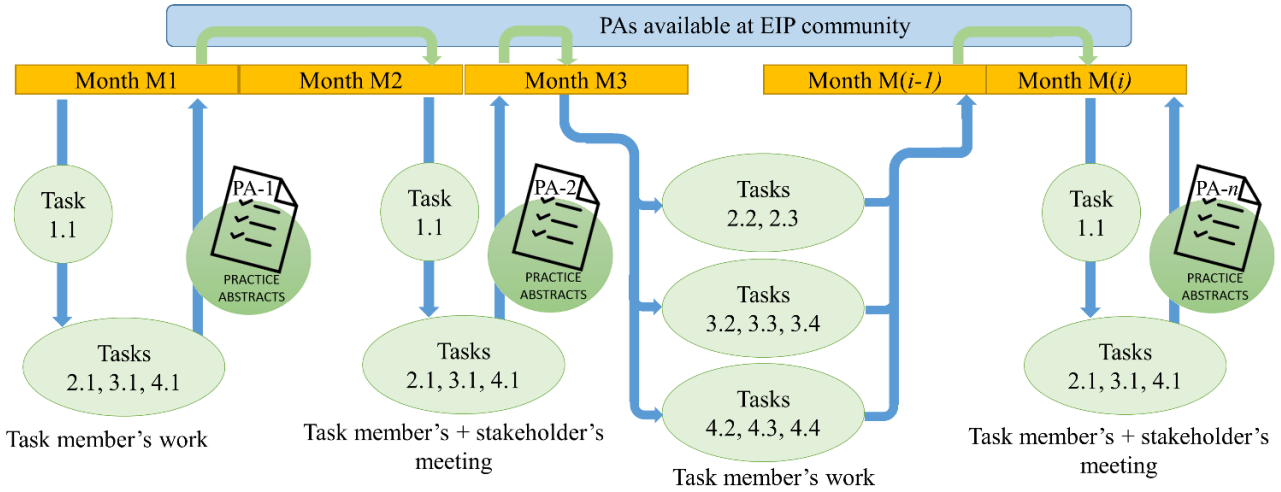



**Fig. 3.1. Multi-actor involvement procedure (scheme for initial tasks)**

This plan will allow us, using the EIP common formats (Practice abstracts), to involve stakeholders in the developing loop.

## 3.2. WeLASER Stakeholders involvement approach

According to the project proposal, WeLASER aims to merge current technologies to build and push close to the market a precision weeding system based on high power laser sources and autonomous vehicles with the main objective of eliminating the use of herbicides and their health and environmental adverse effects while improving productivity and competitiveness.

It is envisioned that in WeLASER project the innovation will achieve TRL 7: System prototype demonstration in operation environment. In the project a few phases can be distinguisehed: design, components development, systems integration, testing and demonstration. Considering this, the Multi Actor approach is envisioned to be a flexible activity depending on the needs and requirements of the particular WeLASER activities with the final objective of achieving a product for its further commercialisation.

In the beginning of the first reporting period, stakeholders participation was focused on designing the robot, its functionalities and conditions of its use. From that perspective, the potential users are the most crucial at this stage. These are predominantly farmers, farmers' associations and agricultural advisors. Moreover, in the course of the project, new ideas about WeLASER application in management of green areas in the cities also arose. These stakeholders are engaged through all events and activities executed in WeLASER project.

Having in mind that there are certain aspects such like legal, environmental, safety, economic and social, a set of stakeholders and experts are to be involved in events dedicated to the specific issues. These stakeholders represent policy making organisations, NGOs, research institutions and experts experienced in implementation of precision agriculture. They are engaged mainly through Stakeholders Events and Focus Group interviews. The prioritisation of stakeholders involvement during the project duration is reflected in the planning of the events as it is defined in Table 3.1.

**Table 3.1. Stakeholders' events, subject and planned participants**

| Stakeholder event | Subject | Priority participants |
|---|---|---|
| 1 | Stakeholder engagement (initial specifications) | Potential users |
| 2 | Security and safety, legal aspects, infrastructures, barriers and economic opportunities | Potential users, experts and policy makers |
| 3 | Environmental impacts, benefits and health issues | Potential users, experts and policy makers |
| 4 | Social and behavioral labor, system conditions and implementation strategies Vision, key functionalities and market perspectives | Potential users and business |
| 5 | Project evaluation | Potential users, business and policy makers |

This approach will be followed also in the second period untill WeLASER will achieve proven in field test designed characteristics. Consequently, in the third year of WeLASER project, representatives

of business, machinery producers, software developers and machinery providers and traders will be approached in more intensive manner to seek the opportunities for efficient production of the laser implement and its potential integration with existing mobile autonomous robots and humans operating platforms as well as its future commercialistion. It has to be noted that this approach has to be carefuly based on consortium decisions related to future commercialisation of WeLASER project results at the final stage of the project.

It has to be noted that particular events and activities are adressing various groups of stakeholders in conjunction with dessemination activities. Business will be addressed especially through fairs, professional literature and business oriented conferences as well as in the last period of the project through field demonstrations and by paricipating in the final Stakeholder Event. It has to be also underlined that all WeALSER activities are open for all kind of stakeholders wishing to take part in project proceeding, although a certain prioritisation in the particualr project phases are taken up as the guiding principle.

A procedure was open to all stakeholders to register as official supporters of WeLASER project based on the European Union General Data Protection Regulation (GDPR) in the beginning of the project and will be continued in the project duration. These stakeholders are visible on the website. Not all stakeholders express that wish and they are registered only for the particular events according to GDPR rules but they constitute a wide network of stakeholders involved in the project activities.

## 3.3. Overview of Multi-actor involvement procedure in the first period

Multi-actor involvement procedure consists of the following steps:

STEP 1 – At the beginning of the project (October 2020), partners involved in the scientific and technical developments (WP2 to WP5) elaborated information related to the expected characteristics of the subsystems and components, as well as the complete system. This information was summarised as an EIP Practice Abstract (PA-2 draft), and issued at the end of October 2020.

STEP 2 – At the end of November 2020, a technical meeting was held to discuss the preliminary equipment characteristics advanced in PA-2 draft. A preliminary list of groups and stakeholders (potential readers of the Practice Abstracts) was prepared at the end of October 2020. Protection of databases personal information according to rules and information storage – see D.8.1-“POPD - Requirement No. 1”.

Stakeholders were invited to attend the meeting to discuss the content of PA-2 draft through the organization of the **First WeLASER Stakeholder Event**. The outcomes of the meeting produced the final version of the abstract (PA-2), which was the starting point of the technical developments (beginning of December 2020).

STEP 3 – A similar WeLASER Stakeholder Event was organized in May 2021. The outcomes of the meeting were summarised in PA-11.

Other stakeholder meetings are planned in months 12, 24 and 32 in line with technical meetings and Practice Abstracts have to be issued reporting the evolution of the project.

# 4. IDENTIFICATION, INVOLVEMENT, COORDINATION AND KNOWLEDGE EXCHANGE WITH STAKEHOLDERS AND OTHER ENTITIES

WeLASER uses a multi-level approach to develop and assess its innovative technology in order to deal with multiple effects in different domains, including environmental, economic and socio-cultural considerations, forecasting system behaviour and technology evolution, uncertainties and risks. This activity performed within Task 1.1 according to DoA is led by COAG with support of IETU and involvement of all partners.

## 4.1. Identification and involvement of stakeholders

Identification and involvement of stakeholders in WeLASER are key aspects because the project intends to offer practical equipment and the knowledge and recommendations from practitioners are critical for developing useful equipment. Stakeholders can provide understandings of circumstantial factors not covered by the project consortium (societal disputes, gender and cultural local aspects, etc.) that are critical for the exploitation of the equipment.

With these aspects as cornerstones, identification of appropriate stakeholders with a balanced perspective was developed.

A coordinated action plan was proposed and set up on a WP1 WeLASER virtual meeting on 26th October 2020. A first identification of stakeholders was carried out by all the WeLASER partners until mid-November. Identification will also continue along the duration of the project.

Stakeholders were identified and selected from four different groups:

- Governments: Regional and local governments, EU policy-makers.
- Institutions: Research, high education and standard institutions.
- Businesses: Industry (manufacturers, users), investors, etc.
- Civil society: NGOs, general public, etc.

Territorial balance was also taken into account and representatives from eight different EU countries were included (Poland, Italy, Spain, Belgium, The Netherlands, Denmark, Germany and France). Also representatives at EU level are present.

Once stakeholders were identified, they were invited to participate in WeLASER co-designing process from the beginning to the end of the project. They were informed of WeLASER general objectives and conditions and advantages of joining, mainly participating in a multistakeholder decision process, with access to first-hand information and access to networking and other incentives.

The process was quite successful and a first list of balanced stakeholders was delivered (Figure

4.1). The engagement process continued with their participation in the first stakeholder event on November 26th 2020.

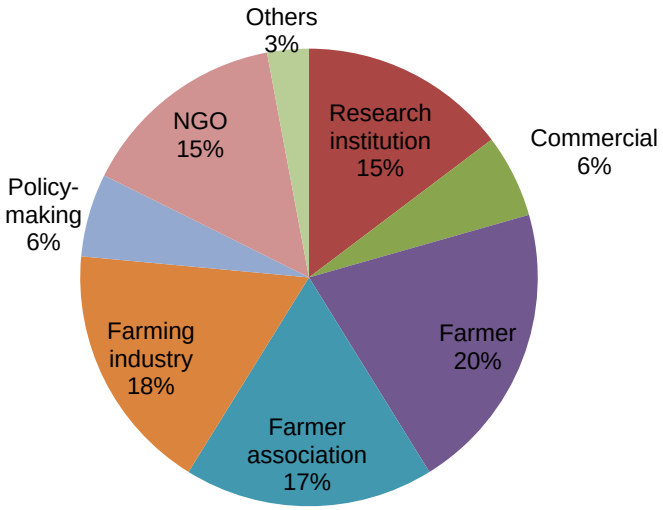



**Fig. 4.1. Stakeholders by area of competence**

Identification and engagement continue after the first stakeholder event with the multistakeholder process loop. Results of this event were shared with stakeholders and taken into account for the second stakeholder event. As a result of this process, several Practice Abstracts were produced.

Informed Consent Process (ICP) rules were elaborated for the multi-stakeholder activities. The Informed Consent documents are included in D8.1-"POPD Requirement No. 1". The events organised took into account voluntarily consent of the participants to the collection and use of their information according to the developed privacy policy/other written documentation provided to them. For this purposes the Informed Consent Forms are used. Personal data provided by participants of workshop's and project events have been used and stored in accordance with the General Data Protection Regulation.

## 4.2. Coordination and knowledge exchange

### 4.2.1. 1st WeLaser Stakeholder Event

A first event with the identified stakeholders was held on November 26th, 2020. The main aims were to stimulate involvement and to include stakeholders in the decision loop regarding the definition of system characteristics. Detailed information was provided to stakeholders about the project and the main features of every subsystem to conclude with the specifications of the overall weeding equipment. It was also provided an overview of the multi-actor strategy, the role of the stakeholders in the project, specific ways to cooperate and different benefits of being involved.

An animated discussion was held, with numerous interventions from stakeholders and consortium members, about the overall WeLASER project with a specific focus on the opportunities and barriers

for market adoption of this technology, but also on specific questions on system characteristics. Also some polls were carried out to optimize participation in this online event.

A very good evaluation was received from participants. 21 stakeholders participated in the event in a well-balanced representation from a regional and background point of view. End-users participation was relevant and, according to the multi-actor strategy, stakeholders' contributions are taken into account in the definition of system characteristics, but also in the design of future activities of WeLASER. As the event was held through an online platform, physical information and engagement material was sent to stakeholders two weeks after to enhance their commitment and to prepare future actions.

### 4.2.2. 2nd WeLaser Stakeholder Event

The Second WeLASER Stakeholder event was held virtually on May 25th, 2021. Over 40 interested professionals representing end users, industry, researchers, policy makers and NGOs interested in this project got together to discuss the WeLASER issues related to successful application of agricultural robots using laser techniques for weeding. These included the security and safety issues, infrastructures needed for efficient performance of the robot, barriers and economic opportunities for implementation of the invention in practice. Invited experts and consortium members presented legal and practical aspects of agro-robotics safety, efficiency of the machine and economics. The panel discussion was held with representatives of farmers with the focus on barriers and challenges for real-life application of WeLASER invention with general discussion following up.

General discussion with participation of stakeholders and consortium members was focused on potential barriers and bridges of WeLASER application in practice related especially to infrastructural requirements, safety issues, legal, policy and economic aspects. Stakeholders expressed positive view on application of WeLASER invention in practice and provided valuable insight into potential problems. Some polls were carried out to stimulate discussion in online event.

A good evaluation was received from participants. 20 stakeholders participated in the event in a well-balanced representation from a regional and background point of view. Stakeholders' contributions are taken into account in further development of the system and in preparation of further activities of WeLASER project. The minutes and presentations were sent to the stakeholders.

## 5. SCIENTIFIC AND TECHNICAL CONTINUOUS ASSESSMENT – VALUE CHAIN FOLLOW-UP

TASK 1.2 in the DoA is devoted to carry out the scientific and technical continuous assessment of the WeLASER project. This task is led by CSIC and supported by all the project partners. The activities started in M5 (February 2021) and will continue until the end of the project development (September 2023).

This task is devoted to monitoring all the aspects included in the value chain presented in Fig. 5.1

(see Fig. 1.1 in the DoA of the Grant Agreement), which comprises

(i) the scientific-technical and evaluation activities and

(ii) the monitoring of all the topics related to financial marketing opportunities to deploy the system in the market

The steps in the value chain illustrated in Fig 5.1 can be covered by the project partners; however, interested stakeholders and institutions have been involved in the activities to feedback the decisions to be made to achieve the proposed results. The identification, involvement and coordination of the stakeholders, both individuals and institutions, have been presented in Section 4 above.

According to the DoA, the task is divided into two subtasks to provide separate evaluation of equipment and procedures: Subtask 1.2.1 – "Assessment of the equipment development and tests" and Subtask 1.2.2 – "Assessment of the procedures (communication, dissemination, exploitation and risks)".

## 5.1. Assessment of the equipment development and tests

The objective of this task is to supervise (from the point of view of the multi-actor approach strategy) **the individual system evaluations (Tasks 2.4, 3.5, and 4.5)** and the **final equipment evaluation (Task 5.3)** to detect possible failures or shortcomings and propose corrections. These activities and their consequences will be reported as a part of D2.1, D3.1, D4.1, D5.3 as well as in the corresponding annual deliverable "Multi-actor involvement plan and activities" (D1.1 to D1.3).

During this first year of project development, the consortium has been developing the different subsystems. These subsystems are unfinished at the moment (expected by month M31) and thus their evaluations have not been made yet; therefore, we provide a preliminary estimation of their status of development in Table 5.1.

**Table 5.1. Status of completion of the subsystems**

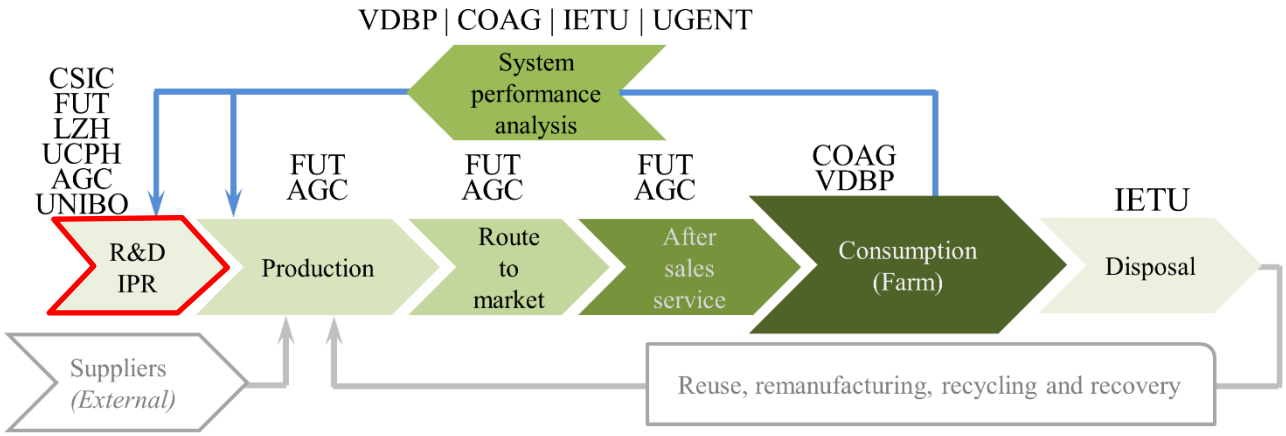



**Fig. 5.1. WeLASER value chain**

Notes:

- The activities in grey are not implemented in this project
- The current activities during the reporting period are highlighted in red

**Table 5.2. Estimation of the development status of the subsystems**

| Subsystem | Component | Leader | Status of design/ implement-tation | Comments |
|---|---|---|---|---|
| Laser-based weeding system | Laser source | FUT | 40 % | Design: 70 %<br>Implementation: 30 %<br>Validation: 0 %<br><br>According to plan |
| | Diode Power supply | FUT | 60 % | Design: 90 %<br>Implementation: 50 %<br>Validation: 30 %<br><br>According to plan |
| | Chiller | FUT | 40 % | Design: 80 %<br>Implementation: 20 %<br>Validation: 0 %<br><br>According to plan |
| | Targeting system | LZH | 40 % | Design: 80 %<br>Implementation: 25 %<br>Validation: 0 %<br><br>A slight delay is estimated due to current lack of components in the world |
| | Tests on crops and living organisms | UCPH | 25 % | According to the plan |
| | Laser safety | LZH | 30 % | Design: 65 %<br>Implementation: 0 %<br>Validation: 0 %<br><br>According to plan |
| Weed-meristem perception system | Weed-meristem perception device (Hardware) | LZH | 100 % | According to plan |
| | Crop/weed discrimination algorithms | LZH | 32 % | Design: 50 %<br>Implementation: 30 %<br>Validation: 0 %<br><br>A delay is estimated due to a staff shortage/vacant position |
| | Impact-point AI-vision system and weeding control system | LZH | 20 % | Design: 40 %<br>Implementation: 20 %<br>Validation: 0 %<br>A delay is estimated due to a staff shortage/vacant position |
| Autonomous vehicle for laser weeding | Mobile platform | AGC | 60 % | A short delay is estimated due to current lack of component in the world. |
| | Smart navigation manager | CSIC | 30 % | A delay is estimated due to current lack of component in the world. |

| | | | | |
|---|---|---|---|---|
| | IoT system | UNIBO | 40 % | According to the plan |
| | Cloud computing | UNIBO | 40 % | According to the plan |
| System integration | Mass distribution | CSIC | 15 % | According to the plan |

Partial assessment of the scientific and technical aspects of the development of the different subsystems configuring the final equipment was made through technical meetings and the steering committee meeting held on July 9th, 2021. Table 5.2 indicates several technical meetings carried out to discuss technical questions and define subsystem interfaces, processes and interaction among subsystems. These meetings were used also for scientific and technical assessment purposes.

**Table 5.2. Technical meetings used for scientific and technical follow-up**

| Participants | Topic | Date |
|---|---|---|
| LZH, FUT, UCPH, CSIC | Laser trial in Denmark | 25/03/2021 |
| AGC-CSIC | Integration of mobile platform and navigation manager | 8 – 9/04/2021 (Visit) |
| LZH, FUT, UCPH, CSIC | WP2 Tech meeting - discussion on Subtask 2.5.3-Risk assessment of large organisms (rodents, humans) | 06/05/2021 |
| LZH, AGC, CSIC | Three-point hitch discussion | 28/05/2021 |
| UNIBO-CSIC | Interaction among Smart Navigation Manager, IoT network and Cloud Computing System | 18/06/2021 and 28/06/2021 |
| All | Steering committee meeting – Project follow-up | 09/06/2021 |

## 5.2. Assessment of the procedures (communication, dissemination, exploitation and risks)

The objectives within subtask 1.2.2 are to supervise the procedures indicated in section 2.2 of the DoA and monitor the expected impact (Tables 2.7 and 2.12 of the DoA). These activities and their consequences will be reported in the corresponding annual deliverable (D1.1 to D1.3).

The key performance indicators used to follow-up the communication, dissemination, exploitation and risk management activities are detailed and analysed in deliverables D6.2 and D7.2 submitted at the same date that this current deliverable (month M12). As a summary of the activity carried out in the first year, some information taken from D6.2 is repeated in the following tables.

**Table 5.3. Key performance indicators for communication and dissemination assessment**

| Key Performance Indicators | | | | | |
|---|---|---|---|---|---|
| **Target audience** | **Type of dissemination activity** | **Measurement** | **Months 1-12** | | **Total in the project** |
| | | | **Current measures** | **Grant Agreement** | |
| **The Scientific Community** | Journal articles | Number of articles | 2 | 6 | 42 |
| | | Number of citations | 2 | 6 | 42 |
| | | Text views | 5.386[1] | | |
| | International conference papers and presentations | N. of papers/presentations | 4 | 6 | 36 |
| | | Number of citations | - | 3 | 21 |
| | Special sessions in international conferences | Number of special sessions | - | - | 2 |
| | Summer School | Number of students | - | - | 30 |
| **Student community** | Lectures in MSc courses | Number of courses | - | 5 | 17 |
| | Lectures in PhD courses | Number of courses | 3 | 5 | 17 |
| **The Industrial Community** | Patents | Number of applications | - | - | 2 |
| | Technical and general press | Number of appearance | 1[3] | 12 | 60 |
| | | Number of references | 32[2] | 20 | 110 |
| | Participation at external related events | Number of events | - | 3 | 5 |
| **The end users** | Dissemination to farmers | N. of field and training days | - | - | 3 |
| **The general stakeholders** | Newsletter | N. of copies sent/downloaded/views | - 58 views on the project website.<br>- 34 downloads.<br>- 220 offices and 31 organizations[3]<br>- 25 stakeholders | 300 | 1200 |
| | The project flyer and posters (Flyer and Poster) | N. of copies sent/downloaded | - 220 offices and 101 organizations[4] | 400 | 1500 |
| | Project Website | Website visits | 3,5K visits<br>907 users[5] | 2000 | 11000 |
| | Practice Abstracts | Number | 16 | | 72 |
| | Social media | Followers/tweets/etc. | Twitter: 55 Followers<br>63 tweets | | |

[1] See metrics at the article links in section 5.1.1.
[2] See "Non-scientific and non-peer reviewed publications" and "Non-scientific and non-peer reviewed publications in technical press" in section 5.1.14.
[3] The Newsletter was sent to 220 COAG's local offices in Spain and 31 organizations in Europe via European Coordination Via Campesina (ECVC)
[4] The flyer was distributed to 31 organizations in Europe via European Coordination Via Campesina (ECVC) and to COPA-COGECA members (70 organizations in the EU) via email
[5] See Google Analytics Report in section 5.1.12.

| | | | | | |
|---|---|---|---|---|---|
| | | | Youtube: 9 subscribers<br>5 videos<br>401 views<br>Facebook: 12 followers<br>Linkedin: 69 followers | | |
| | Professional media | Number of messages/videos/ Press releases | 509[6] | 500 | 1750 |
| | General media | Evidence of debates in the media | - | 3 | 10 |

Most of these measures are lower than planned; therefore, as a next step, the consortium has to make an extra effort to achieve the total planned measures at the end of the project.

Regarding risk assessment, Deliverable D7.2 collects the foreseen and unforeseen risks during the first year of the project development along with the definition of procedures, which have been assessed as quite efficient so far. Table 5.4 summarised the unforeseen risks under management.

**Table 5.4 Unforeseen risks identified in the first year**

| Risk | Description |
|---|---|
| 1 | Delays in the delivery of subsystems due to the delay in component supply because of Covid-19. |
| 2 | Delays in the preliminary integration if Covid-19 persists. |
| 3 | As the optical scanner hardware was not designed for outdoor conditions, the scanner hardware is possibly not robust enough for this application. |
| 4 | Laser safety for outdoor operation cannot be guaranteed sufficiently. |
| 5 | Due to the complex perception task and conditions, the development time for the perception software (algorithms, training, etc.) could take longer than expected. |
| 6 | The training data set for the weed identification/meristem localization does not sufficiently cover the possible environmental conditions on the field. |
| 7 | Due to unexpected insufficient compatibility of components or too slow communication of the implements' elements, the integration and completion of the final perception system could be delayed. |
| 8 | Reflection from a hit stone may harm the environment outside the covered area. |
| 9 | Heating up dry organic matter (straws, leaves, lost paper) in the field may results in fires. |
| 10 | The working capacity (ha/hours) is not sufficient to compete with other weed control methods. |
| 11 | The separation of weeds and crop is not sufficient precise resulting in killing of crop plants or insufficient control of the weed plants. |
| 12 | Larger stones and deep tractor tracks my result in tilting or overturn of the robot, and laser beans my hit outside the covered area. |

# 6. ECONOMIC ASSESSMENT AND RISK MANAGEMENT IN FARMS

A preliminary investment analysis was drawn up in the run-up to the WeLASER project. This analysis was based on a top-down approach. In order to fine-tune the investment analysis and conduct a thorough economic assessment, including sensitivity analysis, of the WeLASER technology, a

[6] According to sections 5.1.13 and 5.1.14

combined top-down and bottom-up approach will be used. To this end, in the first period of the project, a literature study was conducted to collect all necessary top-down data. In addition, a matrix questionnaire was developed, including a detailed breakdown of the revenues and cost structure of the envisaged spin-off. This questionnaire will be submitted to all involved partners to fine-tune the cost and revenue structures of the spin-off. In addition, a sensitivity analysis will be performed, including the results from the PESTEL and competitiveness analysis. Furthermore, the sensitivity analysis will also take into account the estimated Covid-19 impact on supply-chains and cost structure. Afterwards, all results will be consolidated in the exploitation plan.

Next steps:

- Meetings will all involved partners to gather bottom-up information to detail the costs and revenue structure of the spin-off
- Willingness-to-pay survey during the CATI survey
- Economic assessment: sensitivity analysis including results from PESTEL, competitiveness analysis and estimated Covid-19 impact on supply-chains and cost structure
- Review/update of investment analysis and business plan according to the Business Model Canvas

Summary of developed questionnaire:

Legend:

green: input from market (top-down)

blue: input from partners (bottom-up)

| | **WeLASER** |
|---|---|
| **Timing** | |
| Launch of new product | date (year) |
| | |
| **Revenues** | |
| **Market size** | |
| EU production data | |
| Wheat (*Triticum aestivum*) | volume or € |
| Maize (*Zea mays*) | volume or € |
| Potato (*Solanum tuberosum*) | volume or € |
| EU number of crop fields | |
| Wheat (*Triticum aestivum*) | volume or € |
| Maize (*Zea mays*) | volume or € |
| Potato (*Solanum tuberosum*) | volume or € |
| Average field size | |

| | |
|---|---|
| Wheat (*Triticum aestivum*) | ha |
| Maize (*Zea mays*) | ha |
| Potato (*Solanum tuberosum*) | ha |
| Number of farms | |
| large farms | number |
| medium farms | number |
| small farms | number |
| | |
| average farm size | ha |
| Capacity of one We-LASER equipment (per ha) | equipment/ha |
| | |
| Market share estimation (%) | % |
| | |
| **Pricing/product** | |
| willingness-to-pay | €/equipment |
| competitor price | €/equipment |
| estimated price of product | |
| The weed-meristem perception setup (S1) | € |
| vision system (cameras and dedicated computer) | € |
| weed/crop discrimination system | € |
| weed meristem detection system | € |
| Autonomous vehicle (S2) | € |
| autonomous mobile platform | € |
| safety system | € |
| Laser-based weeding tool (S3) | € |
| high-power laser source | € |
| laser-based scanning system | € |
| Smart central controller (S4) | € |
| agri-decision support system | € |
| planner | € |
| supervisor | € |
| IoT and cloud computing system | € |
| Maintenance | € |
| | |
| | |
| **Costs** | |
| **COGS (Costs of Goods Sold)** | |
| Equipment | |
| The weed-meristem perception setup (S1) | €/product + depreciation time |
| vision system (cameras and dedicated computer) | €/product + depreciation time |
| weed/crop discrimination system | €/product + depreciation time |
| weed meristem detection system | €/product + depreciation time |
| Autonomous vehicle (S2) | €/product + depreciation time |
| autonomous mobile platform | €/product + depreciation time |
| safety system | €/product + depreciation time |
| Laser-based weeding tool (S3) | €/product + depreciation time |

| | |
|---|---|
| high-power laser source | €/product + depreciation time |
| laser-based scanning system | €/product + depreciation time |
| Smart central controller (S4) | €/product + depreciation time |
| agri-decision support system | €/product + depreciation time |
| planner | €/product + depreciation time |
| supervisor | €/product + depreciation time |
| IoT and cloud computing system | €/product + depreciation time |
| Processing costs (packaging, safety tests, etc.) | € |
| Transportation costs | € |
| Technical personnel for production and assembly | €/product or €/%revenues |
| Consumables and other parts | €/product |
| ISO accreditation | €/year |
| Other??? | |
| **Indirect costs (*top down approach)** | |
| Marketing & sales | €/%revenues |
| General & administration | €/%revenues |
| R&D | €/%revenues |

Accompanying questionnaire:

- what types of revenue streams will you have (sales of equipment, consumables and spare parts, service contract maintenance, other)?
- what do you estimate will be the selling price of the product?
- what is the economic gain for farmers resulting from using We-LASER technology?
- what is the cost for farmers to use the WeLASER technology? (energy, water use, technical personnel, maintenance, etc.)
    - energy
    - technical personnel
    - maintenance
    - depreciation time?
    - other
- what is the cost for farmers for herbicide use?
- what is the production cost for the We-LASER technology and equipment?
    - equipment
    - processing cost (packaging, safety tests, etc.)
    - costs for ISO accreditation
    - transportation costs
    - technical personnel for assembly
    - software programs, etc.
    - maintenance
    - consumables and other parts

- which parts of the equipment need periodic maintenance (including software updates) and what are the associated costs? What is the frequency for preventive periodic maintenance?
- what are the consumable parts of the equipment and their associated costs and lifetime?

## 7. HEALTH AND ENVIRONMENTAL ISSUES

According to DoA, health and environmental issues are the subject of task 1.4 led by IETU with support from all partners. Activity started in M5 (February 2021) and will be carried out until September M36 (2023). The main objective is to consider all the aspects, direct and indirect, that could potentially affect the health and environment associated with commercial application of the new technology. Health and environmental issues for the innovative technology will be assessed through the Life Cycle Assessment (LCA)

In the first reporting period:

- Second Stakeholder Event was organised and dedicated to safety issues, legal aspects and infrastructural requirements for efficient operations. The results were useful for designing of invention and further planning and preliminary work in this task.
- Assumptions for LCA were elaborated with basic review of literature on LCA for agricultural practices in weeding control (Table 7.1.)
- SimaPro tool and EcoInvent database was updated for the purpose of LCA application

**Table 7.1 Key assumptions for WeLASER invention Life Cycle Assessment**

| LCA key assumptions |
|---|
| LCA methodology based on the ISO 14040:2009 standard and guides (ILCD Handbook(EC-JRC, 2011a), PEF Guide. At least the following impact categories are to be investigated as baseline according to ReCiPe 2016 method:<br>• Particulate matter<br>• Tropospheric ozon formation<br>• Ionizing radiation<br>• Stratospheric ozon depletion<br>• Human toxicity (cancer)<br>• Human toxicity (non-cancer)<br>• Global warming<br>• Water use |

- Freshwater ecotoxicity
- Freshwater eutrophication
- Tropospheric ozon (ecology)
- Terrestrial ecotoxicity
- Terrestrial acidification
- Land use/transformation
- Marine ecotoxicity
- Mineral resources
- Fossil resources

In the assessment WeLASER system will be compared with reference scenarios. The assessment is to be carried out for an application model and/or variants of WeLASER invention which will be worked out during WP1 events. The application model has to refer to the technical parameters, stakeholder interactions and the pilot case application settings.

The results will provide knowledge on the strong and week points of the technology regarding environmental impacts. Based on the LCA, measurable indicators of sustainability of WeLASER approach and recommendations on improvement in design and application models will be provided.

Data will be collected from various sources, including:
- Specific data delivered by WeLASER partner/partners;
- Database containing European data Ecoinvent Ver. 3;
- Literature data.

Information on environmental protection will also be reported in D8.3–EPQ-Requirement No. 3 of WP8.

## 8. SOCIAL ASPECTS CONCERNING THE ADOPTION OF NOVEL TECHNIQUES

According to DoA, Social aspects concerning the adoption of novel techniques are the subject of task 1.5 led by IETU with support from all partners. Although the activities can be carried out by the partners UCPH, IETU, UGENT, COAG, the consortium is proactive in involving both key stakeholders and interested institutions in the discussions. This activity started in M5 (February 2021) and will be carried out until M36 (September 2023). The main objective is to assess the social and socio-economic aspects of innovative weed control system and its potential positive and negative impacts along with its life cycle encompassing manufacturing; distribution; use; re-use; maintenance; recycling; and final disposal. The S-LCA is conducted according to the ISO 14044 framework. The research includes analysis of existing data (literature study) and quantitative and qualitative research using the social sciences methods (CATI survey and Focus Group Interviews – FGI, see Table 8.1). Apart from S-LCA, Life Cycle Costing is planned to be carried out. In the analysis

results of economic assessment will be incorporated. The assessment will be based on LCI models and characterization of the system. The monetized impacts will provide information on the costs to society.

**Table 8.1 Basic assumptions for social studies**

| Social studies description |
|---|
| Quantitative survey (CATI) will be carried out in the three project partners' countries as an initial stage of research leading to a wider qualitative analysis. A qualitative survey will use the focus group interviews (FGI) to deepen the information obtained in the qualitative survey. The planned discussion and interviews with a small group of stakeholders (5 – 15 stakeholders) conducted by a moderator in the three project-partner countries will be organized. During the project development, three FGI workshops will be carried out in three project-partner countries to explore different dimensions of the introduction of the new technology on the market and in agricultural practices.<br><br>The stakeholder events in the format of workshops will focus (i) technical, functional and economical aspects of the development and application of the new technology; (ii) social and behavioural, legal and system conditions affecting farmers' adoption of the innovative technology; and (iii) environmental impact of the innovative technology and the requirements concerning labour, health safety and risk management in farms.<br><br>For FGI surveys and workshops stakeholders will be selected according to the relevance to the specific project aims including: individual farmers, agricultural advisory centres, SME's, organisations, associations, research institutes and academia. This list of stakeholders will be expanded and refined throughout the project realization. |

In the first period the following activities were realised:

- Second Stakeholder Event was organised and dedicated to safety issues, legal and economic aspects. The results were used in preparing of further work in this task.
- Assumptions for S-LCA were elaborated by IETU with basic review of literature on S-LCA for innovation in agricultural sector (Table 8.2),
- Detailed assumptions for social studies were elaborated by IETU and UGENT including planning of the social studies and performance of social LCA including preparation of question bank, FGI scenario and working materials.
- The key stakeholder groups were defined including: farmers, local communities, machinery industry, service providers, farm workers, general community,
- Gender aspects are monitored and controlled as one more activity in this task.

**Table 8.2 Basic assumptions for Social Life Cycle Assessment of WeLASER invention**

| S-LCA description |
|---|
| Social LCA addresses defined themes and impacts. To carry out the study application models in the social context are being developed. It is expected that the impacts in the particular categories and the overall assessment will be at least comparable but the ambition is that they will be better than the reference scenarios of deweeding. Because in some impact categories there might be expected drawbacks and in other categories improvements, appropriate trade-offs between the categories will be evaluated by stakeholders.<br><br>Selected Impact categories defined for various stakeholders: farmers, local societies, general society encompass:<br><br>o Human rights<br>- Gender issues<br><br>o Working conditions<br>- Excessive working time<br>- Wage assessment<br>- Migrant labour<br>- Unemployment<br>- Social benefits<br>- Injuries and fatalities<br>- Occupation health and safety<br>- Local high skills<br><br>o Cultural heritage<br>- Safe and healthy living conditions<br><br>o Social economic repercussions<br>- Contribution to local employment<br>- Contribution to economic development<br>- Food security<br>- Transfer of technology and knowledge<br>- Small holder vs commercial farms<br>- Organic vs large scale<br><br>o Governance<br>- Public commitments to sustainability<br>- Fair competition<br><br>The results obtained will be used to identify the potential of improvement of the social sustainability of the WeLASER system. Recommendations for implementation strategy derived from the results will be provided.<br><br>For Social LCA there will be used results of the social analyses (CATI survey, Focus groups, expert interviews) with quantified statistics based on targeted surveys of farmers (3 surveys in 3 countries: Spain, Netherlands, Poland/Denmark) and qualitative analysis based on topical interviews (3 topics: social, economic, environmental) as a basis for WeLASER common application. |

# 9. ANNEXES

## 9.1. Annex 1 - First Stakeholder Event

### 9.1.1. Minutes of the 1st Stakeholder Event


## MINUTES OF THE 1ST STAKEHOLDER EVENT

### November 26th, 2020

Due to the situation produced by Covid-19, a virtual event (videoconference) was organised by COAG using Zoom service. The agenda of the event is included in Annex 1. The slides of the presentations have already been collected and distributed to the attendees. The list of attendees is included in Annex 2. The meeting started at 9:30 a.m.

| | |
|---|---|
| **Warm up and introduction**<br>Álvaro ARETA<br>(Event organizer) | The event organizer welcomed the participants and explains:<br>❖ The aim of the event: a first contact with the stakeholders and to include stakeholders in the decision loop regarding the definition of system characteristics<br>❖ The agenda of the event<br>❖ Some tips on how the event is going to work |
| **Welcome and Project overview**<br>Pablo GONZALEZ-DE-SANTOS<br>(Project coordinador) | The project coordinator presented a brief overview of the project highlighting the following elements:<br>❖ Project main aim<br>❖ Characteristic of the call: Multi-actor approach and Innovation action (and consequences)<br>❖ The opportunity the consortium had (SFS 04)<br>❖ Project-specific objective<br>❖ Proposed solution<br>❖ Brief description of the consortium<br>❖ Position of the stakeholders in the project management |
| **Stakeholders in WeLASER – What are we going to build together?**<br>Janusz KRUPANEK<br>(Multi-actor strategy WP leader) | The Multi-actor strategy WP leader explained the role of stakeholders in the project and ways to cooperate with special reference to<br>❖ EIP-AGRI and multiactor approach<br>❖ Aspects/issues to be considered in the project like environmental, safety, social<br>❖ The flow of activities and benefits of being involved |
| **Who is present? Short presentation**<br>Álvaro ARETA | The event organizer presented all participants with particular reference to every stakeholder and to their balanced origin and profile. |

| | |
|---|---|
| **System specifications: first draft**<br>Pablo GONZALEZ-DE-SANTOS | The project coordinator revised the main features of every subsystem to conclude with the specifications of the overall weeding equipment |
| **Break** | |
| **Discussion**<br>Laura GARAU (Facilitator) | The facilitator divided the discussion into two different parts:<br>❖ A general discussion about the overall **WeLASER** project with specific focus on the opportunities and barriers for market adoption of this technology<br>❖ Specific questions on system characteristics<br>An animated discussion was held with numerous interventions from stakeholders and consortium members. Detailed information in Annex 3 |
| **Wrap up and next steps**<br>Janusz KRUPANEK | The Multi-actor strategy WP leader summarized the main conclusions and explained the next steps of stakeholders' involvement. |
| **Closure**<br>Álvaro ARETA | The event organizer thanked for the fruitful event and closed the meeting. Very good evaluation is received from participants (Annex 4) |

### 9.1.2. Agenda of the 1st Stakeholder Event


## AGENDA OF THE 1ST STAKEHOLDER EVENT

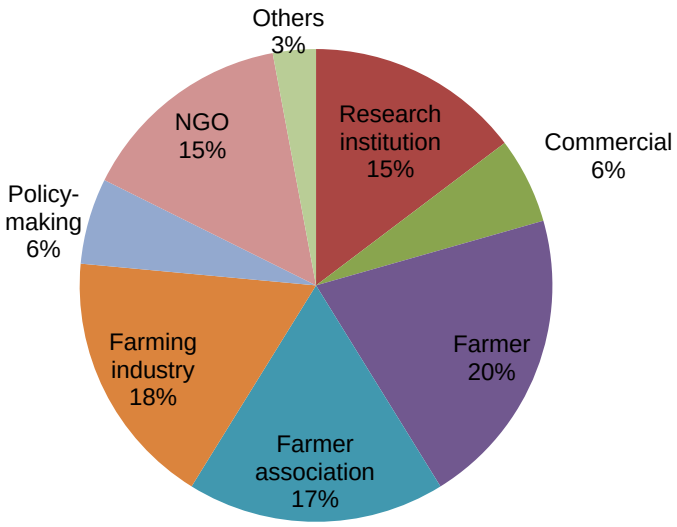
Virtual meeting

Link to the meeting: https://us02web.zoom.us/j/84881065558?pwd=Z0ZMemFMMjVKeGhBbExFbklHR1hiQT09

## November 26th, 2020

| | | |
|---|---|---|
| 09:30 – 9:35 | **Warm up and introduction** | Álvaro ARETA<br>(Event organizer) |
| 9:35 – 9:50 | **Welcome and Project overview** | Pablo GONZALEZ-DE-SANTOS<br>(Project coordinador) |
| 9:50 – 10:00 | **Stakeholders in WeLASER – What are we going to build together?** | Janusz KRUPANEK<br>(Multi-actor strategy WP leader) |
| 10:00 – 10:15 | **Who is present? Short presentation** | Álvaro ARETA |
| 10:15 – 10:45 | **System specifications: first draft** | Pablo GONZALEZ-DE-SANTOS |
| 10:45 – 11:00 | **Break** | |
| 11:00 – 11:50 | **Discussion** | All - Laura GARAU (Facilitator) |
| 11:50 – 12:00 | **Wrap up and next steps** | Janusz KRUPANEK |
| 12:00 | **Closure** | Álvaro ARETA |

### 9.1.3. Overview of attendees




### 9.1.4. Discussion session

Some important issues raised in the discussion session:

- Most of the participants highlighted the importance of this kind of technology and the great interest in autonomous robots /vehicles for farming. One of the questions here was if the robot was autonomous enough.
- Some of the stakeholders raised the issue of an affordable price for the market. But, as the system will be expensive for the average farmers, the solution that some of the stakeholders have risen are service providers; as cooperatives or other figures of end-users. Some of the stakeholders have expressed the importance of comparing prices, for example with human capital and other applications. Square meter prices should be analyzed for different crops.
- Some of the participants have seen that there is a relation between efficiency and frequency of treatment. The efficiency should not that important if the machine can be used often. How often should be treated the field? Differs from different crops and conditions. So it could be a cost efficiency price. For bigger price, we need more efficiency in return. But also the efficiency is not that important if the machine can be used some often. For example, in sowing the machine will be needed quite often the first weeks to kill the little plants.
- Which crops are better for the use of the WeLASER system? High value crops?
- Some stakeholders explained the importance of this technology in specific crops as sugar beets, where the technological capital is already an important one. But there is a need in the market for removing the weeds that are really close to the sugar beets plants. A farmer from Finland stresses the importance of the application in cereal farming. She thinks that the potato and vegetables crops more viable because of the row width. But she thinks that for cereal farms it is an interesting system to and should be developed for it.
- Vineyard industry: Besides the price of the system, the most important thing is the outcome. Human resources are more expensive, every time. So if this autonomous robot has a good outcome in the market it can work. The best way to validate the product is the market, and they think that involving an association of farmers that can test the robots would be interesting. But **WeLASER** group should think what they want to achieve with and from farmers.

- **WeLASER** has to be adapted to different applications with other machineries or autonomous vehicles to combine different systems that already work for different kind of crops. For example, existing maps of possible situation of the weeds that already work.
- The idea is to use this device in a service approach. A service that can provide this technology to some farmers.
- The European Union tends to have more sustainable fields and the use of energy in the machinery is also an important aspect. The use of renewable energy, as the solar panels is a good and affordable solution.
- The system should be analyzed and tested with different weather conditions. For example, water drops or humidity.

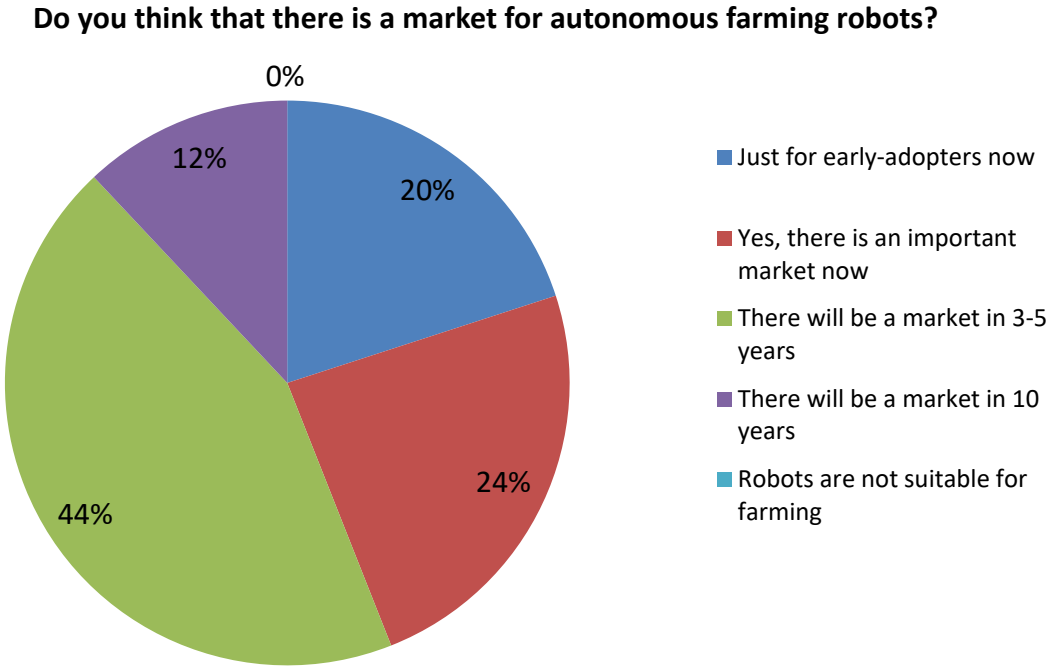
Some other questions that have been raised in the chat:

- What about tree dripline fruit keeping free of weed and grass?
- How comply with the minimum mechanical impact on the soil?
- Is the laser application also developed as stand alone? There are already several autonomous vehicles in the EU. Also to possibly develop a machine that hangs behind the tractor. This allows for faster market introduction of technology in the future.
- Have you considered the opportunity of aerial unmanned vehicles to reduce the impact on the soil?
- The question is what will be the cost of implementing this solution and its operation. It depends on the failure rate and current maintenance costs. The efficiency itself is not very big. Does the project provide for the possibility of changing the system height to work for different crops? Is this supposed to work only in crops not planted in ridges?
- Should be developed for different crops. Also for peas, carrots, potatoes, Spinach
- The sugar-beet prospect is very interesting. This would allow also easier organic sugar-beet cultivating in the organic crop rotation in our conditions. How about adding solar panels on the top and have it used alternatively with solar power? Diesel will be quite expensive and also perhaps not acceptable as sustainable. Price vs. efficiency vs. cost of using very important from farmers´ point of view.
- In Denmark we are very interested in that kind of alternatives to reduce the reduce the use of pesticides, so looking forward to follow the project.
- Every new technology is costly in the beginning: market also will make the price
- Will the laser technology also be available to apply in other autonomous platforms?
- 5 Ha in 24 hours = 70 Ha in 14 days- efficiency is very too low
- I expect in the beginning the weeder will focus on vegetables (low surfaces), velocity for cereals (huge surfaces) will be reached by gradual adaptation
- Could we trust the technology develops during these years and the efficiency would be higher in the end of the project?
- For Sugar beets, could the AI learn to recognize weeds from growing plants?
- Maybe we have to distinguish between the efficiency ensured by the project to that ensured by the machine seller
- 10 hectares a day sounds much better. The question is what will be the cost of purchasing the machine. Even in service, such a machine will have a very limited working time during the year. So the number of services that can be provided will be very limited. This will have to be replaced by purchasing more machines.
- Will the machine be able to work in all weather conditions?
- Why the treatment speed is 2 km/h? Can it be higher in the future?
- One of the partners said that WeLASER only focus on weed in the row because between de rows we can use other machine but others said that depends on the type of crop. And the weed management in the row is most important

- How will be the accuracy of weeds detection near plant?
- Have you included false positives in your performance statistics? I mean identifying weeds from plants
- The stated efficiency is 65%. Does that account for the misleadingly positive results?Or is it just mechanical performance.
- Steketee in the Netherlands have a lot of experience in weeding machines behind the tractor. It is part of Lemken.
- This should be adaptable to various sewing machines? The process should be adapted to existing sewing machines. Absolutely to which crops and sewing machines.

I assume there are also contacts in the EU Agrobofood network?

### 9.1.5. Results from polls



## 9.2. Annex 2 – Second Stakeholder Event

### 9.2.1. Minutes of the 2nd Stakeholder Event


**MINUTES OF THE 2ND STAKEHOLDER EVENT**

## May 25th, 2021

Due to the situation caused by Covid-19, a virtual event (videoconference) was organised by IETU using Zoom service. The agenda of the event is included in Annex 1. The slides of the presentations were collected and distributed to the attendees. General information on attendees is included in Annex 2. The meeting started at 9:30 a.m and ended at 13:00.

| | |
|---|---|
| **Warm up and introduction** Janusz KRUPANEK<br>(Event organiser/Multi-actor strategy leader) Who is present? Short presentation | The event organizer welcomed the participants and explained:<br>❖ The aim of the event: to identify key aspects of WeLASER implementation in practice including environmental, safety, social aspects.<br>❖ The agenda of the event<br>❖ EIP-AGRI and multi-actor approach<br>❖ Some tips on how the event is going to work<br>❖ presentation of participant groups |
| **Project and its activities - overview** | |
| **WeLASER vision and project overview** Pablo GONZALEZ-DE-SANTOS<br>(Project coordinador) | The project coordinator presented a brief overview of the project highlighting the following elements:<br>❖ Project main aim<br>❖ Project-specific objective and proposed solution<br>❖ Brief description of the consortium<br>❖ Overview of project activities EIP-AGRI and Multi-actor approach and Innovation action (and consequences)<br>❖ Position of the stakeholders in the project management and communication of project activities; Newsletters and Practice Abstracts |
| **How do we want to achieve the results ? - status of project activities**<br>WP leaders:<br>Karsten SCHOLLE (FUTONICS) - WP2 | The leaders of technical workpackages presented project activities<br>❖ WP2 main system elements and technical characteristics of the laser scanner that is being developed<br>❖ WP3 Scanner and Perception system development: testing of system efficiency in laboratory conditions and its training using field simulation software |

| | |
|---|---|
| Merve WOLLWEBER (LZH) - WP3<br>Thomas DE SAINTIGNON (AGC), Luis EMMI (CSIC) & Guliano VITALI (UNIBO) - WP4 | ❖ WP4 Autonomous vehicle for laser weeding including development of key devices and system elements:<br>❖ Task 4.2 Adaptation of the mobile platform<br>❖ Task 4.3 Smart Central Controller<br>❖ Task 4.4 IoT and cloud computing integration and management |
| **Expert presentations** | |
| **What do we need to put WeLASER system at work?**<br>Paul van ZOGGEL<br>(Van Den Borne Projecten BV) | Key factors of successful implementation of WeLASER approach were presented such as trust, software integration, support solution, flexible hardware and learning experience during implementation process |
| **How to make autonomous agricultural machines safe?**<br>Jeroen WOLTERS<br>(Smart Agri Technology BV) | Key considerations and practical aspects of safety and security in working in the fields with agri-robots, based on current experiences were outlined. It included planning of the work, controlling of the machine, use of sensors, safety rules for workers, connection issues, standards and good practices |
| **WeLASER – Laser-Safety Issues**<br>Michael HUSTEDT<br>(Laser Zentrum Hannover e.V.) | The main issues of laser technology safety including relevant legal regulations, specific conditions and safety measures (closed shielding, safety circuit and sensors) proposed in WeLASER approach were presented |
| **How to implement WeLASER technique in practice? – opportunities and drawbacks**<br>Xavier GELLYNCK<br>(Prof, Ghent University) | The main economic aspects related to implementation of WeLASER technique were overviewed including opportunities for its application related to precision agriculture and organic farming, market conditions (competing solutions), and potential barriers such as economic feasibility or lack of knowledge |
| **Legal challenges for WeLASER technique implementation**<br>Pamela LATTANZI<br>(Prof, University of Macerata) | Legal issues with regard to EU legislation concerning safety and liability of producers and users were overviewed in relation to characteristics of the WeLASER invention (autonomous vehicle, Artificial Intelligence). |
| **Break** | |
| **Panel discussion**<br>Barriers and Bridges to implementation of WeLASER technique<br>Farmers' voices and general discussion)<br>Panelists:<br>Aira SEVÓN (Organic farm&NGOs Finland)<br>Bo JM SECHER (Nordic Sugar A/S)<br>Marcos Garcés (farmer Spain, COAG)<br>Troels PRIOR LARSEN (farmer Denmark)<br>Andrzej PRZEPERSKI (farmer & agrobusiness Poland)<br>General discussion:<br>All attendees | The facilitator divided the discussion into two different parts:<br>❖ Panel discussion focused on two questions:<br>1. Do you think that use of innovative techniques such as WeLASER could increase competitiveness of your farm? Which current issues are you facing with weeding practices that you expect WeLASER can address in order to improve your business competitiveness?<br>2. What kind of stimulators or barriers would be important in application of inventions such as WeLASER autonomous tools in practice? Please refer to the health and safety concerns related to the use of innovative technologies.<br>Answering the questions panelists provided valuable insight into implementation of WeLASER based on their experiences. The detailed answers for the questionnaires is provided in annex 4<br>❖ General discussion related to the main topics of the meeting was held with interventions from stakeholders |

| | |
|---|---|
| Beata MICHALISZYN (Facilitator)<br>Janusz KRUPANEK (WP1 Leader) | and consortium members. Overview of the discussion and detailed information is provided in Annex 3 |
| **Wrap up and next steps**<br>Janusz KRUPANEK<br>Pablo GONZALEZ-DE-SANTOS | The Multi-actor strategy WP leader summarized the main conclusions and explained the next steps of stakeholders' involvement. |
| **Closure**<br>Janusz KRUPANEK | The event organizer thanked for the fruitful event and closed the meeting. Good evaluation is received from participants (Annex 4) |

### 9.2.2. Agenda of the 2nd Stakeholder Event


**AGENDA OF THE 2ND STAKEHOLDER EVENT**

Link to the meeting: https://us02web.zoom.us/j/84881065558?pwd=Z0ZMemFMMjVKeGhBbExFbklHR1hiQT09

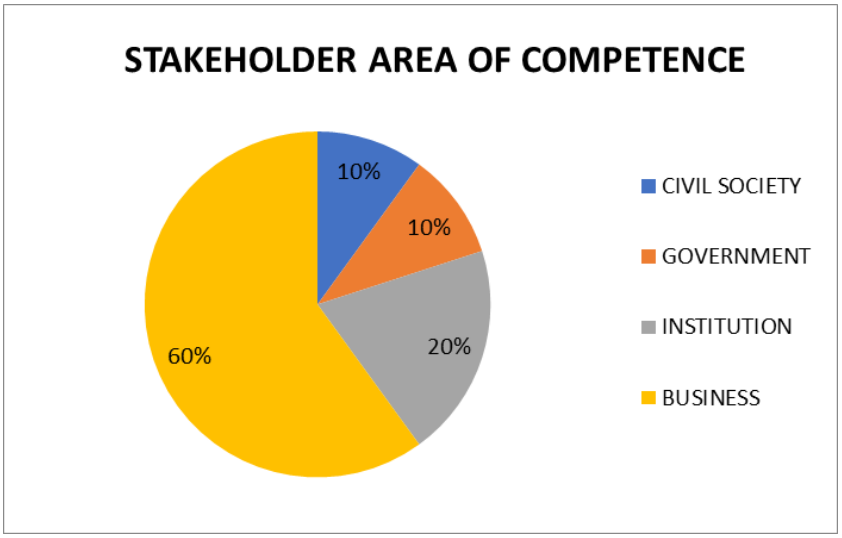
Virtual meeting

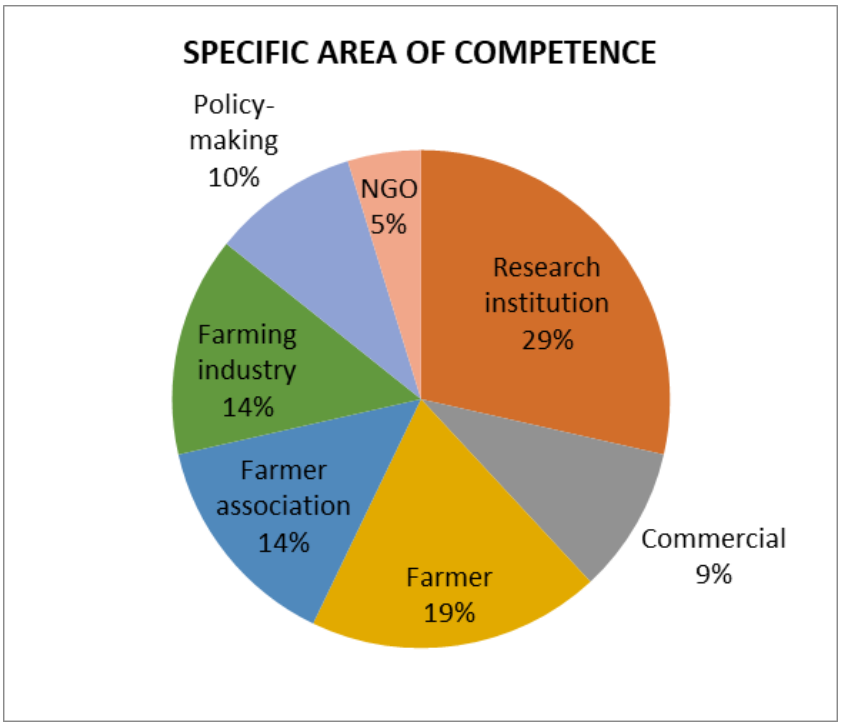
**May 25th, 2021**

| | | |
|---|---|---|
| 09:30 – 9:35 | **Warm up and introduction** | Janusz KRUPANEK<br>(Event organiser/Multi-actor strategy leader) |
| 9:35 – 9:45 | **WeLASER vision and project overview** | Pablo GONZALEZ-DE-SANTOS<br>(Project coordinador) |
| 9:45 –10:15 | **How do we want to achieve the results ? - status of project activities** | WP leaders |
| 10:15 – 10:25 | **What do we need to put WeLASER system at work?** | Paul van ZOGGEL<br>(Van Den Borne Projecten BV) |
| 10:25 – 10:35 | **How to make autonomous agricultural machines safe?** | Jeroen WOLTERS<br>(Smart Agri Technology BV) |
| 10:35 – 10:40 | **WeLASER – Laser-Safety Issues** | Michael HUSTEDT<br>(Laser Zentrum Hannover e.V.) |
| 10:40 – 10:50 | **How to implement WeLASER technique in practice? – opportunities and drawbacks** | Xavier GELLYNCK<br>(Prof, Ghent University) |
| 10:50 – 11:00 | **Legal challenges for WeLASER technique implementation** | Pamela LATTANZI<br>(Prof, University of Macerata) |

| | | |
|---|---|---|
| 11:00 – 11:20 | **Break** | |
| 11:20 – 12:50 | **Barriers and Bridges to implementation of WeLASER technique**<br>**Farmers' voices and general discussion** | Panelists, All attendees<br>Beata MICHALISZYN (Facilitator)<br>Janusz KRUPANEK (WP1 Leader) |
| 12:50 – 13:00 | **Wrap up and next steps** | Janusz KRUPANEK<br>Pablo GONZALEZ-DE-SANTOS |
| 13:00 | **Closure** | |

### 9.2.1. Overview of attendees



### 9.2.2. Discussion session

**Panel discussion**

The short panel session was held. During the session, panelists were asked for a very brief answer to the following two questions:

1. Do you think that the use of innovative technologies, such as WeLASER, can increase the competitiveness of your farm? Please explain why. What current issues are you facing regarding weed control practices that you think WeLASER technology can solve to improve your company's competitiveness?

2. What other stimuli or barriers could be important in implementing technologies such as WeLASER in practice? Please justify your answer briefly. Please also refer to the occupational health safety aspects.

Panelists:

1. Aira Sevón,

2. Bo JM Secher,

3. Troels Prior Larsen,

4. Marcos Garcés

5. Andrzej Przeperski (expressed his opinion by sending written statement)

***Summary of panelists' statements.***
Agricultural crops are associated with weed problems for example the cereal fields. Due to changes taking place in the countryside, agricultural practices are aimed at maximizing the good health and safety of plants, soil and the environment as a whole. We are very much depended on the activities of the Common Agricultural Policy and Green Deal Action Plan. It would be significant to receive investment money to gain new opportunities like this type of machines.

This [WeLASER] invention would be absolutely great for organic farming, especially perfect for sugar beet farming. Many companies, in order to limit the use of chemical agents for weed control, are looking for new solutions in this field. For example, Denmark is close to meeting its herbicide use limits: WeLASER technology could be a good solution for both conventional and organic farms in this country. For companies (example Danish) in the sugar industry, the implementation of the WeLASER technology would be a great support. The use of innovative technologies such as WeLASER can increase the competitiveness of farms, provided that the investment will pay off within a certain period of time. Currently, the costs calculations are not known and there is not possible to compare them with costs of other technologists.

The technology is very interesting. Safety aspects, which were underlined by other participants are important especially having the farm of about 20 hectares and having in mind that there are people around the farm where the robot is operating that could be in danger. But there are other, very important problems - controlling weeds. We are looking for and cannot find alternative solutions for weed removal without chemicals. In the future safety problems will be solved.

Farmers must manage the risk, know how to carry pioneer growing and benefit from professional revolution. The initial trainings and continuous trainings are needed for the implementation of new technologies – the WeLASER technology is an example of this.

The barriers indicated by the panelists were:

- Price of the new technology. Financial assistance will be needed, especially for small farms. Large farms or producer groups are the first to enter the highest technological level.
- Reliability.
- Trust in a new solution.
- There are concerns about the safety aspects of people who move around the field. For example, citizens (Finland) have free possibilities to go round the forest and fields. This would be dangerous.
- Human supervision is needed in order to provide safe, for the environment and people, operation of the technology.
- The issue of some technical matters is important: stability of the GPS system, equipment with sensors.

***General discussion***

We have to think about CAP and possibility of using of pandemic funds which will be just right for WeLASER technology implementation. Unfortunately, it will be coming into force in 2021. There is information that it might be delayed and it will be used in next two years 2022-2023. It might come too quickly for the project. We are hoping that it can be relevant for producers of sugar beets, vegetables and perhaps something else and hopefully also for cereal farmers, if the technology is efficient and the costs are low enough. The project management is urged to approach the EU Commission to make them see the arising opportunities and use the project's results as the possibility to affect the structure of the fund of next CAP.

There was a question of opportunities of WeLASER use for perennial weeds. Perennial weeds such like Thistle and Couch grass will be always the problem. They regrow as their root system can be very deep. They come again and again and we have to treat the field many times, but if we are looking at conventional farmers we can use different techniques for this. Danish farmers have the opportunity to use drones to map their fields and to spray crops for perennial weeds like thistles in the specific places. The combination of different methods could be useful but there still be a problem with organic agriculture and we really do not have a good solution. And it has still to be continued to avoid thistle and couch grass in the field and reduce it as much as possible and if you have a robot you will have to treat it several times as well.

This is also what we have to do today as we treat several times sugar beet in conventional and organic farms. We have to go out very early in the season to the field when the weed seedlings are very small. It will be exactly the same with the robot as there will be also regrowth of all common weeds species such like *Stelaria media* and all the other species

Another question is whether the rain affects the operation of the robot. In muddy fields it is not recommended to carry out the operations. It is rather light robots we are talking about and they do not make the same damage with the pressure as the tractor but if the crops or the weeds are wet, more energy is needed to get rid also of the water off the plants. Water protects the weeds as well. It would be much efficient to use the technique in dry conditions.

One comment is that when developing of such a platform - based on the experience of autonomous vehicles we have so far - one should not underestimate the software that has to be developed in order to control the system. The software must be easily accessible. There are examples where the developers get really confused in the end because of the troubles with operating of the system.

Question was asked whether it was tried to estimate the price tag by cost unit. The answer is: there is not enough data at this moment to estimate the cost. It is not a matter of decimal numbers but rather the range 1 thousand or 1 million. More time is needed to provide reliable figures.

The other comment regarded legislation. We have to lobby to get the approval to work with the autonomous vehicles in the fields because if we have to leave a man watching them, there will be no gain. There are common issues regarding legislation - there are no chemical compounds allowed in sugar beets for thistles. And if the farmers have to do that the compounds have to get the approval. On the other hand, we do not have to control thistle in sugar beet field if we control it in another year in another crop in rotation system. It is important that we can have a field without thistle for sugar beet.

Regarding the software, in the project consortium we do not underestimate this as we have to spend many hours and spend many resources. Regarding the price, we do not have idea about the cost of the system by now. We are going to achieve technological readiness of the level 7 and the system will be tested but not in real environment. The idea is to have 1 phase in the project and we will need additional funding for 2$^{nd}$ phase. It would be good to start to think about more projects and try to engage investors. Then in the second phase we will try to achieve the readiness of technology at the level of 9 what means that the system will be ready for commercialization. We have a horizon of 5.5 years from now. The system at the end of the project will be very expensive but we hope that we decrease the cost in more 3 years.

There is a bit concern that it will take 5.5 years for the consortium to start testing the solution for commercialization as there are several machines already in the US just for sale: with some examples of: EcoRobotics, Carbon robotics 2021 modifications. It is a need to be quicker. It is advisable to have the opportunity to have somehow the technique connected to the tractor. There is declaration [in Finland] to test the solution in a farm up in the north.

We are not going to reach the market at the end of WeLASER project. We are going to bring the system as close as possible to the market. Reduction of the cost is not the objective of the project. The objective is to build a technology capable to kill weeds using laser. After that we will have the chance to work to reduce the cost and develop further the technology. This is normal in technological developments.

There is discussion about the price, the speed of the machine, effectiveness and whether there should be people in the field supervising the autonomous vehicles. We should not look into the limitations in the project but rather we should look into the future. Thanks to this [WeLASER] system we can control the weeds in conventional and organic farming (in smaller crops) without using almost all chemicals. We need the project to go to the field to solve the problem if we get to that point the rest of the concerns like price and the security will be solved.

Can the cost of autonomous machinery be reduced by incorporating the technology to existing solutions (tractor) without automatization?. For the laser technology there is another project in which we are working [project partner] in implementing laser technology integrated with a tractor in a project dealing in sugar beet farming. There we try to combine hoeing in interrow weeding with laser weeding in the row. The work started in April. In the laser part we are thinking in both directions. Using of the technology with a tractor might be also the first thing to do [from Finnish perspective].

There is discussion about the price, the running speed of the machine and effectiveness. Maybe it is a good idea about using of WeLASER in cities. There is more than 20-year experience of chemical free killing weeds in the cities and at the same time carbon emission free solutions. For that purpose, there are produced electric vehicles. In the cities there are different regulations than in the agriculture. There is no need for very high speed, low speed is fine. With the first [WeLASER] machines we can go into the Cities [Netherlands] within

existing networks in which a lot of research is done and find out how the innovation works in agriculture and in the middle of the cities like London and Amsterdam.

What about the solar panels, is it possible to add solar panel? The experience from other projects is that it gives very low power. It is not essential issue in WeLASER to add solar panels just to get a few Watts of energy. Another question is whether it is possible to load the machine with renewable energy.

It has to be well recognized that tractors are different than industrial machines. The rules of operation are completely different for them. In this [WeLASER] case, the agri-robot is a self-moving machine and it needs a red button to stop it immediately as it works in any industrial machine. Contrary, tractors are not autonomous vehicles. Artificial intelligence is related in this case to machines not to tractors with a man aboard.

We have to consider how the legal aspects can have an impact on agri-robots. We have to consider many legal aspects. From a legal point of view, we have to think whether we are dealing with the machinery or a tractor. According to WeLASER presentations, we can assume that we are dealing with machinery because the speed of the robot is below 6 km per hour and consequently the tractor regulation does not apply to such kind of machine. Regarding the artificial intelligence in the WeLASER system two intelligence systems can be differentiated. We have artificial intelligence for moving the machine as autonomous robot and artificial intelligence pertained to the use of laser. The proposal for regulation on artificial intelligence will be very relevant and the “new” regulation on machinery. They will be important for safety requirements and liability rules.

The law in this field is quickly evolving. [EU] Machinery regulation and the artificial intelligence regulation want to tackle legal obstacles to such innovations in several sectors, also in agriculture. New legal acts will aid manufacturer, and also users including farmers using the agriculture robots in precision agriculture. Currently, there are legal barriers even if we can find legal solutions related to liability and safety. The new regulations will be agri-robot friendly. WeLASER will have a lot of possibilities in the future.

It is also the issue of insurance. Given the information, it is assumed that the insurance cost will be a minor issue. The investment costs and operation costs will be more significant. Although, insurance will be essential. It will be critical for both the producers and users to be correctly ensured. If we are looking from cost/price perspective, for the investment, especially given the fact that technology in this domain is evolving rapidly, LiDAR it will mean that the depreciation period for the farmer has to be reduced. Because in the period of 2-3 years a new revolution of technology can come to the market and considering that the hardware is not flexible and cannot be easily adapted to changes there will be a low residual value. Once it is bought immediately the value will drop dramatically, and we should try to avoid such situation in designing of the machine. Then, the cost per year and per hectare can be reduced. If this is not the case, it will be tricky for the consumer to make the investment.

In drone manned system flying safety and security is a big problem. We have a possibility to learn from this sector with regard to safety. For example, it is required to apply a parallel system to shut down the drone fly if there is a problem. The parallel system operates in other frequency than the pilot system and is commanded by another person who is the observer of the fly. You can implement a system like this in cases where it is necessary to observe the agri-robot operating in the field.

The new drones have many sensors, software and other systems. They do only what is safe and man cannot override it. The drone cannot enter the airspace which is not allowed. It is under control. As a user you also cannot do what is not allowed to do. It is European wide system but we do not know whether it can be applied for machine on the wheels. It is good for predictable emergencies. The robot can be smarter in finding out possible accidents than the humans around but it should be a possibility to shut it down by human intervention.

**Other questions**

Some other questions that have been raised in the chat:

- What are the power need from the vehicle to the laser unit?
- About the cooling system have already some experience in Southern Europe regions where the temperature could be a limit?
- we have no experience with high temp environments, but there are different chillers commercially available
- Does it separate weed such as couch grass (elymus repens) from cereals in early stage?
- Thank you for thinking of the IT-issues, it is not farmer business to constantly "discuss and adjust" with the software. But how does it learn? Into what extent farmers have to learn and adjust it to the farm/field level information?
- I am seeing just very "clean and smooth" fields, this is not the reality e.g. in Scandinavia, also Scotland might have the same issues.
- this means these are also the areas where the human work force is very expensive.
- in Poland, there are often power poles in the fields. For what the question of the collected water line? It often happens in the fields that a small lake forms after heavy rainfall. Will the machine enter something like this and get stuck, or will it be able to detect that something is wrong and react?
- If understand right, we need to flag around fields to stop people to come to your field? That takes time e.g. we have 20 to 30-hectare field, that takes quite a bit of time if the machine should save time? How about if deers or moose come near, then the machine stops?
- Damian, we got the same issues. Good questions!
- What happens if the machine reaches the edge of some, for example, an irrigation ditch crossing a field?
- Will the laser work in the air or will it detect that it is higher than it should be?
- We are additionally using a LiDAR camera to monitor the ground and plants. So this ditch would be detected.
- As a lawyer I can think of many safety issues... knowing the court cases increases the pain *LOL* and I know farmers would not probably consider as many hazards...
- will the machine be able to work in the rain? will it turn off automatically when it rains? What if the machine is struck by lightning? maybe a low probability, but still.
- Yes, surely we work the organic fields with various mechanical tools/machines throughout the year (when there is no snow ;-)), not with any chemicals though
- 1000 euro per Ha per year was/is the threshold in application. The costs per unit depends than on how many parts will be ordered at once… We need to Think Tesla ;)
- Bert van Loon makes a good point to also include city for bringing costs down in the future.
- Insurance, for Drones this is maturing. We need an EASA for autonomous machines.

### 9.2.3. Results from polls