Innovative Greenhouse Support System in the Mediterranean Region: efficient fertigation and pest management through IoT based climate control — iGUESSMED

This project is part of the PRIMA Programme supported by the European Union

Deliverable 4.2

Protocol for living labs creation

Due date: 31/05/21

Submission date: 06/05/22

Deliverable leader: **UNIPI**

Author list: Alessandro Buonaccorsi, Luca Incrocci, Oriana Gava, Sara Sturiale (UNIPI), and Fabio Bartolini (Subcontractor UNIFE)

Dissemination Level

☒	**PU:**	Public
☐	**PP:**	Restricted to other programme participants (including the Commission Services)
☐	**RE:**	Restricted to a group specified by the consortium (including the Commission Services)
☐	**CO:**	Confidential, only for members of the consortium (including the Commission Services)

Abstract

The deliverable contains the guideline for living lab creation. In each country, a Living lab (LL) will be established following a common protocol. The LL in iGUESS-MED project will support the stakeholders' involvement, will provide sound evidence-based information about the socio-economic and environmental performance of the innovative solutions proposed in previous WPs, and will support To support farmer investment decisions. The LL will focus on emphasising country-specific issues and will contribute to fostering dialogue on salient issues: (i.e. gender equality and inclusion, equity along the supply chchain. The protocol is designed to provide an adequate understanding of the sustainable implication of the new technology installed in the new greenhouses. To this aim, the deliverable 4.2 will provide also the instructions for LCA, the questionnaire for multicriteria assessment and the questions for susustainability appraisal. The deliverable is integrated by two additional files: a) the xlsx file to collect primary data for LCA and; b) the pptx file with the structure of the participatory workshop. Both files are included in the documents as annex 3 and 4.

Table of Contents

Figure Summary

Table Summary

1. Introduction

The iGUESS-MED project aims to develop a Decision Support System (DSS) able to effectively manage fertigation and prevent plant diseases and pests in tomato crops grown in soil and soilless in commercial greenhouses of the Mediterranean region. This innovative greenhouse DSS will be developed to (i) help greenhouse farmers to improve the management of fertigation in areas with low (saline) quality waters (ii) to reduce the use of chemicals by a sustainable and integrated pest and disease control and (iii) to improve the climatic efficiency in the existent greenhouse by low-cost climate actions. The DSS will allow obtaining healthier and higher quality productions and higher yields, while will reduce the use of water and the losses of nutrients and chemicals to the environment. iGUESS-MED will be able to manage efficient fertigation, to forecast diseases and pests, and to improve the climatic efficiency in tomato greenhouses, using only climate data acquisition and basic information on cropping system. The DSS will provide feedbacks and alerts about crop needs and real time recommendations to the farmers through friendly portable real time data visualisation tools as PC, tablets, or smartphones. To achieve this objective, new models for calculating crop evapotranspiration will be performed by integrating sensor data from plant, soil and climate, and forecasting models for assessing disease and pest risks will be developed by using the Integrated Pest Management.

The project consortium (research centers, SMEs and end-users of EU and non-EU countries belonging to the Mediterranean basin) will collaborate from the beginning to make the DSS marketable involving, end-users and stakeholders to validate the system in own greenhouses, reducing gaps between research, application developers and farmers. The application of DSS will benefit the workers and the consumers, providing better working conditions, crop healthiness and reduction of environmental impact.

1.1 Summary of the deliverable

The overarching objective of WP4 is to create an enabling environment for the transition towards sustainable, resilient and inclusive greenhouse cropping systems.

Sub-objectives are as follows:

- To boost stakeholders' involvement, to empower a new generation of farmer and to overcome gender barriers;
- To provide sound evidence-based information about the socio-economic and environmental performance of the innovative solutions proposed in previous WPs, emphasising country-specific issues;
- To support farmer investment decisions while promoting social dialogue, gender equality and inclusion, by removing knowledge barriers.

The WP4 will provide multifactorial and transdisciplinary research that allows a transition towards an agricultural model that supports simultaneously the prosperity of rural areas, equity among all actors involved, and ensures an ecological transition of the greenhouses system. Reliable and comprehensive decision support needs to be inclusive, encompassing the following point of view:

1) environmental impact; through Life Cycle Assessment (LCA), which serves to identify the main environmental contributors of the different production systems to develop and design efficient input alternative
2) economic; through an assessment of stakeholders' needs and expectations site-specific sustainable solutions
3) social; providing new jobs, and improving current working conditions, characterised in many countries by exploiting immigrant labour and a gender-based labour regime (Palumbo et al.; 2018).

Task 4.2 support these broader objectives through empirical (LCA) and participatory analysis (NEI). Based on the conceptual framework (D4.1), the unit of analysis will be the Socio Technological System, which describes the system's evolution due to interacting internal sub-systems (i.e. people, infrastructure, technology, culture, procedures, goals) with external conditions (formal and informal institutions; policy and political, environmental, demographic, social conditions)of greenhouse production.

These activities will constitute the main element of Living Lab. One living lab will be established in each country, and it is composed of the following activities:

1) Descriptive activities (as indicated in D4.1);
2) Appraisal
    a. Sustainability assessment at the test site and STS level
    b. NEI
3) Drafting Individual report

4) Co-creation process (Task 4.3)

The Annexes includes the workflow of activities with deadlines (Annex 1) and the reporting template (Annex 2). Ancillary files are provided as well as a compressed folder, including (i) a pilot for LCA and LCC data collection; and (ii) the supporting materials for the workshop, i.e. ppt presentation, invitation letter, agenda, multi-criteria analysis questionnaire, as well as evaluation questionnaires and consent forms for participants.

2. Sustainability assessment at the test site and STS level (LCA & LCC)

In this task, a sustainability assessment is carried out both at the test site and STS level. The former contentrates on environmental and economic impacts of the adoption of the iGUESSmed technology at the test site level, based on the integration of Life Cycle Assessment and Life Cycle Costing. The latter uses a participatory Multi-criteria Analysis to rank and prioritse a series of sustainability aspects that are directly related to technology diffusion over the STS. The outcomes of this exercise allow an ex ante sustainability assessment at the STS level.

2.1. Life Cycle Assessment and Life Cycle Costing at the test site level

Life Cycle Assessment (LCA; ISO 14040:2006, 14044:2006) and Life Cycle Costing (ISO 15686-5:2008) are process-based tools to assess the environmental (LCA) and economic (LCC) impacts of products, from the production of raw materials to disposal. LCA and LCC are carried out through a step-wise approach with 4 phases, i.e. goal and scope definition, life cycle inventory analysis, life cycle impact assessment, and interpretation. This section describes the empirical application of the 4 LCA and LCC phases in iGUESS-MED, more details are available, e.g., from Brentrup et al., (2004); Curran, (2013); Pennington et al., (2004); Rebitzer et al., (2004).

2.1.1. Goal and scope definition

The goal of the study is to provide a comparative environmental and economic assessment of the life cycle of greenhouse tomatoes for fresh consumption before and after the adoption of the iGUESSmed technology at the test site level. An additional objective is to compare the findings across test sites.

Three functional units are considered for over a 1-year period: (1) the occupation of 1 hectare with a greenhouse that produces tomatoes for fresh consumption; (2) the production of 1 ton greenhouse tomaotes for fresh consumption; (3) the gross revenue of 1€ from the sale of greenhouse tomaotes for fresh consumption.

The system under study is the test site, i.e. the greenhouse where the iGUESSmed technology will be intalled and tested. The boundaries of the analyses are from input production to the farm gate and cover all the elements (i.e. life cycle stages) of the system (Figure 1).

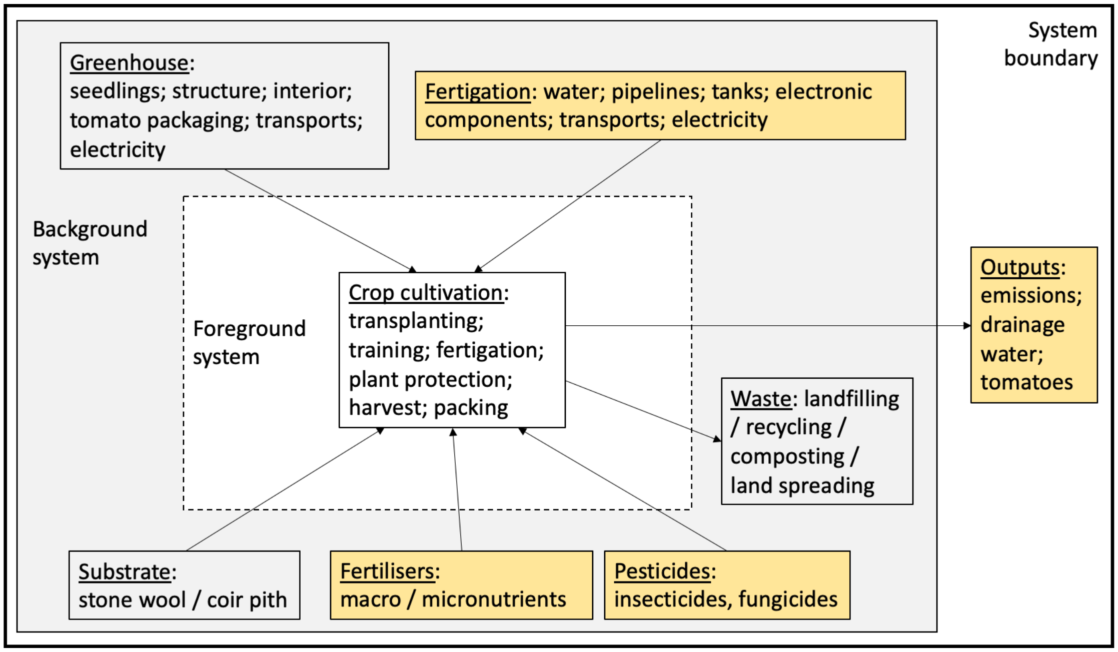

Figure 1 - System boundaties for LCA and LCC at the test site level.

In figure 1, each box displays a stage of the system. The background system includes all the stages that are needed to allow crop cultivation. Those stages are the greenhouse infrastructure, the fertigation infrastructure, the cultivation substrate (in case of soilless cultivation), fertilisers, pesticides and waste management. The foreground system includes crop cultivation (the "use" stage), i.e. the stage where background system stages are "used" to deliver system Outputs. Those Outputs are emissions to air, water and soil, drainage water (if present) and tomatoes for fresh consumption. Yellow boxes show the elements of the system that are subject to change after the adoption of the iGUESS-MED technology.

2.1.2. Life cycle inventory

This phase includes data collection and the creation of the final dataset for analysis. Primary information is gathered by iGUESSmed Partners on the field about the quantities and costs of all the inputs (materials and natural resources) and outputs (the Outputs stage) within system boundaires.

Inventory for LCA

The production of system inputs generate indirect emissions to air, water, and soil; those data are extracted from the Ecoinvent database. Direct emissions are included in the Outputs stage and will base on primary data (emissions to water from fertilisers) or will be calculated using standard models or emission factors (emisssions to air from machinery, in case of soil cultivation; emissions to air from fertilisers; emissions from pesticides).

Inventory for LCC

Costs are considered as prices for the relevant decision-making actor, here the farmer. Given system boundaires, information about costs includes building and maintenance (e.g. administrative costs, project design, advisory), labour (family and/or hired workers) and demolition (e.g. demolition company, disposal of costruction waste). The monitored costs for the farmer are enouth to build the LCC inventory, as they incorporate all the costs of upstream phases in the value chain.

2.1.3. Life cycle impact assessment

Impacts will calculated in the LCA only, as costs are already expressed in the relevant unit of measure, i.e. currency.

Data about emissions and resource consumption from the LCI are classified to impact categories and characterised, based on the selected life cycle impact assessment model, ReCiPe 2016 Midpoint (H) (Huijbregts et al. 2017). This model is selected as it allows the comparison of European and non-European countries. Characterisation factors ($CF_{i,j}$) represent the potential contribution of emissions (E_j) or resource consumption (R_j) to impact categories (IC_i) they are classified to, as follows:

$$IC_i = \sum_j (E_j \vee R_j) \times CF_{i,j}$$

2.1.4. Interpretation

LCC and LCA findings are interpreted in a comparative way. The driving comparison is to show the differences and trade-offs among categories before and after technology adoption. This comparison is done both at the test site level and at the project level.

Analytical findings are compared and discussed with the relevant literature, as well.

3. Assessment of stakeholders needs, expectations and impact

Need Expectation and Impact appraisal will generate shared knowledge on the potential impact of new ICT at different levels (individual producers, institutional level and societal level). The NEI appraisals will be conducted through a workshop with Participatory methods to ensure an inclusive approach to data collection. This activity will be combined by submission of questionnaire to local stakeholders in order to collect individual individual preference about impact domain and assess the relative importance of the proposed indicators. Ideally each LL should collect 10 questionnaire filled, to cover the main Actors Gorup listed in the table 7 of D4.1. The workshop has the objective to better understand the main changes in STS due to technological changes as well as to provide a participatory impact assessment.

The rationale behind this exercise is to generate a broader understanding of the potential sustainability impacts of the diffusion of the iGUESS-MED technology at the territorial level. Then, you are asked to adopt a future perspective, by prospecting a what if though feasible enough situation, where the technology is adopted by all relevant greenhouse producers in the reference area.

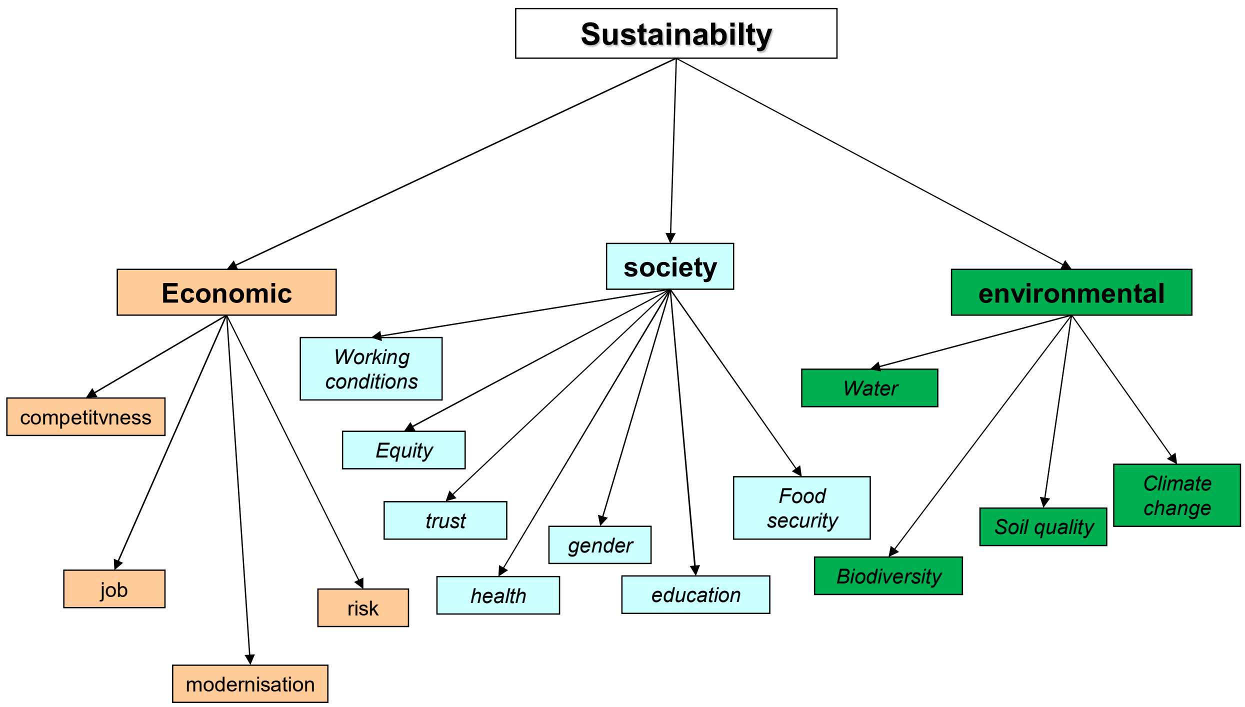

Figure 2 – Hierarchy of sustainabily priorities.

4. Conclusion

The LL represents a hot topic in the field of social science as can stregnt the capacitie of actors and regions by involving and mobilising stakeholders' knowledge in a quadruple helix model (Carayannis, Campbel 2009). In addition, a continuous stakeholders dialogue can ensure the acceptability of proposed technological solutions, innovation and sustainability as ultimate results (Compagnucci et al., 2021). However, as McCrory et al. (2020) pointed out, the LL needs ofter remains limited to qualitative analysis. The LL activity should include a quantitave exercise to be salient and provide a robust analysis. Therefore, the proposed guideline aims to integrate both qualitive analysis of stakeholds needs with a robust empirical assessment of innovation in the greenhouse and its impact on the territorial scale.

5. References

Brentrup, F., Küsters, J., Kuhlmann, H., Lammel, J. 2004. Environmental impact assessment of agricultural production systems using the life cycle assessment methodology: I. Theoretical concept of a LCA method tailored to crop production. European Journal of Agronomy 20, 247–264.

Carayannis, E.G., Campbell, D.F.J. 2009. “Mode 3” and “Quadruple Helix”: toward a 21st century fractal innovation ecosystem. International Journal of Technological Managagement 46, 201–234. https://doi.org/10.1504/IJTM.2009.023374

Compagnucci, L., Spigarelli, F., Coelho, J., Duarte, C. 2021. Living Labs and user engagement for innovation and sustainability. Journal of Cleaner Production 289, 125721.

Curran, M.A. 2013. Life Cycle Assessment: a review of the methodology and its application to sustainability. Current Opinion in Chemical Engineering 2, 273–277.

Huijbregts, M.A.J., Steinmann, Z.J.N., Elshout, P.M.F., Stam, G., Verones, F., Vieira, M., Zijp, M., Hollander, A., van Zelm, R. 2017. ReCiPe2016: a harmonised life cycle impact assessment method at midpoint and endpoint level. Int J Life Cycle Assess 22, 138–147.

McCrory, G., Schäpke, N., Holmén, J., Holmberg, J. 2020. Sustainability-oriented labs in real-world contexts: An exploratory review. Journal of Cleaner Production 277, 123202.

Pennington, D.W., Potting, J., Finnveden, G., Lindeijer, E., Jolliet, O., Rydberg, T., Rebitzer, G. 2004. Life cycle assessment Part 2: Current impact assessment practice. Environment International 30, 721–739.

Rebitzer, G., Ekvall, T., Frischknecht, R., Hunkeler, D., Norris, G., Rydberg, T., Schmidt, W.P., Suh, S., Weidema, B.P., Pennington, D.W. 2004. Life cycle assessment: Part 1: Framework, goal and scope definition, inventory analysis, and applications. Environment International 30, 701–720.

Annex 1 Workflow

What to do	Time	Who
Training	End of march	UNIFE All LL coordinators
LCA and LCC inventory (before adoption)	End of April	All LL coordinators
LCA and LCC inventory (after adotion)	End of May	All LL coordinators
Individual report section 1.1	End of May	All LL coordinator
MCA questionnarie	End of June	All LL coordinator
Workshop	End of September	All LL coordinator
Individual report all section	End of Sectember	All LL coordinator
Comparative Report	End of Novembre	All LL coordinator

Figure 3 – workflow

Annex 2 Template for individual report

Analysis of the context and needs **(based on preliminary information)**

Context analysis (max 3 pages including tables)

Add here the most salient information of the Description of the protected Horticultural production in the country and mian drivers of change.

Domain	Indicator	answer
Diffusion	Total area in hectares (ha)	
	Average extension	
	Distribution (concentrated or dispersed)	
	% entrepreneurs and foreign investments	
	Level technology	
	Structure: • type of prevailing structure (high tunnel, classic greenhouse, multi-span etc.) • Average eaves/ridge height • prevailing coverage type (plastic film, glass etc.) • type of opening • % heated greenhouses	
Performance	Main cultivated crops (up to five)	
	% tomato production	
	Average annual production (t)	
	Average annual profitability (€)	
	Annual waste production (plastic, substrates, etc.)	
Technology	% of soilless culture and main technique used (hydroponic, substrate, etc..)	
	The main substrate used	
	Irrigation: • main irrigation system in soil and in soilless crops • Irrigation scheduling in soil crops and in soilless crops • % closed or semi-closed cycle systems	
	Dominant pest control typology (organic, integrated etc.)	
	Climate control technique (manual, automatic, temperature sensors etc.)	
	Excess humidity control technique (fans, greenhouse opening etc.)	
	Low humidity control technique (mini-fog, foliar spraying, etc.)	
	Chemical inputs (Type and number of treatments)	
	Crop protection (chemical, biological, etc.)	
	% sustainable systems (e.g. rainwater storage, Use of renewable energy, etc.)	
Worker	Level of specialisation (roles and mansions)	
	Level of salary	
	Average working hours	
	Type of contract (fixed-term or open-ended)	
	Immigrant/national workers ratio	
	Top five country of origin of workers	
	Average age immigrant workers	
	Male/female ratio	

Economics	Estimated production costs	
	Higher production cost (labour, transportation, irrigation, etc.)	
	Incentives and facilities for technological and eco-sustainable investments	
Production chain	Main stakeholders (seed producer, fertiliser and defence systems, technical consultancy, transport, waste disposal, et.)	
	Distribution market (GDO, local market, direct sale, etc.)	
	Critical point	
	Public opinion on greenhouse products and environmental impact	
	Manufacturers opinion on manufacturers' confidence in IoT	

Table 1 - Factors of change in the country

Please develop and comments (based on preliminary infomation). The table is referred at country level

Short heading/title of the need	Short Description	Who needs it? (LL, farmers' association, society, tourists, forestry holding, etc.)

Table 2 - Assessment of needs

Description of the Greenhouses production in the LL (max 3 pages)

Please identify a sub-level of analysis where to develop a LL (i.e. region or area relevant for greenhouses production)

- What are the main actors that interact with the greenhouses production? (please reffere to D4.1 for explanation of actors)
- What are the main resources/entities mobilised in greenhouses production? (please reffere to D4.1 for explanation of resources/entities)
- What are the main drivers involved in greenhouses production in each case study and how they interact in driving changes to greenhouses production in each case study?

Please describe what are the main drivers involved in greenhouses production in your LL?

Factors	Description
Group age distribution (i.e. are elderly people relevant?)	
Depopulation (emigration rate, birth rate, etc.)	
Economic conditions (income level, householder expenditure, etc.)	
Social asymmetries (female employment rate, relative poverty rate, etc.)	
Education (tertiary education rate, presence of high schools, etc.)	
Environment (Use of renewables, organic prodcution, etc.)	

Digitalisation (people using the net for interact with public authorities, etc.)	
Social concerns in the area (food security, social justice etc.)	
Level of tecnhology	
Please, insert other parameters if it is necessary	

Table 3 - Drivers and Barriers to greenhouses

SWOT analysis (max 2 pages including table)

Please add and discuss the final SWOT analysis table, using the example below as reference.

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
• **Qualities that distinguish your context from others** • **Things that in your context are done well** • **Conditions that make your context unique**	• Long term and persistent problems in your context • Things that your context lack • Things that other contexts do better • Resource limitations	• External trends and development which can offer new possibilities to solve problems • Social, market, technological, policy development in the last years	• External trends and development which can worsen specific problems • Etc.

Table 4 - SWOT analysis

Sustainability assessment (max 6 pages)

This section shows the test site's Description and the LCA and LCC findings at the test site level (see the pilot …..), and the outputs of the multi-criteria analysis at the STS level.

LCA and LCC at the test site level

Description of the test site

Add here the Description of the test site, possibly by including one of two pictures. Please refer to the provided pilot

Impact assessment at the test site level

Add here the final inventory for LCA and LCC provided by UNIPI.

Add here and discuss the outputs of the LCA and LCC provided by UNIPI.

Multi-criteria analysis at the STS level

Add here the Description of the technology diffusion scenario(s) used to carry out the multi-criteria analysis, using the synthesis matrix below. (3 pages including table and comments)

What has been changed in the STS? Which technologies are involved?	**Outputs (describe the main change)**	**Effects** Socio-economic-environmental- (based on relevant dimension)		**Level of effects** Use 9 point likert scale (1 extremely positive to 9 extermily negative)	**How dos it generate this effect? Why?**
This can be pre-filled by the LL coordinator and then completed with the participants	This can be pre-filled by the LL coordinator and then completed with the participants	Economic	Select the domain (from list of indicators from MCA)		
		Social			
		Envi om			

Table 5 - Synthesis matrix

Add here the outputs of the MCA exercise provided by UNIPI.

Sustainable upgrading of STS (max 2 pages inlcuding tables)

This part aims to describe what is needed to upgrade the current STS to the desirable one. The section presents a list and a description of the current critical points which deserve to be tacked to support a more sustainable, protected horticultural production. The data collection procedure indicates two

Critical points	Description

Table 6: Identification of critical points of the current STS that needs to be addressed.

Please describe the most relevant changes to support the transition toward desirable sustainable upgrading of the STS.

Factors	Requirred changes
Political	
Economic	
Social	
Technological	
Legal	
Environmental	

Table 7 - Needed changes

Conclusions

References

Annex 3 Questionnaire for MCA weights

Test site (name and location)		Date	

Questionnaire for the prioritisation of sustainability issues at the territorial level

This brief questionnaire aims at identifying and valuing the most relevant sustainability aspects related to the adoption of the iGUESSmed technology at the territorial level. You are asked to fill-in the questionnaire based on your personal knowledge and experience, as well as on the research findings of the iGUESSmed project, about the environmental and economic impacts of the adoption of the iGUESSmed technology on demonstration sites.

The rationale behind this exercise is to generate a broader understanding of the potential sustainability impacts of the diffusion of the iGUESSmed technology at the territorial level.

To root the exercise in the social and political context, the questionnaire concludes with two open questions, where you are asked to provide concise inputs about key farmers' needs to allow the achievement of the prospected "what if" situation.

Any personal information about the participants in this activity is confidential and will be used for research purposes only after anonymisation.

Section 1: Information about the interviewee

Name	
Surname	
Organisation	
Role/Position	
Gender	
Age group	Below 30 ☐ 30-45 ☐ 45-60 ☐ 4 Over 60 ☐
Education	Primary ☐ Secondary - agriculture ☐ Secondary – not agriculture ☐ Tertiary – agriculture ☐ Tertiary – not agriculture ☐
Email	
Phone number (optional)	
Type of stakeholder group	Agriculture, agro-industries ☐ Policy & administration ☐ Technology & ICT development ☐

	Civil society ☐ Research & innovation ☐ Services & consumption ☐

Section 2: Identification and prioritisation of sustainability issues and potential project achievements at the territorial level (what if situation)

In this section, you are asked to evaluate the relevance of each BROAD SUSTAINABILITY ISSUE (question 2.1) and the related potential improvements achievable through the diffusion of the iGUESSmed technology at the territorial level (what if situation). The evaluation is on a 0 to 9 scale, where 0 means "no relevance" and 9 means "extremely high relevance.

•Question 2.1: Please evaluate the relevance of each BROAD SUSTAINABILITY ISSUE

BROAD SUSTAINABILITY ISSUES	Evaluation
Economics	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Society	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Environment	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high

•Question 2.2: Please evaluate the relevance of each ASPECT of the ECONOMIC ISSUE

ASPECTS of the ECONOMIC issue	Evaluation
Increase of farmer competitiveness	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Creation of rural jobs	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Greater availability of sustainable technology for greenhouses	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Risk of misuse of technology	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Please add any MISSING SPECIFIC ECONOMIC ISSUE ________________________________	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high

•Question 2.3: Please evaluate the relevance of each ASPECT of the SOCIAL ISSUE

ASPECTS of the SOCIAL issue	Evaluation
Improvement of working conditions	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Greater equity in the distribution of value added along supply chian actors	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Greater affordability of food	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Increased trust among value chain actors	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Improvement of farmer health	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Greater food safety	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Greater job opportunities for women	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Increase of female entrepreneurship in agriculture	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Improved farmer education	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Improved women education (especially in farming)	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Improved farmer livelihood	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Condition for vulnerable groups (i.e. minority & migrants)	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high
Please add any MISSING SPECIFIC SOCIAL ISSUE _______________	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low---high

•Question 2.4: Please evaluate the relevance of each ASPECT of the ENVIRONMENTAL ISSUE

ASPECTS of the ENVIRONMENTAL issue	Evaluation
Increased protection of ecosystems	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Cleaner surface water bodies	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Cleaner underground water	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Increased availability of water for agricultural uses	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Increased biodiversity	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Increased soil quality	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Reduced climate vulnerability	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Greater water security	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high
Please add any MISSING SPECIFIC ENVIRONMENTAL ISSUE ________________	0 1 2 3 4 5 6 7 8 9 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ low--high

Section 3: Farmer needs

•Question 3.1: Please list up to 5 policy improvements that might encourage the diffusion of the iGUESSmed technology

•Question 3.1: Please list up to 5 improvements of the governance of the greenhouse section that might encourage the diffusion of the iGUESSmed technology

Comments on the exercise and/or on the iGUESSmed project