D4.2: Test Case evaluation report for reporting period 1

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Abstract:	This document begins with a contextualization of the strategy developed to operationalize the TCs (D4.1 – Testing and Assessment Guidelines), continues with the description of monitoring and reporting procedures for TCs activities, the evaluation of each TC along with DATSs use related results as derived from the application of the Assessment Framework, and concludes with the presentation of aggregate metrics from all TCs, best practices, lessons learnt and recommendations for improved operational efficiency during the second testing year.

Document Revision History			
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QuantiFarm Consortium			
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22	UAB ART21	ART21	LT
23	AGROSMART SIA	AgroSmart	LV
24	BENCO BALTIC DOO ZA SAVJETOVANJE IUSLUGE	BENCO	HR
25	FARM FRITES POLAND DWA SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA	FFP2	PL
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Executive Summary

The “Test Case evaluation report for reporting period 1” provides an overview of the operational progress and the main results from the 30 Test Cases that compose the QuantiFarm project during the first (out of three) year(s) of testing. The first year of testing followed the first version of the Assessment Framework (WP2) to analyse the use of Digital Agricultural Technology Solutions (DATS) in commercial farms in three main levels: economic, environmental, and social. The 30 Test Cases (TCs) are spread across 20 countries in 10 biogeographical regions of Europe. Each TC has an appointed a Test Case Leader that is a project partner and is responsible for the local operationalization of the TC activities. WP4 is responsible for coordinating the TCs by centralizing the information collected locally and report back at project level. QuantiFarm is thus an ambitious active research project that requires thorough monitoring and reporting resources and capabilities.

This document begins with a contextualization of the strategy developed to operationalize the TCs (D4.1 – Testing and Assessment Guidelines), continues with the description of the coordination for monitoring and reporting the TCs’ activities and concludes with the evaluation of the testing period 1 for each TC concerning the main outcomes, lessons learned, and recommendations.

The focus of this document is providing detailed and organized information about the TC adaptation required to perform active research, data collection process, and the evaluation of the first annual testing cycle. With this information, the project partners will be able to reflect upon the first year of testing and improve the tools and methodologies for the following two years of testing ensuring a complete analysis of the use of DATS in real-life farms.

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List of Abbreviations and Acronyms	
TCs	Test Cases
DATS	Digital Agricultural Technology Solution
TCL	Test Case Leader
DIHs	Digital Innovation Hubs
DIA	Digital Innovation Academy
AKIS	Agricultural Knowledge and Innovation Systems
GA	Grant Agreement
DMP	Data Management Plan
AF	Assessment Framework

1 Preface

1.1. Project summary

The QuantiFarm project focuses on supporting the further development of Digital Agriculture Technologies (DATSs) as a key factor for improving the sustainability performance (economic, environmental, and social) and competitiveness of the agricultural sector. To this end, QuantiFarm introduces a comprehensive Assessment Framework for independent qualitative and quantitative assessments of the multiple costs and benefits of digital agriculture technologies. Ensuring replicability and uptake of digital technologies by deploying innovative tools, services, recommendations and making them relevant and of practical use to farmers, advisors, and policy makers across Europe. QuantiFarm is building the project activities around 30 Test Cases (TCs) which span over 20 countries in 10 Biogeographical regions across Europe, capturing multiple geo-political and financial settings. More than 100 farms of different types, sizes, ownership, and operating conditions, committed to participate in the project, both directly but also through cooperatives and large umbrella organisations. The TCs actively engage farmers, advisors, Digital Innovation Hubs (DIHs), researchers/scientists, DATSs providers, certification experts and policy makers. Moreover, QuantiFarm Digital Innovation Academy (DIA) will be established as the main capacity building mechanism for advisors and other Agricultural Knowledge and Innovation Systems (AKIS) actors on the various types of digital technologies available, their costs, benefits and impact on sustainability and will offer training sessions for advisors. QuantiFarm comprises 32 partners, representing all relevant stakeholders, including 8 scientific organizations and 12 farmer representatives and consultants.

1.2. Document Scope

The deliverable D4.2 “Test Case evaluation report for reporting period 1” is the first annual periodic report on monitoring and evaluation outcomes of each TC during the first year of testing, including lessons learnt. It is a reflection on the most operational segment of QuantiFarm, the Test Cases.

The document begins by commenting the launch of Test Cases and the preparation done in the initial six months of the project. As testing initiated, also did the monitoring and reporting activities for all 30 TCs. The layout of the plan of activities for the first year of testing was the result of a collective work with special emphasis to WPs 2, 4, 7, and the TCLs. Without all the initial contributions, it would have not been possible to begin testing and would not make sense because it sets the stage for the work of many partners in the project. The document continues with the evaluation of every TC concerning outcomes, commons conclusions and lessons learned, and it concludes with an overall assessment of results.

1.3. Document Structure

This document is comprised of the following chapters:

Chapter 1 provides a brief introduction to the QuantiFarm project, as well as the scope, structure, and content of this deliverable.

Chapter 2 explains the line-based work done in the first six months to contextualize the monitoring, reporting, and evaluation done during the first testing period of QuantiFarm.

Chapter 3 details the plan for the first testing period concerning calendar, data protection, training, reporting, and updates since the last deliverable.

Chapter 4 describes and reflects on the data collection process.

Chapter 5 presents the Evaluation Report for every Test Case.

Chapter 6 discussion of the high-level results for testing period 1.

Chapter 7 outlines the main conclusions and next steps.

Annexes include the various materials that assisted in the process of monitoring, reporting, and evaluation of Test Cases.

2 Introduction to QuantiFarm Test Cases

During the first six months of the QuantiFarm project, WP4 focused on collecting information that could feed the construction of the Assessment Framework, to operationalize the Test Cases, and to develop the appropriate tools to monitor the 30 TCs' activities.

The main goals of WP4 are testing and demonstrating DATSs at farm level, assessing their impact in real conditions, testing the QuantiFarm Toolkit and the QuantiFarm DIA, and organising demonstration events to present the QuantiFarm results in 20 countries. Therefore, this WP was divided in 3 tasks: T4.1 Launch of Test Cases (M1-M6), T4.2 Coordination, Monitoring & Evaluation of Test Cases (M7-M42) and T4.3 Knowledge sharing of Test Cases (M31-M42).

The first task resulted in deliverable D4.1 "Testing and Assessment Guidelines" that helped Test Case Leaders to establish the parameters to be monitored in the project.

The deliverable D4.2 "Test Case evaluation report for reporting period 1" is the first annual periodic report on monitoring and evaluation outcomes of each TC during the first year of testing. This deliverable is a result of Task 4.2. Following the deliverable (D4.1), the TC Leaders used the framework developed in WP2 to assess the different DATs used in the farms (evaluating costs, benefits and sustainability impact). Tests will follow an iterative approach with three (3) annual cycles, at the end of each cycle, an annual evaluation report is going to be written (D4.2, D4.3, D4.4). These deliverables will be fed back to WP2, WP3 and WP5 to further refine their results.

Given the large number of Test Cases across 20 countries in 10, out of 11, biogeographical regions of Europe, organizing and storing information was crucial. It is important to recall that all TCs are based on commercial farms using operational DATSs. Meaning the farmers involved in the TCs have the final say on any decisions regarding the utilization of the DATS. QuantiFarm counts with 19 partners that take on the role of Test Case Leader (TCL). Every TC has an appointed TCL that leases between WP Leaders/ Task Leaders/ Project coordination, and the farmers. This link is crucial to shorten the distance between theoretical and practical learning. Additionally, the working cultures around Europe weigh in decision making, so the TCL is also the representative of both the local culture and the institutional culture in QuantiFarm.

No	Sector	Crop/Animal	Digital Solution	Country	Biogeographical Region
1	Arable	Potatoes	SF DSS/ App	Greece	Mediterranean
2	Arable	Corn	Precision irrigation	Portugal	Mediterranean
3	Arable	Wheat	DSS/Agri-environmental Monitoring	Spain	Mediterranean
4	Arable	Cotton	VRA add-on for old tractors	Greece	Mediterranean
5	Arable	Wheat	SF DSS/ App	Turkey	Anatolian
6	Arable	Wheat, onion, potato	Machinery with VRA, data analytics	Netherlands	Continental
7	Arable	Potatoes	SF DSS/ App	Poland	Continental
8	Arable	Wheat	Drones, sensors, silo management, AI	Latvia	Boreal

No	Sector	Crop/Animal	Digital Solution	Country	Biogeographical Region
9	Arable	Corn, Wheat	FMIS/ Financial Modelling	Slovenia	Alpine
10	Arable	Wheat	FMIS/ app	Romania	Steppe
11	Fruit	Olives	SF DSS/ App	Greece	Mediterranean
12	Fruit	Apples	Drones and soil sensors	Poland	Continental
13	Fruit	Grapes	SF DSS/ App	Italy	Mediterranean
14	Fruit	Strawberry, Blueberry	Precision Irrigation	Serbia	Pannonian
15	Fruit	Olives	SF DSS/ App	Cyprus	Mediterranean
16	Fruit	Apples	Drones and soil sensors	Netherlands	Continental
17	Fruit	Grapes	Harvesting robotic and SF DSS	Romania	Black Sea
18	Vegetables	Tomatoes	SF DSS/ App	Italy	Mediterranean
19	Vegetables	Tomatoes	Automated greenhouses	Netherlands	Continental
20	Fruit	Bananas	Precision Irrigation, Monitoring	Spain	Micronesian
21	Vegetables	Tomatoes	Automated greenhouses	Finland	Boreal
22	Meat	Poultry	Cleaning robot, AI	UK	Atlantic
23	Meat	Cows	Heat box collar, feeding robots, calving detectors	France	Continental
24	Meat	Pigs	Automated monitoring, AI	Belgium	Continental
25	Dairy	Cows	Feeding robot	France	Continental
26	Dairy	Cows	Milking robot	Ireland	Atlantic
27	Dairy	Cows	Automated monitoring	Germany	Continental
28	Dairy	Cows	Livestock feeding DSS	Romania	Steppe
29	Apiculture	Bees	Automated monitoring	Lithuania	Boreal
30	Aquaculture	Oyster	Sensors for quality assessment	Croatia	Mediterranean

Table 1 - Test Cases summarization

2.1. Launching the Test Cases

The first task of WP4, T4.1 Launch of Test Cases, which produced a set of guidelines (D4.1) to help Test Case (TC) Leaders establishing the parameters monitored in the project finished with a workshop at the second plenary meeting where all the tools prepared by CONSULAI were presented along with the developments of the TC specific list of indicators that was part of the Assessment Framework (WP2). In this workshop, CONSULAI presented the tools: Test Case Checklist (Annex A), Online Regular Issue Report Monitoring and Archive (Annex B), Meeting minutes template (Annex L), and the Test Case Evaluation Report (Table 5, will be discussed in section 5). All these tools proved useful along the first testing cycle.

To deliver a message about the necessary starting conditions of a QuantiFarm Test Case to such a diverse group of partners requires having the necessary information available and easy to access. For that purpose, the Checklist was an important tool to monitor the fundamental requirements of each TC. Inevitably, when the agreed upon requirements to launch the Test Case were defined and presented, some troubleshooting was necessary in several TCs. Some TCs had to adapt their original situation as

it become clearer what QuantiFarm would ask to its TCs. Examples of this happened when some TCLs felt more comfortable changing the original farmer, some had minor adaptation to the DATS given the real-life commercial reality of the farms under testing, other faced unforeseen climate related incidents that prevented the farm to continue making part of the TC. Active research projects such as QuantiFarm must find a way to deal with the constantly evolving reality of farming. And it would be significantly bad for the project if a TCL preferred to hide or mask any obstacle faced at farm level just to "check" the requirements and try to push forward with the collection of data in the Assessment Framework regardless of proper relatability. For this reason, the WP4 motto from the beginning was "We are aware some unforeseeable changes in your TC may occur and we can find a solution together as long as you promptly report them". Taking this motto seriously and, together with the POLIMI colleagues, a TCL was invited for a meeting every time there was a doubt about their description in the questionnaire that fed D4.1, or on their feedback regarding the indicators list provided by WP2. This close interactions with TCLs in the first stages of launching were instrumental to create the conditions to have the most success possible in the first annual cycle of data collection. Once encountered a barrier, the assembled team worked together on finding a solution that worked for all involved: TCL, WP2, and WP4 (in some cases other WPs got involved as well). Sometimes these procedures were quite forward, and a solution could easily be found in one meeting. But other times, the solution required deeper reflection on the matter at hand and several meetings and calls were organised. Nonetheless, all the changes that resulted from those conversations were recorded and archived in the Online Regular Issue Report Monitoring tool.

The work of Task 4.1 Launching of Test Cases culminated with the submission of D4.1 Testing and Assessment Guidelines. This deliverable defined all the necessary mechanisms and structures to monitoring and control the TCs, establishing a unified methodology and the appropriate tools to promote good coordination, communication, and interaction between all the actors participating in TCs. Additionally, a comprehensive description of every TC was reported to provide detailed knowledge of the DATSs used and their operational context. The description is composed by TC identification and general information, commercialization model for DATS usage, software and hardware descriptions, installation process and DATS maturity, whole-farm approach vs individual production steps, data types and collection process, and finally DATS operation vs non-DATS operation. This information was provided with the instrumental assistance of all TCLs. The deliverable D4.1 was meant to provide information and assistance to the development of the Assessment Framework (WP2), the TC contextualization for the behavioural analysis (WP1), and the analysis of digital tools for farmers, advisors, and policy makers (WP3).

2.2. First training session in December 2022

During the second project meeting held online between 13th – 14th of December, WP4 presented an overview of the state of TCs and the launching procedures. First a summary of identified parcels (115), farmers (51), and different types of DATSs (15) in the context of QuantiFarm GA was presented. Subsequently, the basic structure of a QuantiFarm TC was explained as follows.

CONSULAI explained it was responsible for ensuring the proper functioning of the work package, as well as leading all aspects related to the organization and monitoring of the different TCs in accordance with the Assessment Framework from WP2 and its tool to collect quantitative data. In this sense, the WP4 leader (CONSULAI) would be coordinating the execution of all TCs in close collaboration with WP2 but also WP1, WP3, and WP5. It is especially important to search for synergies, common problems and solutions that can affect all TCs in terms of the economic, environmental, and social impact of the project along the agri-food value chains.

In turn, the TC leader is responsible for coordinating all actors and resources of the TC. Therefore, the TC leaders must seek to ensure that the implementation of the Assessment Framework is followed, and the quantitative data requested is properly collected and reported. TC Leaders are also responsible for facilitating and partially organize encounters with other WP Leaders for the collection of qualitative data, which is particularly important for WP1. At proposal stage, each TC defined its biogeographical region, the role in the value chain of each partner involved in the respective agricultural sector, as well as a description of the DATS and the end-user.

Each TC is formed by the TC leader and different farmers who actively participate in the execution of the project, establishing in many cases the location of the TC within the designated biogeographical region and the exact functionalities of the selected DATS. In this sense, it should be noted that in each TC there is at least one technological farmer that uses the DATS for its activity and one non-technological farmer that works in the same agricultural sector in the same region without the DATS.

It is very important to have a clear idea of the DATSs in the TC, its characteristics, and data available for collection, allowing for overall contextualization for the development of the Assessment Framework. Therefore, each TC leader answered a detailed questionnaire, indicating what has changed since the application stage, followed by a detailed description of the DATS regarding several aspects like, benefits from the technology, software and hardware description, installation process, comparison between DATS use and non-DATS use, data integration and collection process.

3 Coordination of Test Cases: Setting the stage for the first annual testing cycle

After completing the launching procedures in the first 6 months, the TCs were more prepared to face the next challenge of collecting the latest farm data for the first annual cycle of testing from M7 to M18. This required concrete procedures on:

a) where and how to submit data,
b) how to report issues,
c) how the evaluation will be performed, and finally,
d) what is the calendar report information in time.

3.1. Calendar for data submission

The first year of Task 4.2 came with a set of challenges. The uniformization of the 30 Test Cases under the same project and the common requirements of the Assessment Framework involved a lot of different considerations. One of the most important considerations was the calendar for data collection and submission. All TCLs were asked to provide the information contained in Table 2 about the growing season timing in their TCs to evaluate the establishment of a common calendar for data collection and submission.

TC	Sector	Country	End month of growing season
28	Dairy	Romania	alpha alpha-Jun-Sep, feed corn - Aug-Sep
17	Fruit	Romania	Aug-Oct
11	Fruit	Greece	December
15	Fruit	Cyprus	February
3	Arable	Spain	July
8	Arable	Latvia	July
10	Arable	Romania	July
5	Arable	Turkey	June
14	Fruit	Serbia	June
19	Vegetables	Netherlands	Not applicable
20	Fruit	Canary Islands	Not applicable
21	Vegetables	Finland	Not applicable
22	Meat	UK	Not applicable
23	Meat	France	Not applicable
24	Meat	Belgium	Not applicable

TC	Sector	Country	End month of growing season
25	Dairy	France	Not applicable
26	Dairy	Ireland	Not applicable
27	Dairy	Germany	Not applicable
30	Aquaculture	Croatia	Not applicable
1	Arable	Greece	October
2	Arable	Portugal	October
4	Arable	Greece	October
6	Arable	Netherlands	October
7	Arable	Poland	October
12	Fruit	Poland	October
16	Fruit	Netherlands	October
9	Arable	Slovenia	October (corn), July (wheat)
13	Fruit	Italy	September
18	Vegetables	Italy	September
29	Apiculture	Lithuania	September

Table 2 - Growing season end month for the 30 Test Cases.

Analysing Table 1 most Test Cases would finish their growing season by the end of October, several others are" Not applicable" because there are crops with either multiple growing seasons or because it is continuous. QuantiFarm GA states that testing will start in January 2023 (M7) and will run for three (3) annual cycles, covering an equal number of growing seasons. The results and lessons learnt from each cycle will be used as feedback to help refine the Assessment Framework. In addition, the data collected by all 30 TCs will be integrated into the QuantiFarm Toolkit to feed the respective assessment and decision support tools for farmers, advisors, and policy makers with the necessary input.

Since the annual report must be submitted by the end each of the three annual testing cycles, the project faces a timeframe to perform data verification, evaluation by TCLs on the data collection process, and analytical evaluation of the data collected in that annual cycle. The lower limit is set by the end of growing season for the majority of TCs, and the upper limit is set by the timing of the deliverables D4.2, D4.3, and D4.4 in the month of December for each of the three annual cycles.

3.2. Data protection and storage

TCs act as data providers for the Assessment Framework (AF) using standardised methods and procedures. Collecting data for the assessment of the digital agriculture solutions they are using on their farms, in terms of their costs, benefits and impact on sustainability. POLIMI has prepared a template for each TC with a comprehensive list of indicators divided by the three conceptual pillars of the AF: economic, environmental, and social. The next testing cycle will include a new common template for

all 30 TCs with hidden cells for the TC specific irrelevant indicators. This will be particularly useful to improve the efficiency of the Toolkit. The methodology is described in detail in D2.2 Assessment Framework and Governance Mechanisms - first updated version". As mentioned before, CONSULAI and POLIMI held several meetings with the different TCs to discuss the applicability of the indicators, selected from literature review to address farm reality. Usually, the discussion had an analytical part and a logistical one, this being one of the aspects where WP2 and WP4 cooperate the most from these discussions, given the detailed list of data requested, TCLs stressed their concerns about data storage. While great care was taken in the selection of TCs, for various reasons some farmers could find the data collection processes too burdensome. Also, some of them may be reluctant to share economic data. Up until the point of discussing the list of indicators google drive was used to share documents. This was a pragmatic solution for quick access to necessary files and only consortium partners had access to it. But the nature of the farmer's data requested by the project required a more exclusive access to the data once stored for verification and analysis. For those reasons, WP3 prepared a secure cloud-based data storage to be utilised for maintaining sensitive data that will be generated during testing. For this purpose, and as it was specified in the Data Management Plan (DMP), a dedicated private cloud infrastructure maintained in NEUROPUBLIC's cyber premises in Greece will be used (https://kydbox.neuropublic.gr/). TC Leaders will have controlled access to it through dedicated folders per TC. During the 3rd plenary meeting it was ensured that the use of this cloud-based storage and the respective data collection process described is in line with Task's 2.2 "Governance Mechanism for Independent Assessment" directives and that it complies with all relevant (legal) regulations.

The datasets will include attributes of the farm, farmer, cultivation activities and parameters necessary for DATS performance evaluation. These data are extremely sensitive, as they contain personal and economic parameters. Two partners per test case have access, by using their email and password. TC leader have access only to a dedicated TC folder and the WP leaders to all folders. An email explaining the access procedures was shared among TCLs and WPLs to access the respective folders.

3.3. Test Case updates and alignment with the Assessment Framework

QuantiFarm is assessing 30 Test Cases composed of commercial farms operating with DATSs in real-life conditions. These are not experimental stations or farmers using DATSs for academic purposes. This brings great merit to the project's objectives, but also comes with a set of difficulties. It is important to recall that on real-life farms the farmer has the last word when it comes to any decision that take place on the farm, including the utilization of the DATSs. It has been communicated to TCLs since the very beginning to select farms and farmers that are aware of the project's objectives and that have good chances to remain part of the project until its completion, minimizing changes in the TC. Once again, the strategy to deal with the inevitable TCs' updates was to ask TCLs to always communicate changes and justify it as detailed as possible.

Upon the arrival of feedback from TCLs on the list of indicators included in the Assessment Framework, some TCLs felt that adjustments were needed to ensure the farmer participation and the relatability of the TC to the Assessment Framework. As such, through calls and emails between TCLs and WP4/ WP2, some changes in the TCs occurred (see Table 2). These updates were also communicated to the Project Officer by the project's coordination in late spring 2023.These changes took place before data was submitted by TCLs within the frames of the AF. In total, eight TCLs reported updates regarding location, DATS end-user, crop change (within the same sector), and DATS updates. Given the fact that

none of these changes placed a complication to deliver what was promised in the GA, these changes were reported and validated by WP4, WP2 and the project coordination.

TC Leader	Update	Observations
TC 8 AgroSmart (Latvia)	End-user change	The TC went from a big company working on port facilities to a small grain purchasing and storage company. This would reflect the difficulty in find a similar operation without a DATS to compare. Additionally, the project can be closer to the end-user for the purpose of data collection, namely regarding the behavioural analysis.
TC 14 Terra (Serbia)	End-user, and DATS update	Upon the feedback from the TCL on the Assessment Framework indicators, it become clear the end-users selected (tech adopter vs non-adopter) were not suitable for data comparison. A new set of end-users was selected and the new feedback on the AF was validated by WP2. The TC will still focus on precision irrigation for the same crops but will not include root pruning technology.
TC 19 Delphy (Netherlands)	Crop change	From cucumber to tomato.
TC 20 AnySol (Canary Islands)	Location change, crop change	TC changed from Madeira (Lettuce) to Canary Island (Bananas). It a very similar version of the DATS (DSS).
TC 21 LUKE (Finland)	DATS addition	Digitally dimmable led lights and ultrafiltration system for used irrigation water disinfection for recirculation purposes.
TC 23 IDELE (France)	DATS addition	In addition to heat box collar, TC23 had the same feeding robot as TC25 and calving detectors.
TC 25 IDELE (France)	DATS change	Instead of milking robotics were used feeding robotics.

Table 3 - Test Case updates before data collection process.

3.4. Training workshop on data collection procedures

The 2nd QuantiFarm workshop was held on May 25th, 2023, to provide TCLs with the necessary information, methodologies, and tools for the data collection and submission procedures. The workshop was organized by CONSULAI and counted with the participation of TNO from WP1, POLIMI and PETERSON from WP2.

First, WP1 presented the results of the data collection on DATS adopter farmers so far, in an interactive way. TCLs were quite spot on with their estimation of what the TC farmers answered regarding their main concerns and sources of pride. Also, it was agreed that the aim of the project should be influencing adoption behaviour of farmers already cautiously considering DATSs (rather than trying to influence opposers). The interactive part was followed by a presentation of the integrated framework for farmer decision-making & DATS adoption created by WP1 based on all the collected data in year 1, and an example of a farmer story on how this decision-making journey takes place and is shaped in a fictitious, though real-life inspired, scenario.

POLIMI provided a presentation on the Assessment Framework, emphasizing its significance and objectives. The timeline of the Data Collection Template was presented, outlining the sequential steps involved in its development. These steps encompassed the clustering of TCs, the execution of the 1st TC Training Workshop, the submission of the initial version of the Data Collection Template to 30 TCs, and the subsequent collection of feedback from these TCs, which was followed by calls organized with selected TCs. POLIMI then delved into the methodology employed for creating the templates, drawing upon Deliverable 4.1 devised by CONSULAI and incorporating the inputs received from the 30 TCs. The templates were presented in the form of Excel files, designed with a specific structure in mind, comprise the following sections:

- Instructions. In this section, information for completing the Data Collection Template is presented. In addition, the Table of abbreviations is provided.
- General Information. In this section, the cells (with the required data) need only to be filled once as they should not change during the project.
- Parcel sheets with DATSs. These sheets are coloured in yellow and numbered consecutively as "parcel 1 with DATS", "parcel 2 with DATS", etc.
- Parcel sheets without DATSs. These sheets are coloured in purple and numbered incrementally as "parcel 1 without DATS", "parcel 2 without DATS", and so forth.

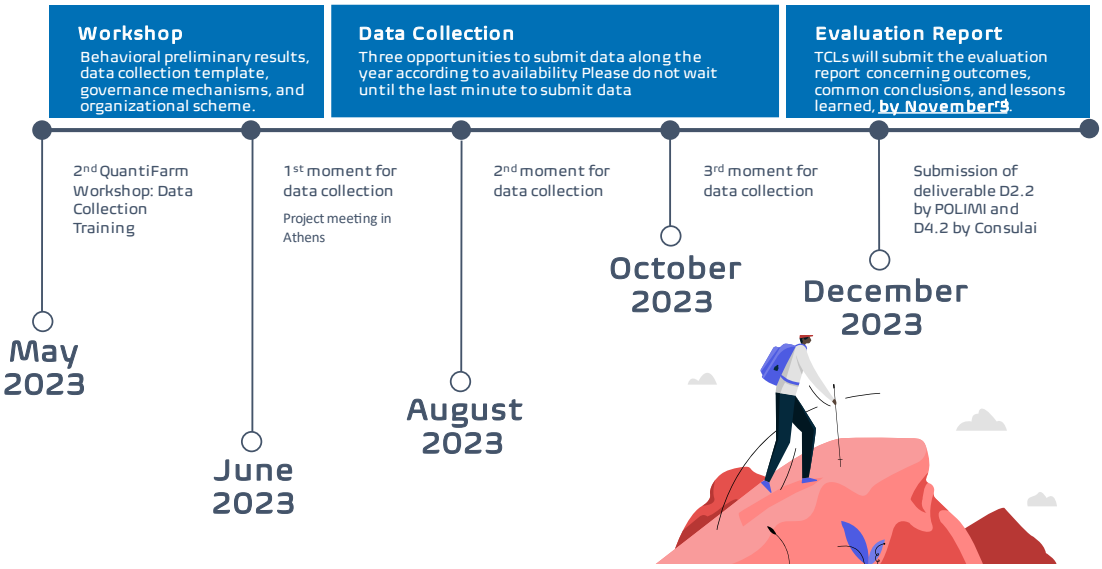

Figure 1 - Timeline presented at the data collection training workshop in May.

Two templates were used—one for arable and one for livestock. Template components and data were presented in detail. The TCLs were informed that they will be requested to provide some additional information related to labour productivity (e.g., average soil preparation time, average seeding time, and the number of workers involved in seeding activities).

Peterson presented the Governance Mechanism principles, roles and responsibilities and key documents required for the collection of data. The principles discussed included transparency, impartiality, efficiency, credibility, and relevance. Subsequently, there was an interactive Q&A session where the TCLs shared their insights and opinions on the consent forms and framework. The questions and suggestions were documented using Klaxoon. TCLs provided important feedback regarding the Governance Mechanisms and suggested to prepare a story board to make the important bureaucracy

more relatable to the producers. Also, it is important to make sure it is clear for producers that QuantiFarm is a research project, and it does not intent to legally validate whether the producers are using their DATS or data analysis in a correct/incorrect manner. It must be clear in the documents that the producers are not under any legal threat by participating in QuantiFarm. The project wishes to collect data in good faith, analyse this data while aiming towards helping each other, and share the results along the way.

CONSULAI presented the proposed calendar until the end of 2023 regarding data collection moments as seen in Figure 1. The calendar was idealized to split the remaining six months of the year into three data collection moments: end of June, end of August, and end of October. CONSULAI also presented an updated version of the evaluation report based on the plan laid out and the available time for analysis. A reminder for updating the online checklist was made. A Q&A followed with some takeaway points written on Klaxoon. CONSULAI promised to send out reminders to all TCLs upon each data collection moments, and chase TCs for data, if necessary.

3.5. Final adjustments for data collection and evaluation: Calendar definition, meetings, and evaluation report

Following the considerations explained in section 3.1, the data collection moments would not be deadlines to submit a particular set of data but rather an opportunity for TCLs to submit data as it becomes available. The idea was to prevent TCLs to feel overwhelmed with the long list of indicators, and for WP2 and WP4 to not be overloaded with work upon the end of the reporting period and close to the deliverables' deadline. The timing between the final data submission and the deliverables' deadline will greatly influence the analysis that can be made and reported. It would be fundamental to have sufficient time to go over the data submitted to provide a good quality preliminary analysis. The data collection moments were signalled to TCLs by WP4 with a string of emails at every date of each data collection moment. The emails contained the timeline context, detailed description on the procedures to download the data collection template and submit it to the private cloud detailed in section 3.2. Along with the general calendar in Figure 1 from May to December 2023, a close-up of final three months was also presented and discussed. The "Final Sprint" detailed in Figure 2 aims to stress the importance of submitting data by, or as close as possible to, the end of October. Apart from the data verification procedure, a preliminary analysis of the results should be included in this deliverable. Meaning that WP2 and WP4 most likely would have to give feedback to the TCLs and troubleshoot the final version of the template containing the list of indicators.

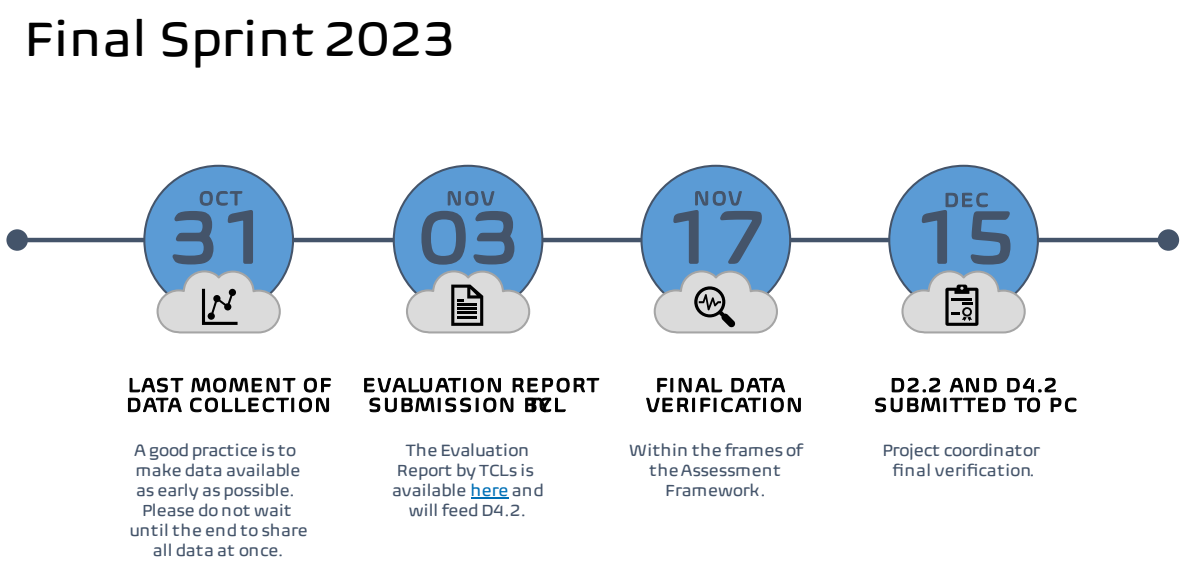

Figure 2 - Timeline from the final data collection moment and D2.2 and D4.2 submission.

In ”D4.1: Testing and Assessment Guidelines”, it was stated that individual meetings with all TCs would take place every three months to report back any issues or news, following the logic of individual meetings with TCLs used in the first six months of the project. However, the general feel of TCLs during the first half of 2023 and at the training workshop was that there was no need to schedule mandatory individual meetings as long as WP4 would remain able to meet whenever a TCL thought necessary. So, the basis of the agreement shifted that way enabling WP4 to cater to the TCs according to the TCL (consortium partner) need to clarify any issue with WP4. Indeed, some TCLs preferred to have several meetings along the first reporting period and other preferred a more independent approach. By the end of the reporting period there was only one TCL, out of thirty, that mention would prefer to have more regular meetings to be updated on the progress of the other WPs. This feedback will be taken under consideration nonetheless.

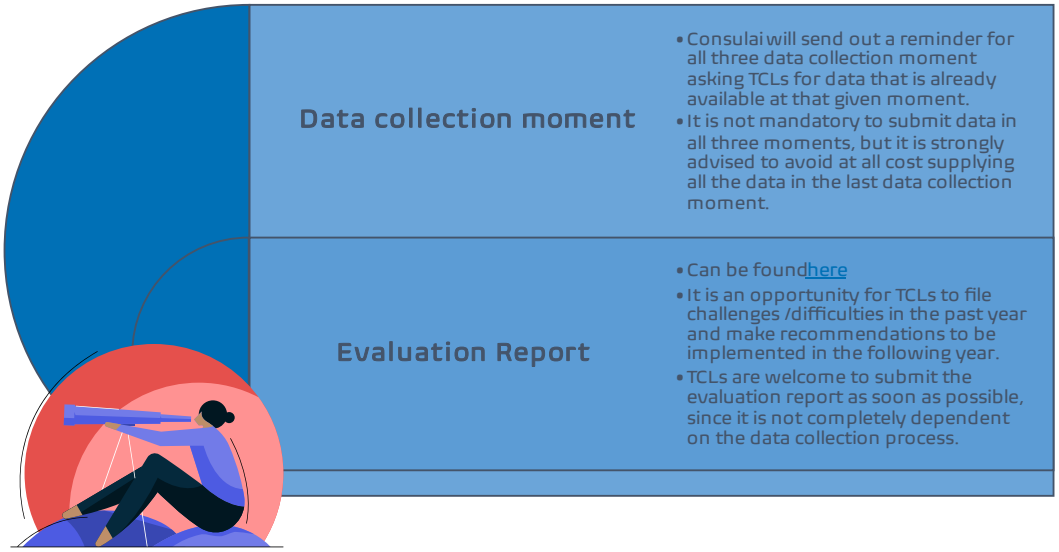

Figure 3 - Conceptualization of the Evaluation report and data collection moment.

The section of the Evaluation Report in which the TCLs were asked to reflect upon the results of the analysis of the economic, environmental, and social indicators, along with the cost and benefits of using DATSs, was adapted to a reflection of the Assessment Framework relatability to the TC, as well as a reflection upon the calendar proposed and the training sessions provided. The reason for this update was the fact that TCLs would only have access to raw data collected from the farms now of the Evaluation Report submission. Meaning TCLs would not have access to a proper analytical treatment of the data, so their conclusions regarding the analytical comparison between DATS use and non-DATS use would be significantly superficial. This adaptation aimed to get tangible input from TCLs on the process of data collection and analysis, in contrast with imposing analytical feedback from TCLs at a stage that would lead to decontextualized feedback. Instead, the Evaluation Report would mainly focus on the operationalization of the data collection procedures with the introduction of high-level quantitative results from the Assessment Framework analysis. A deeper reflection on the analytical results of the TCs would be done after the submission of D4.2 and D2.2 during the already planned workshop in February-March. This would give time for TCLs to carefully read the reports and comeback to debate with the consortium about the major outcomes, comments, and suggestions to improve the analysis. The conceptualization of the data collection moments and the evaluation report (Figure 3) were presented and validated by all at the training workshop in May 2023.

4 Monitoring Test Cases: Chasing data and report news

As it has been analysed in the previous section 0, the large majority of TCs were not capable of gathering data, for the first annual testing cycle, before the end of October given the expected growing season end. According to the original plan, assuming most TCs would be able to gather data until the end of October, the project would have two months (November and December) to review the forms, verify the data, finetune necessary adjustments to the data provided, if necessary, verify the final dataset, perform the analysis, evaluate, and report the results.

4.1. Burger conundrum

All the steps mentioned previously were the main content of the present deliverable and of D2.2. It would be thus a heavily dense two months aggravated by the holiday season in Europe. The project was then facing what was called the "burger conundrum" (Figure 4) because there were a significant constrained by the timeframe: the end of growing season for most TCs in the end of October, and the original deadline to submit deliverables D4.2 and D2.2 set to December 2023. To mitigate this timeframe challenge and allow for a preliminary quantitative analysis of the majority of TCs, the project requested a delay of 1 month for both deliverables D2.2 and D4.2. This extension allowed WP2 and WP4 to work intensely on the analysis of all data available and present quantitative results of the first annual testing cycle.

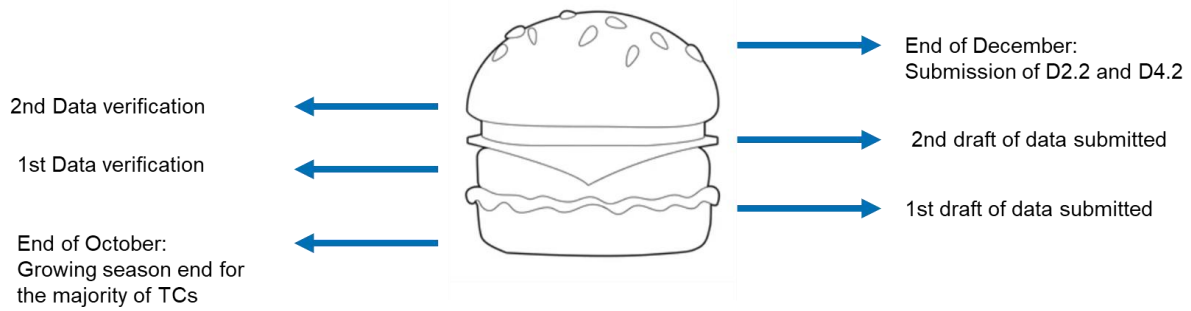

Figure 4 - The burger conundrum for a stuffed calendar.

The close contact and contribution between WP2 and WP4 during the year of 2023 enabled the understanding that it would be significantly challenging to have quantitative results available to discuss before December. Meaning the project would face a serious problem to collect, from TCLs, the necessary contextualization of the analytical results retrieved by the Assessment Framework. For this reason, the original Evaluation Report was updated, as described in section 3.5, and validated at the 3rd consortium meeting in Athens, with the intention of enabling TCLs to give context about the data they provided before having access to the results provided by the Assessment Framework. This was seen as a necessary adaptation to feed the present deliverable with important feedback from TCLs. We recognise that the final part of the TCL's reflexion on the quantitative results is not included here, but it is not forgotten. According to the GA, WP4 must prepare a workshop with TCLs after the submission of D4.2 to assist partners to monitor and evaluate TCs (presenting a roadmap, sharing good practices, brainstorming on how to overcome challenges). WP4 and WP2 will seize this opportunity to profoundly reflect on the results presented in D2.2 and D4.2 together with TCLs. Additionally, this workshop intends to produce practical outcomes on how to improve the analytical methodologies used in the first annual testing cycle.

4.2. Data submission

Following the overall procedures for data collection and the calendarization described in the previous section, an email string circulated before the end of June to signal the first moment of data collection. Two more emails followed, until October 31st, with detailed instructions on how access the TC respective templates and NextCloud folders, the necessary materials to be downloaded, and a reminder for the completion of the Evaluation Report.

Until October 31st, only 11/30 TCs were able to complete the first draft of data collection using their respective template and submit it to NextCloud. Meaning a 37% success rate for this specific goal. Of those eleven, only five drafts were validated in the first run by WP2 and WP4 and made it to analysis stage. The remainder six drafts had different types of unclarified information like missing data, unspecified units, different file formats, etc. For these reasons the drafts had to go back to TCLs for further clarification. Meaning the overall process only reached a success rate of 17%. Since this was the first time all the stakeholders would go through this process it was expected some issues to arise and more time was needed to finetune the templates and Evaluation Reports.

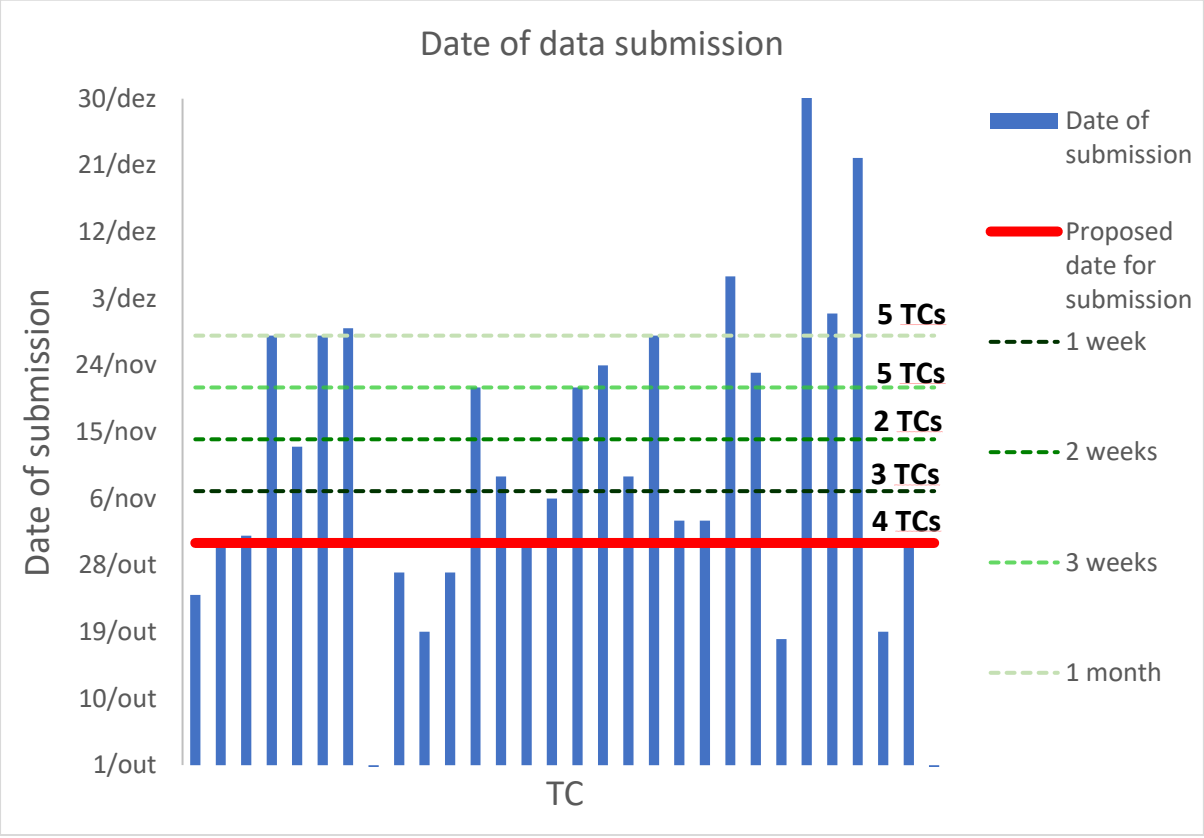

Figure 5 - Date of submission of the first draft of the list of indicators.

Since only eleven TCs were able to submit the first draft of data before the final moment for data collection, on October 31st, WP4 analysed the deviations recorded and the results can be seen in Figure 5. After the "Proposed date for submission" (representing October 31st), three TCs submitted data one week after the limit, three TCs submitted two weeks after, two TCs submitted three weeks after, six TCs made it one month after the limit, and five TCs did not manage to submit before one month had passed since the original deadline. There were reasons from different nature to justify the delay in data

collection. An overarching reason is related with the lack of familiarization, from both farmers and TCLs, with the materials produced and methods developed by WP2 and WP4 to collect data and troubleshoot issues. This was the first time all the partners involved went through this process together, meaning it was a period of learning and many opportunities to improve have been identified. Once concluded, this process will object of careful reflection by TCLs and WPs, during the already mentioned workshop, to identify avenues that will lead to a timely predicted data collection and will subsequently allow for a more detailed integrated discussion of analytical results in the future annual testing cycles. The next section details the specific barriers found in the certain TCs and the solutions adopted to overcome them.

4.3. Test Cases updates on data collection process and justifications

The monitoring work did not stop during data collection procedures. The online tool in place for this purpose was particularly useful to record all circumstantial news about the TCs. The work developed by TCLs and WP4 allowed the project partners to be updated on the local evolution of their TCs, facilitating a logbook during the first reporting period. The constant information flow allowed for WP Leaders to know when to expect data for the most cases, and to assist TCLs whenever possible in finding solutions to overcome the issues that came up.

Table 4 offers a summarization of the challenges faced by different TCs concerning the data collection procedures and the deviations from the foreseen calendar that are represented in Figure 5. All TCLs that had to request a delay to submit data provided the following justifications and solutions to conclude data collection.

TC Leader	Observations
TC3 (Spain)	Only 2 farmers (Farmer 1 and 3) have carried out the fertilization of the proposed plots according to the recommendations of the proposed DATS (SATIVUM). Farmer 2 and Farmer 4 have used the tool to make a nutrient balance and the calculated nutrient needs. However, they did not follow the DATS recommendations given the adverse weather condition. Instead, the farmers considered the best approach would be to make an additional fertilization. Finally, Farmer 5 has decided not to participate this year, due to personal reasons, and prefers to participate next year.
TC4 (Greece)	Due to the recent unfavourable situation of the flooding phenomena in Thessaly region, the TCL had to identify new fields for the projects' purposes since the previous ones have been deemed unsuitable for cotton cultivation. A solution was found to transfer the original site to Pella and the data collection procedure was slightly delayed. Given the new site, the list of indicators also suffered an update since it was not possible to collect all the quantitative information as originally planned.
TC5 (Turkey), TC13 (Italy), and TC18 (Italy)	Data collection of test cases took longer than expected and was running late. TCL needed some more days to complete all the three test cases.
TC6 (Netherlands)	Most data were only available in November due to delays during crop season related with climate conditions.

TC Leader	Observations
TC7 (Poland)	Data was only available in December due to weather conditions. There was a significant exchange between TCL and WP2/WP4 to make sure all the indicators were collected in the correct format to feed the analysis.
TC12 (Netherlands)	Data was only available in November. There were significant subsequential issues with the quality of the data gathered due to technical problems with the moisture sensors.
TC15 (Cyprus)	Harvesting was expected to continue through November. Any data updated on the relevant forms cannot be complete if harvest is not completed. TCL suggested an extension on the submission of data by 30/11.
TC16 (Netherlands)	Data only available in November due to calendar conflicts with the busiest time of the year for the grower.
TC17 (Romania)	Data was available shortly after the beginning of November. There was a mistake with the selection of files. The first file submitted was the feedback on the template (tasks from launching TCs phase). The file was replaced by the correct one with no difficulties.
TC19 (Netherlands)	Most of the data was available in December given growers' decision at farm level. Data referring to the fertilizers was only available in January due to an issue in the informatic administrative system governing fertilizer application.
TC20 (Spain)	"Bodegas El Grifo" has opted to withdraw from "test cases" operations, despite the efforts made by the TC Leader to reconsider their resolution. "Bodegas El Grifo" was an additional farmer engaged in TC20 operations, not originally planned/foreseen in the project's initial application. Their decision to withdraw stems from the expectation of receiving financial return for their participation, which is not foreseen by the Action. This perspective also seems to undermine the perceived benefits associated with their involvement in pilot activities. The rest of the farmers were fully engaged in TC operations.
TC21 (Finland)	Data collection took more time than expected by TCL. The process unfamiliarity led to believe it would be faster, aggravated by an overwhelming number of emails that arrived during the holidays in Summer.
TC22 (UK)	The TCL reported some internal issue regarding the lack of human resources to address data collection. But by the end of November the TC managed to submit quantitative data.
TC23 (France)	The TCL requested more time to provide data because there was a delay regarding the farm selection to ensure good comparability. Nonetheless, quantitative data arrived by the end of November.
TC25 (France)	There was an issue with the advisors that work closely with the farmers and are responsible for gathering data. Data became available at the end of December.

TC Leader	Observations
TC26 (Irland)	There was a difficulty related with gathering data from the non-DATS parcel. The official data collection integrated in Teagasc methodologies would make data available in January 2024, so the advisors had to by-pass that process taking more time than expected. Nonetheless, the final part of data was made available in November.
TC 27 (Germany)	The farmer using the DATS was only available from November 20th onwards. TCL guided him through the data collection process. The non-DATS farm was considerably more complicated, and data was not made available to perform analysis. The Evaluation Report was not made available either despite multiple requests.

Table 4 - Test Case updates during data collection procedures.

5 Evaluation reports from Test Cases and quantitative results from the application of the Assessment Framework

As mentioned in section 4, the original Evaluation Report targeting TCLs was updated. The final version of the template is in Table 5. According to the GA, this report should include the outcomes, common conclusion and lessons learned from the different TCs. Given the TCLs contribution was essential to evaluate the TC, and since there are 30 TCs (and 20 TCLs), it was necessary to create a template of an evaluation report to uniform as far as possible the information provided.

The header of the report identifies the TC with the name of TCL (project partner), name of the DATS used, the biogeographical region, agricultural sector, and crop. A detailed description of each individual TC has been made in D4.1 – Testing and Assessment Guidelines, so that information will not be repeated.

The outcomes of the report focus on the Assessment Framework relatability to the TC and to the structural component of QuantiFarm to compare between DATS use and non-DATS use. The common conclusion section of the report asks TCLs to reflect on the calendar purposed, the training provided to use the tools and methodologies developed and criticize the quality of the support given by WP4 during testing. Finally, the lessons learned asked TCLs to identify best practices and to recommend on the improvement of the test case operations. An entry was also reserved for the farmers motivations towards the project. This was of particular interest to better understand how farmers felt about the process and outcomes of QuantiFarm, and to assess possible preventive measures in case of farmer loss of interest.

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Monitoring and Evaluation of the activities</td></tr>
<tr><td colspan="4">Partner Name and TC number: [Please enter here]
DATS: [Please enter the DATS used in your TC here]
Agricultural Sector and Crop: [Please enter here regarding your TC]
Biogeographical Region: [Please enter here regarding your TC]</td></tr>
<tr><td rowspan="4">Main Results</td><td>Cost Benefit analysis</td><td>Net benefit (or net loss)</td><td rowspan="2">(Comparison between costs and revenues obtained by farmers using and not using DATSs on a given year. According to equation (1), (2), and (3))</td></tr>
<tr><td>Economical</td><td rowspan="3">[TC specific indicators (%)]</td><td rowspan="3">(According to equations (4) and (5).)</td></tr>
<tr><td>Environmental</td></tr>
<tr><td>Social</td></tr>
<tr><td>Outcomes</td><td colspan="3">Assessment Framework</td></tr>
</table>

Test Case Evaluation Report	
	[Please provide details on the DATS data collection process, relatability to your TC, and clearness of the Assessment Framework. Identify challenges, and possible recommendations, for the collection of the data associated with the list of indicators]
	Comparison between DATS use and non-DATS use
	[Please provide details on the challenges of collecting data from farms (or parcels) using the DATS and the farms (or parcels) not using a DATS.]
Common Conclusions	**Calendar**
	[Please provide details on how the calendar for data collection moments were suitable (or not).]
	Training
	[Please provide details on how the training sessions could be improved in order to facilitate the data collection moments and the evaluation report.]
	Test Case Operability
	[Please provide details on the usefulness of the monitoring and evaluation tools provided (and missing), as well as the communication channels available for troubleshooting and decision-making support]
Lessons Learned	**Best practices**
	[Please provide information on what were the best practices you found useful for the success of your TC up to the present moment]
	Farmers motivations
	[Please provide information on the farmers' overall motivations towards QuantiFarm, and what (if any) action should be considered towards improving said motivations.]
	Recommendations
	[Please provide details on the recommendations you may have to improve the processes of data collection, monitoring, reporting, and verification.] *[Please provide recommendations for data collection purposes: qualitative and quantitative. E.g., additional tools, tool adaptation, communication channels, etc.]*

Table 5 - Test Case Evaluation Report template

The Evaluation Report includes high-level results of the quantitative analysis detailed in D2.2. The cost-benefit analysis is calculated using equations (1), (2), and (3). The TC specific indicators variation is calculated using equation (4). These results are expressed in percentage using equation (5). All the

results included in the individual Evaluation Reports in section 5 use the minimal number of significant figures.

$$Benefit(t) = \Delta\, Revenues(t) + \Delta\, Costs(t) \quad (1)$$

$$\Delta Revenues = \sum R(farm\ with\ DATSs) - \sum R(Farm\ without\ DATSs) \quad (2)$$

$$\Delta Costs = \sum C(farm\ without\ DATSs) - \sum C(Farm\ with\ DATSs) \quad (3)$$

$$\Delta\, Indicator_i = Indicator_{i\ DATS} - Indicator_{i\ without\ DATS} \quad (4)$$

$$\Delta\, Indicator_{\ i\ (\%)} = (\Delta\, Indicator_i\ / Indicator_{i\ without\ DATS}) * 100 \quad (5)$$

A detailed desciption of each TC is made in "D4.1 – Testing and Assessment Guidelines", for that reason we will refrain from further description. Additionally, D2.2 also provides a brief description of each TC upon detailed discussion of the analytical results. The header of the Evaluation Report identifies the TC main characteristics.

5.1. TC1: SF DSS/ App for potatoes in Mediterranean region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: NEUROPUBLIC, TC1
DATS: DSS, gaiasense
Agricultural Sector and Crop: Arable, Potatoes
Biogeographical Region: Greece, Mediterranean</td></tr>
<tr><td rowspan="10">Main Results</td><td>Cost-benefit</td><td>Net benefit</td><td>+ 3 816 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+14%</td></tr>
<tr><td>Labour productivity</td><td>+154%</td></tr>
<tr><td rowspan="7">Environmental</td><td>N use efficiency</td><td>-5%</td></tr>
<tr><td>P use efficiency</td><td>+3%</td></tr>
<tr><td>K use efficiency</td><td>+8%</td></tr>
<tr><td>Pesticides use</td><td>-6%</td></tr>
<tr><td>Irrigation water use</td><td>-16%</td></tr>
<tr><td>Irrigation water productivity</td><td>+42%</td></tr>
<tr><td>N2O emissions</td><td>+36%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The data collection process went smoothly in all parcels in TC1. The cooperation with the local agronomist was good. The Evaluation Framework was quite clear to the agricultural advisor who was monitoring the progress of the TC. Challenges encountered are that some indicators, for example the hours a producer spends on the plot are difficult to identify by the producer.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">Since the DATS and non-DATS parcels are owned by the same producers, no challenges were encountered. One thing worth noting is that one of the producers did not do well due to little spraying she did, resulting in a lot of damage caused by perennial pollen beetle (Her crop is organic).

The other producer with 3 parcels did very well because he followed the advice on powdery mildew to the letter and managed to reach harvest levels of 3.5 tonnes/acre.</td></tr>
<tr><td></td><td colspan="3">Calendar</td></tr>
</table>

Common Conclusions	The calendar provided comprehensive and detailed information. Of course, too much detail makes it difficult for the people working with the producers, as their time is limited.
	Training
	Adaptation of questionnaires and timetable according to the growing season. Interim meetings with producers or agronomists/advisors working with producers.
	Test Case Operability
	The monitoring and evaluation tools fulfilled the CT needs.The communication with the WP4 and WP1 leaders was very good.
Lessons Learned	**Best practices**
	The best practices highlighted through the pilot were the benefits that smart farming offered to the farmer and the environment. How the producer was able to saved money and tim, but also to reduce his environmental footprint through advice on irrigation, pest management and fertilization..
	Farmers motivations
	It gives them the opportunity to examine the technology they are already using, to see how much it has improved their farming. They will also be able to access tools that will be built within the project.
	Recommendations
	There could perhaps be some meetings during the growing season to inform WP leader about the progress of the pilot. The growing season should also be considered for data collection. I think it is not easy to ask for information during the growing season as the workload of the producers is quite heavy in that period.

5.2. TC2: Precision Irrigation for corn in Continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: 6
DATS: Probe humidity
Agricultural Sector and Crop: Arable, Corn
Biogeographical Region: Portugal, Mediterranean</td></tr>
<tr><td rowspan="10">Main Results</td><td>Cost-benefit</td><td>Net benefit</td><td>+ 917 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+29%</td></tr>
<tr><td>Labour productivity</td><td>+217%</td></tr>
<tr><td rowspan="7">Environmental</td><td>N use efficiency</td><td>+61%</td></tr>
<tr><td>P use efficiency</td><td>+35%</td></tr>
<tr><td>Irrigation water use</td><td>+8%</td></tr>
<tr><td>Water Productivity</td><td>23%</td></tr>
<tr><td>Fuel Consumption</td><td>-9%</td></tr>
<tr><td>Electricity consumption</td><td>-25%</td></tr>
<tr><td>N2O emissions</td><td>-1%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">In addition to direct and constant contact with farmers, TCL had access to platforms for continuous monitoring of weather conditions (weather stations) and soil moisture monitoring probes. As a challenge, The Test Case Leader identifies the optimization and synchronization of information in a single computer application.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">With the various ways of exploiting plots and different data for each farmer, the real sharing of data between farmers is the main challenge faced.</td></tr>
<tr><td rowspan="4">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">The timing of data collection was appropriated considering the type of farmers and farms.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">Joint farmer sessions have been and will be held to share relevant information.</td></tr>
</table>

	Test Case Operability
	The share of basic information to each farmer was extremely important. This sharing promoted the desire for improvement and optimization in general and in each of the farmers.
Lessons Learned	**Best practices**
	The best practices identified were based on the sharing of information and data between farmers.
	Farmers motivations
	The main motivation of participating farmers was based on increased income and greater efficiency in the use of resources.
	Recommendations
	Data collection and processing could be inserted into a single platform that, in addition to processing information, could make some universal recommendations.

5.3. TC3: DSS/Agri-environmental Monitoring for wheat in Mediterranean region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: ITACYL TC3
DATS: SATIVUM
Agricultural Sector and Crop: Arable crops, mainly winter cereals (wheat and barley)
Biogeographical Region: Mediterranean, Spain</td></tr>
<tr><td rowspan="10">Main Results</td><td>Cost-benefit</td><td>Net benefit</td><td>+ 151 € / ha</td></tr>
<tr><td>Economical</td><td>Labour productivity</td><td>+120%</td></tr>
<tr><td rowspan="8">Environmental</td><td>N use efficiency</td><td>+46%</td></tr>
<tr><td>P use efficiency</td><td>+5%</td></tr>
<tr><td>K use efficiency</td><td>+4%</td></tr>
<tr><td>Pesticides use</td><td>-78%</td></tr>
<tr><td>Fuel Consumption</td><td>-5%</td></tr>
<tr><td>Fuel GHG Emissions</td><td>-5%</td></tr>
<tr><td>N2O emissions</td><td>-68%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Solid contacts have been established with farmers, and all objectives have been achieved in data collection. The required volume of data is high and includes highly sensitive information about their business.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">This comparison is proving to be complex because farmers do not fully follow the nutritional recommendations of the DATS. They take them into account subjectively, but then modify their decisions based on meteorology and market conditions.</td></tr>
<tr><td rowspan="4">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">When contact with farmers was initiated, base fertilization had already been carried out, so the data had to be collected retrospectively. It is advisable to have closer contact with the farmer during the execution of the work. The spring has been incredible dry so that the top-dressing fertilizer application has not been done.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3"></td></tr>
</table>

	The training in the use of the DATS has been straightforward. However, filling out the forms with the data of each farmer for the project has been very tedious and confusing for them. Their responses were disorganized and ambiguous, and it was necessary to make multiple calls and interactions with them to put things in order.
	Test Case Operability
	Nothing to add here.
Lessons Learned	**Best practices**
	Direct and personal contact has been fundamental, but the need to provide so much data has caused one of the 5 farmers to give up this year.
	Farmers motivations
	The farmers as partner's collaborators have a bond because of the partner's support to them. The tool was adjective as useful and free, so their approach was positive. However, the data asked to fill out was sometimes tedious and invaded their business privacy, causing them to lose interest in collaboration. It is expected that the use of a DATS for nutrient balances will be mandatory in the coming years, which will encourage farmers to participate. Keeping direct contact with the farmers by WhatsApp had been the most convenient way to resolve problems collecting data.
	Recommendations
	Minimize the data that is requested to ensure that it is of higher quality and consider the timing of when it is available. Sometimes the DATS is used at the beginning of the crop, but data from the closed campaign is required, so this time frame needs to be considered. It is expected that subsequent data collections will be simpler given that this first edition is a good basis for updating the results of subsequent years.

5.4. TC4: VRA add-on for old tractors for cotton in Mediterranean region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Augmenta
DATS: Augmenta Field Analyzer (AFA)
Agricultural Sector and Crop: Cotton Crop
Biogeographical Region: Thessaly and Macedonia Prefectures, Greece</td></tr>
<tr><td rowspan="3">Main Results</td><td>Cost-benefit</td><td>Net benefit</td><td>+ 148 € / ha</td></tr>
<tr><td>Economical</td><td>Crop productivity</td><td>+10%</td></tr>
<tr><td>Environmental</td><td>Pesticides use</td><td>-6%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Data collection process include 3 levels:
Data collected with AFA (Field Application Maps, Rate applied per region)
Ground-truth measurements
Yield Data
Assessment framework included information about the operation with/without DATS and yield data, though it could include data from ground-truth measurements. There are many data sections irrelevant to TC4.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">As Augmenta team is responsible to carry out the operations and data gathering there were any significant challenges. The only data that was challenging to gather has to do with the yield data collection as the treatments (plots or parcels) must be weighted separately. A process that sometimes can be challenging.</td></tr>
<tr><td rowspan="6">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">As the crop type of TC4 s cotton, it was necessary to rescheduled data collection and analysis timing. Cotton in Greece is usually harvested after the mid of October, so the full data set can be available after mid of November.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">No further input.</td></tr>
<tr><td colspan="3">Test Case Operability</td></tr>
<tr><td colspan="3">Current tools and communication channels fit the TC.</td></tr>
</table>

Lessons Learned	**Best practices**
	Being pre-active, starting TC one year earlier and having back-up farmer. This practice was quite useful as the initial set-up of the TC needed to be changed because of extreme weather condition in Thessaly.
	Farmers motivations
	Provide farmers with annual data and results, so they can see immediately DATS's impact.
	Recommendations
	Assessment frameworks could include forms for the ground-truth measurements collections. These measurements can support and explain agronomically the outcome (yield secure/increase with the use of DATS).

5.5. TC5: SF DSS/ App for wheat in Anatolian region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: HORTA TC5
DATS: Decision Support System
Agricultural Sector and Crop: arable crop / durum wheat
Biogeographical Region: Anatolian, Turkey</td></tr>
<tr><td rowspan="12">Main Results</td><td rowspan="3">Economical</td><td>Net benefit</td><td>+ 306 € / ha</td></tr>
<tr><td>Crop productivity</td><td>+51%</td></tr>
<tr><td>Labour productivity</td><td>+21%</td></tr>
<tr><td rowspan="9">Environmental</td><td>N use efficiency</td><td>-34%</td></tr>
<tr><td>P use efficiency</td><td>+63%</td></tr>
<tr><td>Pesticides use</td><td>-21%</td></tr>
<tr><td>Irrigation water productivity</td><td>+37%</td></tr>
<tr><td>Fuel consumption</td><td>+6%</td></tr>
<tr><td>Fuel GHG emission</td><td>+6%</td></tr>
<tr><td>N2O GHG emission</td><td>-39 CO2e/ha</td></tr>
<tr><td>Protein % dry matter</td><td>-2%</td></tr>
<tr><td>Humidity</td><td>-8%</td></tr>
<tr><td>Test Weight</td><td>-4%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Data on the crop management operations carried out in the parcels were entered as input in the Decision Support System. The main challenge is given by the communication with farmers, due to language barrier and the novelty of the use of DSS in the area.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">Parcel managed with the DSS yielded better quality grain than the ones managed in a conventional way. This is mainly due to the improvement of the use of technical inputs. This also impacted in the economic domain, as the product obtained from the DSS managed parcels had a higher value.</td></tr>
<tr><td></td><td colspan="3">Calendar</td></tr>
</table>

Common Conclusions	The actual data collection was possible only after the closure of the growing season, so data were provided only in the last collection moment.
	Training
	Give a practical example of how the file needs to be completed during the training sessions.
	Test Case Operability
	The provided monitoring and evaluation tools are satisfactory.
Lessons Learned	**Best practices**
	The comparison with common practice enhanced farmers understanding of the DATS usefulness. All the data requests need to be clarified at the beginning of the season.
	Farmers motivations
	Improved management of the crop thank to the DATS can be a levier for farmers motivation. The request of large amount of data can discourage farmers participation.
	Recommendations
	No specific recommendations.

5.6. TC6: VRA Machinery, data analytics for wheat, onion and potato in Continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Delphy – TC6
DATS: Soil maps, sat images, soil sensors, weather sensors
Agricultural Sector and Crop: Arable crops
Biogeographical Region: Continental, Netherlands</td></tr>
<tr><td rowspan="7">Main results</td><td>Cost-benefit</td><td>Net loss</td><td>- 37 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop production</td><td>5%</td></tr>
<tr><td>Labour productivity</td><td>-56%</td></tr>
<tr><td rowspan="3">Environmental</td><td>N use efficiency</td><td>4%</td></tr>
<tr><td>P use efficiency</td><td>+7%</td></tr>
<tr><td>K use efficiency</td><td>+1%</td></tr>
<tr><td>Social</td><td>Working hours</td><td>+2 h/ha</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">No comment was provided.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">For this TC, there is a rotation plan for typical arable crops in this region. Year 1 = wheat, Year 2 = Potato and Year 3 = Sugar Beet.

In the first-year wheat grown, which is not typically a crop where there are many opportunities for using DATs. Nor is this in practice. Wheat is typically a crop with low financial returns and growers don't often invest in that, preferring to do so in the 'cash crops' like potatoes and onions. The following DATs were used: Soil maps and sat images and finally a small difference with the non-DATS, namely in yield and use of active ingredients. For next years, with the crops being potato and sugar beet, there are more opportunities to use DATs and more differences are expected.</td></tr>
<tr><td rowspan="3">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">Some of the data was only available at the end of November.</td></tr>
<tr><td colspan="3">Training</td></tr>
</table>

	No need for further training.
	Test Case Operability
	No feedback was provided.
Lessons Learned	**Best practices**
	As described above, wheat is not the most suitable crop for the application of DATs. However, it is an integral part of arable farming in the Netherlands. It is therefore a good idea to include this crop in QuantiFarm. It was not to be expected that the differences would be large and that did not materialise. There should also be a caveat as to whether these differences were caused by the difference in DATS vs non-DATS.
	Farmers motivations
	How do you keep a grower involved in this project?
	Recommendations
	Be cautious about drawing conclusions when it comes to the results of DATS vs non-DATS. It is important to contextualize to what extent is it reliable that, for example, a difference in yield can be explained from that difference.

5.7. TC7: SF DSS/ App for potatoes in continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner name and TC number: TC7 FP2
DATS: Weather Stations - irrigation
Agricultural and crops sector: potatoes
Biogeographic Region: Continental, Poland</td></tr>
<tr><td rowspan="10">Main Results</td><td>Cost Benefit</td><td>Net benefit</td><td>+ 140 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+15%</td></tr>
<tr><td>Labour productivity</td><td>+154%</td></tr>
<tr><td rowspan="7">Environmental</td><td>N use efficiency</td><td>-5%</td></tr>
<tr><td>P use efficiency</td><td>+3%</td></tr>
<tr><td>K use efficiency</td><td>+8%</td></tr>
<tr><td>Pesticides use</td><td>-6%</td></tr>
<tr><td>Irrigation water use</td><td>-16%</td></tr>
<tr><td>Irrigation water productivity</td><td>+42%</td></tr>
<tr><td>N2O emissions</td><td>+36%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment framework</td></tr>
<tr><td colspan="3">The data is collected in Tupflow; an in-house program developed for supply chain management and full product traceability. In addition, the data is collected on the weather station platforms used at the Metos or Gaia farm.</td></tr>
<tr><td colspan="3">Comparison Between DATS Use and Non-DATS Use</td></tr>
<tr><td colspan="3">In the case of parcels with DATS, irrigation is carried out based on data from the sensor, in plots without dates organoleptically. In both cases, the data is entered into the Tupflow program.</td></tr>
<tr><td rowspan="6">Common conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">On the FFPDwa farm, data has been collected independently for many years, regardless of the program carried out.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">The collected data is part of our company's strategy to make the product fully traceable.</td></tr>
<tr><td colspan="3">Test case activity</td></tr>
<tr><td colspan="3">The dashboard of the station is fully transparent, and the analysis of the soil moisture graph fully allows you to make efficient decisions about irrigation planning.</td></tr>
</table>

Experience	**Best practices**
	The ability to make the right decisions about when and when to water the plantation.
	Farmers' motivations
	Savings in irrigation quantities and timely irrigation based on electronic readings.
	Recommendations
	To make the economic result of the analysis of the collected data visible.

5.8. TC8: Drones, sensors, silo management, AI for wheat in Boreal region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Agrosmart SIA, TC-8
DATS: Silos management
Agricultural Sector and Crop: Arable, Wheat
Biogeographical Region: Boreal (Latvia)</td></tr>
<tr><td rowspan="5">Main Results</td><td>Cost benefit</td><td>Net loss</td><td>- 1 € / ha</td></tr>
<tr><td>Economical</td><td>Quality analysis time rate</td><td>-5%</td></tr>
<tr><td rowspan="3">Environmental</td><td>Fuel consumption</td><td>-72%</td></tr>
<tr><td>Fuel GHG emission</td><td>-72%</td></tr>
<tr><td>Electricity consumption</td><td>+17%</td></tr>
<tr><td rowspan="3">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Data collection started after finding a second smaller company that was more like a farmer. Since the company already used the system installed by Agrosmart, the data was collected immediately.
First, a questionnaire was coordinated between the project coordinators and what information can be collect from the software used.
Next, the project was presented over the phone and Excel was sent to get familiar with the questions.
Because there were some unclear questions and how to answer them. it was taken to the place and a questionnaire was filled out to help understand what was being asked.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
</table>

	Data collection and management in agriculture, specifically on farms, can vary significantly depending on whether a Digital Agriculture Technology (DATS) system is in use or not. • DATS Use: Farms with silos management systems often have digital records readily accessible through the system. Data is centralized and can be accessed in real-time. • Non-DATS Use: Farms without silos management systems rely on manual record-keeping, making data collection and retrieval more time-consuming and prone to errors. • DATS Use: Digital systems enable automated data collection and minimize human error, resulting in more accurate and consistent data. • Non-DATS Use: Manual data collection is susceptible to errors due to transcription mistakes, misinterpretations, and variations in data recording practices. Farms using silos management systems and other DATS solutions have a distinct advantage in terms of data collection and management. These systems offer improved data accessibility, accuracy, and the ability to conduct advanced analyses, making them essential for modern, data-driven agriculture.
Common Conclusions	**Calendar**
	Timing was right. Since the company was already using our software, no additional time was needed for its installation. Regarding data collection, it can be said that it is enough to collect them two times a year. This is during the grain growing season, when grain is transported to grain elevators (July/August) and adjustments in the month of December, when grain is unloaded and exported/sold, etc.
	Training
	Training to use the silos management system takes an average of 4-8 hours per person. However, this is not a rule and depending on the person, these trainings can take up too few days. To facilitate training with the program, perhaps short videos on the procedures with the program could be created, but this will not really replace a live meeting and live explanation.
	Test Case Operability
	Nothing to add here.
Lessons Learned	**Best practices**
	I think the best practice for gathering data is a live meeting. After sending the tables to be filled in, you must remind them to do it by phone. Therefore, it is best to arrange a live meeting, when it takes place, and the data is collected immediately and maintains a good relationship with the client.

	Farmers motivations
	I can't say exactly what their motivation was now, but I had to persuade them to participate in the project. Because farmers are already like that. If they do not see any additional used or financial used, then their motivation to participate somewhere is low. Therefore, for other cases, you should think about the benefits for farmers then they agree to participate and easily share data. Because it should also be mentioned that farmers are very sensitive to data disclosure.
	Recommendations
	Now everything is fine. However, to think about: • What we should do if the farmer is late in providing data, • Provides too little of it, • Or in the worst case, refuses to participate and no longer wants to provide data. Then how should the old data be equated with the newly found participant, etc.

5.9. TC9: FMIS/ Financial Modelling for Barley, corn and wheat in the Alpine region

<table>
<tr><th colspan="5">Test Case Evaluation Report</th></tr>
<tr><td colspan="5">Partner Name and TC number: KGZS, TC9
DATS: FMIS Farm Manager
Agricultural Sector and Crop: Arable; corn, barley, wheat
Biogeographical Region: Alpine</td></tr>
<tr><td rowspan="13">Main Results</td><td rowspan="7">Corn for silage</td><td>Cost benefit</td><td>Net loss</td><td>- 23 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+0.1%</td></tr>
<tr><td>Labour productivity</td><td>-9%</td></tr>
<tr><td rowspan="4">Environmental</td><td>N applied</td><td>162 kg/ha</td></tr>
<tr><td>P applied</td><td>103 kg/ha</td></tr>
<tr><td>K applied</td><td>-303 kg/ha</td></tr>
<tr><td>Pesticide use</td><td>-22%</td></tr>
<tr><td rowspan="6">Wheat</td><td>Fuel GHG emission</td><td>-2%</td></tr>
<tr><td>Cost benefit</td><td>Net benefit</td><td>-312 €/ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>-14%</td></tr>
<tr><td>Labour productivity</td><td>-96%</td></tr>
<tr><td rowspan="4">Environmental</td><td>N applied</td><td>+48 Kg/ha</td></tr>
<tr><td>Pesticide use</td><td>-20%</td></tr>
<tr><td>Fuel use</td><td>-76%</td></tr>
<tr><td>Fuel GHG emission</td><td>-47%</td></tr>
<tr><td rowspan="2">Outcomes</td><td colspan="4">Assessment Framework</td></tr>
<tr><td colspan="4">During the first year, the data collection process was more ’manual’, because the platform that will use in future is still under development. So, the data about the work tasks (time) on farms were collected by interviews, later it will be more automatically form the tracking system. But for all other data, the TC will still need to collect by interview (like data of crop yield, the fertilizers and pesticides used, economic data, societal data). The Assessment Framework is clear, did not have problems to get the data from farmers. The only thing identified as an issue is that a lot of data is just some assumption provided by the farmer. There are not exact data (e.g., Time used for tasks). Further, data about the fuel consumption</td></tr>
</table>

	were calculated according to the time consumption and the kWh data about the mechanization used for work.
	Comparison between DATS use and non-DATS use
	There was no difference, all farmers are willing to collaborate.
Common Conclusions	**Calendar**
	For TC9 the calendar is not the most optimal. The DATS Farm Manager needs the data from the whole year, but the Assessment Framework needs the data before the end of the year. For TC9 it would be more appopriate to deliver the data about the 2023 in March 2024, similar as the accounting data are reported. Also, there is no significant DATS output/result from the DATS farmers, because this will be done next year, based on data from whole year 2023.
	Training
	More often meetings, like once per month the WP4 meeting, so TCL would be more up-to date to not forget something.
	Test Case Operability
	The monitoring tool is useful. But the TC still did not used the issue reporting tool, it is more natural to write an email.
Lessons Learned	**Best practices**
	The regular communication with farmers. Farmers are not from the region, so TCL was a stranger at the beginning of the project. But with more visits the easier and better is for all.
	Farmers motivations
	Our farmers are motivated, because TCL installed the tracking systems, and provided them the app that they can use to see the data from tracking system. This technology is exciting to all of them, either they will in future use Farm Manager advisory service (DATS) or not. One concern is that the motivation of non-DATS user will not be so high in the upcoming testing years. It is good there is a financial reward reserved, although not high amount, but still good for motivation.
	Recommendations
	Much more convenient for TC9 would be to send the data in March 2024 for 2023. Or repair the data already sent if there was some mistake. For TC9, the intermediate data collection (m4 and m8) has no sense (regarding DATS Farm Manager), only TCL would have additional work with collecting data. And bothering farmers. Also, for getting data from farmers, the most appropriate time is winter, between November-February. It would be good if you could synchronize the data collection for different purposes deadlines. EG. Like data for assessment framework, data for social

	indicators, data of behaviour, surveys, different consents... so all this could be collected from farmers max. twice per year. e.g. visit farmers at the end of the year, make face-2-face interview, forward them the papers needed, explain which surveys they should filled out.

5.10. TC10: FMIS/ app for wheat in Steppe region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: ANAMOB / TC 10
DATS: Satellites, Weather station, Instrumented machinery
Agricultural Sector and Crop: Arable / Winter Wheat
Biogeographical Region: Steppe / South-East Romania</td></tr>
<tr><td rowspan="12">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 427 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+2%</td></tr>
<tr><td>Labour productivity</td><td>+39%</td></tr>
<tr><td rowspan="9">Environmental</td><td>N applied</td><td>+3%</td></tr>
<tr><td>N use efficiency</td><td>-8%</td></tr>
<tr><td>P use efficiency</td><td>+11%</td></tr>
<tr><td>Protein content</td><td>+1%</td></tr>
<tr><td>Standard mass per storage volume</td><td>+5 kg/hl</td></tr>
<tr><td>Pesticides</td><td>-0.3%</td></tr>
<tr><td>Fuel consumption</td><td>-2%</td></tr>
<tr><td>Fuel GHG emission</td><td>-3%</td></tr>
<tr><td>N2O GHG emissions</td><td>0.04%</td></tr>
<tr><td rowspan="3">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The data collection process was carefully tailored to fit the needs of our test case in wheat cropping as part of raw vegetal farming business. The Assessment Framework was designed to be clear and comprehensive, providing a well-rounded view of the business performance metrics. TCL identified only minor adjustments needed to better suit the specific characteristics of our test case in terms of quality indicators and detail the fertilizer and phytosanitary activities. On the other hand, regular training sessions and cross-check of the indicators with sector benchmarks could improve the process. These steps will ensure smoother and more accurate data collection in future assessments.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
</table>

	More flexibility in planning and executing work activities. Improved decision-making regarding the pace of work. The DATS implementation was not only devoid of complexity and time-consuming challenges but was, in fact, engaging and motivating.
Common Conclusions	**Calendar**
	The data collection took place in October 2023, well after the harvesting of wheat occurs, marking the conclusion of the agricultural year for wheat cropping. So, the timing of the data collection process overlaps quite well with the end operational activities offering a quite fair annualized view of business performance for this crop. However, one should notice that in some instances the full commercialization of the harvested wheat may take longer, if the crop is stored for a while to take advantage of a better pricing off-season.
	Training
	TCL conducted only limited training sessions to help the management understand our analysis framework. They are quite experienced and regularly use MIS and data analytics in their activity, so it was easy to understand requirements. Just some little efforts will be necessary in the future, to adapt them to incorporating more interactive elements in our Assessment framework, when ready.
	Test Case Operability
	Accurate assessment of the vegetal farm's operations relies on the capabilities of the monitoring tool. Effective communication through meetings, emails, and online resources has proven valuable for discussions and resolving issues. Moving ahead, TCL strived to improve interactive reporting to offer timely information for more informed decision-making.
Lessons Learned	**Best practices**
	The achievements so far in our wheat cropping TC 10 stem from the implementation of effective strategies: a) meticulous planning of data collection using the Assessment Framework with precision. b) establishing transparent communication with the farmer, leading to a deeper understanding of their needs and collaborative problem-solving. c) ensuring ongoing training for both farmers and DATS providers to grasp the potential of our reporting tool in decision-making. These methods will serve as the foundation for our future assessment endeavours.
	Farmers motivations
	The farm management shows motivation towards the practical benefits of the QuantiFarm project. They value the tools and resources that aid in decision-making. To further enhance motivation, organizing regular engagement and training sessions would help them see continued value in utilizing QuantiFarm for their business. Additionally, providing complimentary invitations to relevant events for the owner and other stakeholders would facilitate discussions with

	fellow vineyard managers, allowing them to gain valuable insights from industry peers.
	Recommendations
	Optimizing data collection, monitoring, reporting, and verification processes is fundamental to the success of our wheat cropping TC10. Proposed enhancements include a) Implementing real-time reporting for immediate access to current information. b) Customizing the Assessment Framework to focus on pertinent metrics. c) Actively seeking feedback and integrating validation procedures for accuracy. These measures are anticipated to significantly improve the efficiency of our data management processes for the wheat cropping TC 10.

5.11. TC11: SF DSS/ App for olives in Mediterranean region

Test Case Evaluation Report

Partner Name and TC number: NEYROPUBLIC, TC11

DATS: DSS, gaiasense

Agricultural Sector and Crop: Fruit, Olives

Biogeographical Region: Greece, Mediterranean

Main Results	Cost benefit	Net benefit	+ 3 467 € / ha
	Economical	Crop productivity	+69%
		Labour productivity	+162%
	Environmental	N applied	+11%
		P and K applied	+11%
		Pesticides	+0.4%
		N2O GHG emissions	+15%
	Social	Working time	-2%

Outcomes

Assessment Framework

The data collection process went smoothly in all parcels in TC1. The cooperation with the local agronomist was quite good. The Evaluation Framework was quite clear to the agricultural advisor who was monitoring the progress of the TC. Challenges encountered are that some indicators, for example the hours a producer spends on the plot are difficult to identify by the producer.

Comparison between DATS use and non-DATS use

Because the parcels with DATS user and non-DATS user belong to the same producers, no challenges were encountered.

Common Conclusions

Calendar

I thought it was quite explanatory and detailed. Of course, too much detail makes it difficult for the people working with the producers, as their time is limited.

Also, the olive growing season ends at the end of November to mid-December, so the completion of the data collection template will be completed later than the date requested.

Training

Adaptation of questionnaires and timetable according to the growing season. Interim meetings with producers or agronomists/advisors working with producers.

	Test Case Operability
	I have nothing to add about the usefulness of the monitoring and evaluation tools provided. The communication with the WP4 and WP1 leaders is very good.
Lessons Learned	**Best practices**
	The best practices that I would like to highlight through the pilot are the benefits that smart farming offers to the farmer and the environment. How through advice on irrigation, pest management and fertilization the producer manages to save money and time but also to reduce her/his environmental footprint.
	Farmers motivations
	It gives them the opportunity to examine the technology they are already using, to see how much it has improved their farming. They will also be able to access tools that will be built within the project.
	Recommendations
	There could perhaps be some meetings during the growing season to inform those responsible about the progress of the pilot. The growing season should also be considered for data collection. I think it is not easy to ask for information during the growing season as the workload of the producers is quite heavy in that period.

5.12. TC12: Drones and soil sensors for apples in Continental region

<table>
<tr><th colspan="2">Test Case Evaluation Report</th></tr>
<tr><td colspan="2">Partner Name and TC number: Delphy TC 12
DATS: Data maps, water sensor, insect traps
Agricultural Sector and Crop: Fruit (apple)
Biogeographical Region: Poland, Continental</td></tr>
<tr><td>Main results</td><td>This TC did not register different agronomic practices between the parcel using the DATS and the parcel not using it. There were several reasons behind, related with the early implementation stage of the DATS, the operational issues in moisture sensors and the language barrier between farmer and TCL.</td></tr>
<tr><td rowspan="4">Outcomes</td><td>Assessment Framework</td></tr>
<tr><td>The data that is collected is giving support on making decisions. Water sensors are giving indication of the soil moisture. Data that is collected and changes that are made from it are sometimes also carried on by grower in the non-DATS area because of the extra knowledge he gets. But comparing two different companies will result in less comparable outcomes.</td></tr>
<tr><td>Comparison between DATS use and non-DATS use</td></tr>
<tr><td>A challenge on collecting data and information is the language. Sometimes difference may occur because it is not the native language of both parties. In this season the yield of the field was so high that there was no reason to make a difference in task maps. A challenge is also that sometimes the water sensors have problems with recording this is not helpful for giving better information.</td></tr>
<tr><td rowspan="4">Common Conclusions</td><td>Calendar</td></tr>
<tr><td>The collection data is suitable, most data will be available after harvest of the product. End of the growing season.</td></tr>
<tr><td>Training</td></tr>
<tr><td>No further training needed to complete the data template.
Test Case Operability
No further comments on the monitoring and evaluation tools and the communication.</td></tr>
<tr><td>Lessons Learned</td><td>Best practices</td></tr>
</table>

	The grower gets more detail from a field what will help him to make better decisions.
	Farmers motivations
	The grower has good motivation to help in the project, only during the season there are moments that the grower has a lot of work what will make the time that is available limited. The grower is curious about the overall outcomes of this project and how this project will help him further.
	Recommendations
	To maintain grower involvement for the further course of this project, it is important to share the results of the project though.

5.13. TC13: SF DSS/ App for Grapevine in Continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Horta TC13
DATS: Decision Support System + drone and remote sensing data
Agricultural Sector and Crop: Grapevine
Biogeographical Region: Italy, Continental</td></tr>
<tr><td rowspan="11">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 683 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+8%</td></tr>
<tr><td>Labour productivity</td><td>+14%</td></tr>
<tr><td rowspan="8">Environmental</td><td>N use efficiency</td><td>+3%</td></tr>
<tr><td>P use efficiency</td><td>+1%</td></tr>
<tr><td>K use efficiency</td><td>+4%</td></tr>
<tr><td>Pesticides use</td><td>-35%</td></tr>
<tr><td>Irrigation water use</td><td>-35%</td></tr>
<tr><td>Irrigation water productivity</td><td>+67%</td></tr>
<tr><td>Fuel consumption</td><td>-21%</td></tr>
<tr><td>Fuel GHG emission</td><td>-20%</td></tr>
<tr><td rowspan="3">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The farmer recorded all the information on the crop management in the dedicated functionality of the Decision Support System.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="4">Comparison was assessed both for IPM and organically managed fields. In both cases, the use of DATS allowed a reduction in the use of plant protection products, without compromising crop yield and quality.</td></tr>
<tr><td rowspan="3">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">Data could only be retrieved at the end of the growing season.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="4">Training should also focus on the use of the data.</td></tr>
</table>

	Test Case Operability
	Monitoring and evaluation tool were fine.
Lessons Learned	**Best practices**
	Farmers need to be supported during the cropping season in the use of DATS.
	Farmers motivations
	Farmer is interested in new technologies, and in the improvement of the management of his crop.
	Recommendations
	Nothing to add.

5.14. TC14: Precision Irrigation/ Variable root pruning for Strawberry, Blueberry in Pannonian region

Test Case Evaluation Report				
Partner Name and TC number: Terra Littera TC 14 **DATS:** Netafim "NETAJET"- system for irrigation and fertilization with field sensors, Netafim pro system for irrigation and fertilization with light sensors **Agricultural Sector and Crop:** Fruit production – Blueberry, Strawberry **Biogeographical Region:** Pannonian region, Serbia				
Main Results	Blueberries	Cost benefit	Net loss	- 53 285 € / ha
		Economical	Crop productivity	-50%
			Labour productivity	-31%
		Environmental	N applied	+0.7 kg/ha
			P applied	+22%
			K applied	+67 kg/ha
			Irrigation water use	-26%
			Water productivity	-33%
			Fuel consumption	+117%
			Electricity consumption	+111%
			N2O GHG emission	+4 kg
	Strawberries	Cost benefit	Net benefit	+ 59 047 € / ha
		Economical	Crop productivity	+433%
			Labour productivity	-630%
		Environmental	N applied	+101 kg/ha
			P applied	+81 kg/ha
			K applied	+213 kg/ha
			Pesticides use	-80%

			Irrigation water use	-108%
			Water productivity	+156%
			Fuel consumption	-100%
			Electricity consumption	+332%
			N2O GHG emission	+472 kg
Outcomes	**Assessment Framework** Data Collection process was going ok, given the circumstances that owner of the farm is businessman, and that besides his fruit production he has his regular work. He didn't have all data right away, so it was needed that data collection process goes thru couple of stages. Good relationship was made between Farmer and TC leader. Assessment framework was clear. One of the challenges is to build confidence between farmer and consultant, and to make farmer believe that his participation in the project can benefit him in the improvement of production. No recommendations. **Comparison between DATS use and non-DATS use** Producers on Farms with DATs were more aware of their expenses compared to producers without technology, also they (producers with DATS) have vision of their business. In my case producer without DATS looked on fruit production more less like some kind of extra job or hobby.			
Common Conclusions	**Calendar** It was suitable. **Training** Training sessions was ok, and they made our work little easier, maybe recommendation is that future trainings can focus on agricultural sector. **Test Case Operability** Communication channels were very good. Monitoring and evaluation tools were good prepared, and farmers had satisfaction in participating in them.			
Lessons Learned	**Best practices** Most useful lesson was that you need to come to the farmer with open and sincere intensions and to present the project in a short and clear way. Also, you must give him some kind of perspective about their involvement in the project. When they see that your intensions are good and, at the intersection of all the involved parties' interests, then the collaboration will be smooth.			

	Farmers motivations
	Overall motivations at farmers side are that they always want to learn something new, because they are aware that methods and technology in agriculture is in constant change. In connection to that, they know that they need to stay informed about new trends and methods of production and they see this project to accomplish that. Another motivation of farmers is fact that they measure their expenses and income on very low level. They look at QuantiFarm to upgrade this part of their business.
	Recommendations
	In case of blueberry, maybe to get more realistic results to include in some way year of planting (or plant), and number of plants because it is not same number of plants on different farms per m2 or per ha.

5.15. TC15: DSS for Olives in the Mediterranean region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: FILAGRO TC15
DATS: GAIASENSE STATIONS
Agricultural Sector and Crop: OLIVES FOR OLIVE OIL
Biogeographical Region: CYPRUS, Mediterranean</td></tr>
<tr><td rowspan="14">Main Results</td><td>Cost benefit</td><td>Net loss</td><td>- 1 062 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>-25%</td></tr>
<tr><td>Labour productivity</td><td>+4%</td></tr>
<tr><td rowspan="10">Environmental</td><td>N applied</td><td>-38%</td></tr>
<tr><td>P applied</td><td>-41%</td></tr>
<tr><td>K applied</td><td>+26%</td></tr>
<tr><td>N20 GHG emissions</td><td>-33%</td></tr>
<tr><td>Pesticides use</td><td>+145%</td></tr>
<tr><td>Water consumption</td><td>+146%</td></tr>
<tr><td>Water productivity</td><td>-7%</td></tr>
<tr><td>Fuel consumption</td><td>-9%</td></tr>
<tr><td>Electricity consumption</td><td>-17%</td></tr>
<tr><td>Fuel GHG emission</td><td>-9%</td></tr>
<tr><td>Social</td><td>Working time</td><td>-0.4 h/week/ha</td></tr>
<tr><td rowspan="2">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The assessment framework was incorporated into the data collection process from the outset hence all data became part of the work programme. Data collection was frequent, i.e. from the months December – April collection of data was done every 20 days and in the months May-Non every 10 days.

Data reliability issues arise primarily with the estimation of energy costs for water supplies. Irrigation is usually dependent on boreholes and the energy cost for the pump must be estimated on various variables for which their accuracy is weak.

Recommendations: a benchmarking tool must be in place that will compare the test case data with the sector averages for the country. This is an exercise that</td></tr>
</table>

	the TCL is going to perform and come up with conclusions of the sample vis-a-vis the sector performance.
	Comparison between DATS use and non-DATS use
	Taking into consideration the careful selection of DATS and non-DATS parcels as well as the fact that out of the five non-DATS three belonged to the holders of DATS parcels, the collection process of data did not result to any difficulties. The difficulty lies across all holdings (DATS and non-DATS) in making estimates for fuel cost consumption since this is related to the pumping equipment from boreholes and the cost estimation is a difficult task.
Common Conclusions	**Calendar**
	TCL followed a 10-day calendar for data collection between the periods May-November and a 20-days for the period Dec-April.
	Training
	Online electronic data collection via a mobile phone application could facilitate the data collection process and training could be linked to such an application.
	Test Case Operability
	Valuable source of information to the farmers for monitoring irrigation needs of olive trees. However, the fact that in 2 of the TC, irrigation supplies are not constant from the water sources, the info provided from the DATS could not be followed. The data provided was of less use in terms of crop diseases; this is attributed to the fact that disease infection is limited in the olive trees. The availability of electronic traps for the well-known olive insect Bactrocera oleae (Gmelin) (Diptera: Tephritidae) could have greatly improve the prediction of outbreak in the olive groves. Overall, TC operability proved to be a useful support tool in olive tree irrigation for the three TC cases which could be adequately supported in their decision making by the DATS.
Lessons Learned	**Best practices**
	Preparation of an update report about the DATS, conveying targeted information about the agricultural practices of irrigation and pesticide use. This report was prepared every 15 days and sent to the growers as a reference document for discussions with the agronomist advisor. It serves as an additional support tool offered to DATS TC, which is not available to non-DATS members.
	Farmers motivations
	Farmers have been motivated through (a) a lump sum of 1000€ paid annually to provide data and (b) through the fortnight report (explained above) which

	kept an ongoing discussion and close relations with the advisor, (c) frequent visits by the advisor onsite to offer free advice with the support of the DATS tools. It is important to stress the fact that in this project the TC is working with a crop that needs limited agricultural activity compared to other crops e.g. vegetables, potatoes. Hence data collection is an easier task and farmer motivation for collecting and reporting data is a simpler task.
	Recommendations
	Annual benchmarking tool for comparing country averages with DATS data and non-DATS data.

5.16. TC16: Drones and soil sensors for Apples in Continental Region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Delphy TC 16
DATS: Data maps (vigour, blossom, soil), Water sensors QMS water
Agricultural Sector and Crop: Fruit (apple)
Biogeographical Region: The Netherlands, Continental</td></tr>
<tr><td rowspan="9">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 5 934 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+18%</td></tr>
<tr><td>Labour productivity</td><td>+38%</td></tr>
<tr><td rowspan="6">Environmental</td><td>N efficiency</td><td>+8%</td></tr>
<tr><td>Pesticides use</td><td>-1%</td></tr>
<tr><td>Irrigation water use</td><td>+4%</td></tr>
<tr><td>Irrigation water productivity</td><td>+10%</td></tr>
<tr><td>Electricity consumption</td><td>+8%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The data is collected throughout the season and worked with. The results are only at the end of the season. This brings challenges because the end data needs to be collected at the busiest time of the year for the grower. The Assessment framework is providing enough clearness.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">On the farm the data is not always broken down to parcel level. That results in average data, when there is no possibility to link it to a certain parcel.</td></tr>
<tr><td rowspan="5">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">Most data are only available at the end of the season after harvest.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">At first, Delphy needed help to get through some questions. In the end it was possible to finish filling the template. At this moment there is no need for further training.</td></tr>
<tr><td colspan="3">Test Case Operability</td></tr>
</table>

	No comments about the tools. The opportunities for communication are sufficient.
Lessons Learned	**Best practices**
	The more robust the contact and the greater the grower's cooperation, the easier and more effective the data collection process becomes.
	Farmers motivations
	The overall motivation of the farmer is good. They see possibilities with the DATS's. TCL should keep supporting them to use the DATS's.
	Recommendations
	To keep the grower motivated for the coming years the project should update him with the project results.

5.17. TC17: Harvesting robotic and SF DSS for Vineyard in Black Sea region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: ANAMOB TC17
DATS: IoT
Agricultural Sector and Crop: Vineyard
Biogeographical Region: Black Sea, Romania</td></tr>
<tr><td rowspan="9">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 4 402 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>+31%</td></tr>
<tr><td>Labour productivity</td><td>+399%</td></tr>
<tr><td rowspan="5">Environmental</td><td>Irrigation water use</td><td>-49%</td></tr>
<tr><td>Water productivity</td><td>+200%</td></tr>
<tr><td>Fuel consumption</td><td>-26%</td></tr>
<tr><td>Fuel GHG emissions</td><td>-13%</td></tr>
<tr><td>Electricity consumption</td><td>-25%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Despite being resilient and robust perennials, grapevines can be finicky creatures, especially in a warming climate. They grow best in soil that has good ventilation and drainage, but the soil must also have good water retention. They like environments with a large temperature difference between day and night, which is when they accumulate nutrients. They need enough sun to produce the right levels of acid, sugar, and pH, but not so much that they burn and shrivel into raisins. When those levels are just right, it’s time for harvest, the moment that winemakers and grape growers patiently await each year, making daily vineyard visits in the lead-up to harvest — and sometimes multiple times a day — to taste and run analysis on the berries. Pick too soon, or too late, and that decision can have a cascading effect on the quality of the wine.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">In non-digital precision vineyard, there has been challenges in accurate data. Because there was no analytics data our expenses in non-DATS was with 30 % more than DATS.</td></tr>
<tr><td></td><td colspan="3">Calendar</td></tr>
</table>

Common Conclusions	Calendar for DATS was 24/7 and based on the monitoring platform was comfortable to get all the date in one page. On non-DATS the TC must send employ to inspect vineyard and always our source of data was only one person so only one point of view.
	Training
	DATS - Based on our collaboration with AgriCloud. non-DATS was standard work. After the person identify some anomalies in vineyards, TCL must clarify and to make double check.
	Test Case Operability
	Nothing to add here.
Lessons Learned	**Best practices**
	DATS Perspective: "We embrace rapid adoption of technologies in our daily professional activities." Non-DATS Perspective: Farms, not using a DATS, send employees to gather information from the vineyard. They base their investments in inputs and treatments on this gathered information.
	Farmers motivations
	DATS perspective: For farmers with over 30 years of experience, adapting to digital technologies can be challenging. What might take one a day to do manually, digitalization accomplishes in 30 minutes. Non-DATS perspective: Comparing treatment costs with DATS, non-DATS farmers may see the benefits of digitalization and consider it for future use.
	Recommendations
	DATS Perspective: Farmers collaborate closely with the digitalization partner to support their employees in the digital transformation process. There's a clear need for additional assistance in navigating the complexities of digitalization. There's an abundance of data available, which can be overwhelming. Both TCL and farmers seek to better comprehend their data to inform decision-making processes.

5.18. TC18: SF DSS/ App for tomatoes in the Continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Horta TC18
DATS: zero residue web app
Agricultural Sector and Crop: Horticultural crop / Tomato
Biogeographical Region: Continental, Italy</td></tr>
<tr><td rowspan="12">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 3 173 € / ha</td></tr>
<tr><td rowspan="2">Economical</td><td>Crop productivity</td><td>164%</td></tr>
<tr><td>Labour productivity</td><td>+0.5 t/h</td></tr>
<tr><td rowspan="8">Environmental</td><td>N use applied</td><td>-43%</td></tr>
<tr><td>P use applied</td><td>-87%</td></tr>
<tr><td>K use applied</td><td>-47%</td></tr>
<tr><td>Pesticides use</td><td>+13%</td></tr>
<tr><td>Water consumption</td><td>-26%</td></tr>
<tr><td>Irrigation water productivity</td><td>+2%</td></tr>
<tr><td>Fuel consumption</td><td>+5%</td></tr>
<tr><td>Fuel GHG emission</td><td>+1%</td></tr>
<tr><td>Social</td><td>Working time</td><td>-0.03 h</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Farms enter information of the crop operations performed in the field in an IT tool. The main challenge is given by the timely completion of information.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">The use of DATS allowed an improvement in the use of plant protection products. Parcels managed with DATS also had an improved use of water and of fertilisers.</td></tr>
<tr><td rowspan="4">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">Data could only be provided at the end of the growing season.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">Training sessions were suitable.</td></tr>
</table>

	Test Case Operability
	Monitoring and evaluation tools are satisfactory.
Lessons Learned	**Best practices**
	The requests made to farmers need to be very clear and should be limited.
	Farmers motivations
	Displaying of results to farmers can enhance their motivation.
	Recommendations
	The need of data needs to be clearly state as early as possible.

5.19. TC19: Automated greenhouses for tomatoes in Continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Delphy - TC19
DATS: QMS Tomato
Agricultural Sector and Crop: Greenhouse Horticulture - Tomato
Biogeographical Region: Netherlands</td></tr>
<tr><td rowspan="7">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 36 793 € / ha</td></tr>
<tr><td>Economical</td><td>Crop productivity</td><td>+4%</td></tr>
<tr><td rowspan="5">Environmental</td><td>Irrigation water use</td><td>-20%</td></tr>
<tr><td>Water productivity</td><td>+30%</td></tr>
<tr><td>Gas consumption</td><td>-5%</td></tr>
<tr><td>Electricity consumption</td><td>-98%</td></tr>
<tr><td>Average fruit size</td><td>-25%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Some indicators are not relevant for greenhouse horticulture and/or not relevant for the difference between DATS and non-DATS. I believe it can have a revised version for coming years. Next to that, I was waiting a long time on feedback on a concept version.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">Data collection itself is okay, considered that some indicators are confidential and that some assumptions are taken. The growers are wondering what is happening with their data, e.g. what will be the results/conclusions of the data collection.</td></tr>
<tr><td rowspan="4">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">A bit too tight regarding the cultivation season. End of December is most suitable for this TC.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">No real feedback, it could be useful to take real examples next time from the collected data collection templates. To learn from others as well.</td></tr>
<tr><td colspan="4">Test Case Operability</td></tr>
</table>

	No feedback was provided.
Lessons Learned	**Best practices**
	TCL did not provided feedback.
	Farmers motivations
	They are wondering what will be done with the data and what it will result.
	Recommendations
	TCL did not provided feedback.

5.20. TC20: Precision Irrigation for Bananas and Grapes in Macronesia region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Anysolution TC20
DATS: IoT, Precision Irrigation, Monitoring, Sensors, and automatizations
Agricultural Sector and Crop: Fruit. Bananas
Biogeographical Region: Micronesian</td></tr>
<tr><td rowspan="4">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 20 570 € / ha</td></tr>
<tr><td>Economical</td><td>Crop productivity</td><td>+125%</td></tr>
<tr><td rowspan="2">Environmental</td><td>Irrigation water use</td><td>+11%</td></tr>
<tr><td>Water productivity</td><td>+103%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The challenge of the TC is the lack of data. Farmers are not aware of data relevance. Our recommendation is the creation of synthetic indicators based on the data gathered</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">Farmers using the DATS are more aware about data collection but they do not trust the technology because they do not understand it. Farmers who do not use the DATS are not involved and it is very difficult to get their commitment because there is no incentive.</td></tr>
<tr><td rowspan="6">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">In the case of bananas, farmers make an annual planning of irrigation and fertilizers, so the data remains unchanged.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">Short and to the point and in small groups would be the ideal training. They are already obliged to some compulsory training, so TCL organises it in advance when it doesn’t overlap with other duties.</td></tr>
<tr><td colspan="3">Test Case Operability</td></tr>
<tr><td colspan="3">The project information reaches the TC efficiently. But sometimes overloads the TC, being such a small project and involvement, it would be better to have specific deadlines to submit anything that is needed from the TC from all WPs.
The request of information should be linked to the data generated, which in the case of bananas is once a year.</td></tr>
</table>

Lessons Learned	**Best practices**
	Not yet identified.
	Farmers motivations
	Farmers do not see yet the value of the project. The data collection process is time-consuming and unrewarding, more time will be needed to show with results.
	Recommendations
	To involve farmers, they must see a return on their investment on time and resources in a clearer way. Data collection for bananas should happen only once since bananas are collected only once a year.

5.21. TC21: Automated Greenhouse for tomatoes in Boreal Region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: LUKE - Martin Sigg Ab and Siggarden (Jonathan Sigg who shares the same greenhouse with his father) =TC21-2 DATS-farm; (Stefan) Gulin Ab non-DATS farm representing the current standard of production = TC21-1

DATS: 1) Digitally dimmable led-lights and 2) Kathari ultrafiltration system for used irrigation water disinfection for recirculation purposes (TC21-2)

Agricultural Sector and Crop: Greenhouse production, tomato (year-round)

Biogeographical Region: Boreal region, Finland</td></tr>
<tr><td rowspan="11">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 680 023 € / ha / 6 months</td></tr>
<tr><td>Economical</td><td>Crop productivity</td><td>+ 244 t/ ha/ 6 months</td></tr>
<tr><td rowspan="9">Environmental</td><td>N use applied</td><td>+20%</td></tr>
<tr><td>P use applied</td><td>-52%</td></tr>
<tr><td>K use applied</td><td>-18%</td></tr>
<tr><td>Pesticides use</td><td>+0.6 kg / ha /6 months</td></tr>
<tr><td>Water consumption</td><td>-20%</td></tr>
<tr><td>Water productivity</td><td>+171%</td></tr>
<tr><td>Electricity consumptions</td><td>-48%</td></tr>
<tr><td>Fuel consumption</td><td>-14%</td></tr>
<tr><td rowspan="2">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Background for TC21 data collection: Data collection for crop cycle 2022-23 has been completed. For this 1st round, data was collected after the crop cycle had come to an end. TCL has initiated data collection for the first months of the 2nd crop cycle (2023-24). This time data will be collected by quartiles for TC21-2 DATS farm (i.e., 4 times during the 11-11,5 Mo crop cycle), or 2-3 times for TC21-1 non-DATS farm, according to the farmers' preferences and busyness.

During the 2022-23 crop cycle, electricity (needed for artificial lighting from Sep – to April) was abnormally expensive. For this crop cycle, KPIs must be interpreted considering this exceptional context. There is a connection to the DATS of dimmable led lights (electricity consumption by luminaires and the possibilities of regulating the amount of light given to the plants, with eventual consequences to crop quality).</td></tr>
</table>

The price of electricity fluctuated unpredictably. This influenced TC21 farmers' decisions regarding how long to continue cropping. That, in turn, influenced decisions regarding the social domain. The DATS farm continued growing for 11 months, whereas the non-DATS farm stopped prematurely already in February after 6 Mo cropping period. The non-DATS farm laid off workers for 2,5 months in Feb-April, whereas the TC21-2 DATS farm continued throughout the winter as it was easier for him to regulate the amount of lighting. But the contracts concerning electricity purchase also played a role. Thus, it is not only the DATS associated with the lighting system that played a role. The non-DATS farmer had bought electricity options which he sold in December, after deciding he would stop prematurely. Owing to this, he eventually **did not pay for electricity consumption at all** during the winter 2022-23, he only paid for transfer costs! He stopped prematurely because of the uncertainties concerning fluctuations of electricity prices concerning the part based on stock exchange electricity (instead of flat/fixed rate contracts).

Data collection process: Data collection was initiated in May 2023, when the DATS-farm was approaching the end of its cropping cycle (and the non-DATS farm had stopped already in February). At first, the KPI Excel-form was used as such for data input. However, it was learned that an auxiliary table to simplify the data collection in practice for both TCLs and the farmers was needed. Quite a lot of work must be done to process the raw data obtained from farmers to fit the data with the requirements of the KPI table. There was a learning process during the first data collection round to make the process simpler, more reliable, and more convenient for TCLs and the farmers.

The learning concerned particularly in which form and how easily the data are available from the farmers, and how to make sure the final data corresponds to the KPI requirements. Many data on these farms concern **the whole area** of greenhouse production, whereas we are working on data concerning **a specific greenhouse** only. Thus, one must be very attentive to know what area the data concerns in order not to make mistakes. The auxiliary tables we are now preparing takes this challenge into account. The DATS farmer is willing to partly fill it himself beforehand as much as he can. This really requires the auxiliary tables must be tailor-made according to in what form and how easily the data are available on these two farms.

After working on the initial data collected in May, there was a continuous work on it in October, since there were missing values and uncertainties in the data. At the same time, the collection of data initiated from the first 3 or 5 months (from the TC21-2 and TC21-1 farms, respectively) of the 2nd crop cycle.

Challenges of the KPI table associated with TC21: The KPI table was modified somewhat to make it more fit with the data produced on greenhouse farms of year-round production:

	Some new variables were added to consider the different sources of heating energy in Finnish conditions, the role of biocontrol as the main form of pest management, and CO_2 as an important fertilization component. It was difficult for the DATS farmer to give data on the amount of training hours associated with the DATs. We urged them to estimate the hours, and thus there is uncertainty involved, as they do not keep records of those hours explicitly. Starting from the 2nd crop cycle (2022-23), we will collect data also on the **amount of water recirculated owing to the ultrafiltration system** (Kathari) on the DATS farm. There was an expectation to see the fertilizers' amount to reduce on the DATS farm compared to the non-DATS farm. Currently, however, the water data shows only the amount given to the plants, thus it is not considering the amount of water saved due to the Kathari system. The system was taken into use in March 2023, so it only was working for 2,5 months before the 1st crop cycle came to an end. The 2nd crop cycle will show Kathari's full effect accompanied with data on different lots of water (input, overirrigation, disinfected, returned to the irrigation system). For this, we are collaborating with Vattre project (https://vakra.fi/vattre) that is also working with the DATS farm and takes water samples regularly there. We need to understand better how the system stores data and how it can be accessed and whether an additional meter for water flows in the system is needed to get accurate data. **The values of variables calculated in the KPI table for the 1st round (2022-23) must be seen through the exceptionality of the conditions regarding electricity prices.** There was a try to depict this situation in the Notes part of the KPI table. We provide further information if necessary. It would be important to see an explicit statement whether the costs fed into the KPI should or should not include VAT. Given costs as VAT 0% as VAT may vary from country to country and cost factor to cost factor. A status for this in the beginning of the KPI table was made, to make it clear.
	Comparison between DATS use and non-DATS use
	The DATS-farmer has more organized systems to collect and store data and retrieving them. With him, data collection has proceeded quite smoothly. The non-DATS farmer is different in character and decision-making, has not as organized data storage systems, and is busier due to also having agriculture. Some of his data are not as accurate as those of the DATS farmer. We have tried to state this in the KPI table. There was an adaptation to these differences during the 1st crop cycle data collection round and adjusted our behaviour when collaborating with the farmers. Tailor-made auxiliary tables are being finalized for data collection to consider the differences between the two farms.
	Calendar

Common Conclusions	Year-round production in tomato greenhouses differs from field crops in that data accumulates continuously during 10,5-11,5 months. In Finland, year-round tomato crops are usually planted in June-August. But as it has been seen for the 1st round of data collection, factors associated with input costs can abruptly change the normal timing of cropping. Two options were contemplated for timing of data collection with the farmers: all data at once in the end of the almost year-long cropping period, or data collection quarterly. The DATS farmer is willing to provide data after every quartal, i.e., at 3 Mo intervals. His data accumulation system gives summary information after every quartal of the year. The non-DATS farmer would like to provide data 2-3 times per crop cycle. We will see in the spring of 2024 which of the options come true. It really depends on his time schedule, and we do not want to be too pushy with him. The suggested deadline of 31st October for submitting the data fits very well with the schedules of TC21 farms' crop cycles: **we can provide data for the whole preceding crop cycle by the end of October irrespective of whether the data has been collected in quarterly lots of all at once after the crop cycles has ended.** However, in 2025 there is a possibility to collect and submit the last lot of data of the 3rd crop cycle already in June 2025. This would ensure that data from three full crop cycles are available for analysis from TC21. Due to the length of the all-year cropping cycle, the last data collection can be done only in 2025. Regarding quarterly data collection: the DATS and the non-DATS farm's cropping schedules are not exactly similar, and the non-DATS farmer prefers a smaller number of data collection bouts. Due to different starting dates of the crop cycles, the different crop stages (vegetative, generative) will fall on different months/ seasons between the two. These differences influence the dynamics of irrigation and lighting needs a lot. Even so, we will stick to collecting data from both farms during the same week due to practical reasons when possible (data collection trips are made easier). This decision was justified by the fact that the full picture of these two farms becomes visible only after the data covers the whole cropping cycle, irrespective of TC starting time.
	Training
	The training was quite adequate, as all challenges during the data collection become knowable only once one starts doing it. Then it is a matter of the collectors to adjust the collection process according to the conditions on the farms. It was correct to ask for help from the project when needed.
	Test Case Operability
	As to working with TCs, we have used the KPI table, templates for meeting minutes (meetings with TC-farmers, meetings concerning MoUs i.e. collaboration with other projects directly associated with TC work), templates with MoU, and the TC

	Evaluation report. These tools are working well and guide the documentation of the work with TCs and associated tasks. **Each template could, however, have a clear statement and address where the filled files should be sent when they are ready**. For example, the meeting minutes are now stored, being useful to keep track on what has been done and what kind of decisions have been taken, as well as for later reporting, but there is a difficulty to understand where it must be sent when having been filled. As to communication channels, there was an appreciation for the direct contacts with WP4 leader and with the coordinator of the whole project. Prompt and friendly answers to all my questions and flexibility if there is a dire need for it e.g., concerning deadlines.
Lessons Learned	**Best practices** 1. Creating **auxiliary tables** that are tailor-made according to the data provision conditions of the two farms. These tables are needed to make the collection process smoother, reduce errors and consider the differences in how the data are stored and accessible on the two farms. 2. Adjusting the time schedules of data collection according to the motivational states and busyness of the two farmers. This has not, luckily, been in contradiction with the deadlines of submitting the full data to the project. 3. **Doing the data collection together with a former greenhouse grower** (a consult from whom the service is purchased) who knows greenhouse production and can verify the correctness of the final values of variables (so that they are comparable to normal values and not something totally different which would point to errors in raw data and data collection). 4. The consult, with his knowledge on greenhouse production, provides **discussion support to both farmers**, but particularly to the non-DATS farmer, who contemplates his decisions regarding the same DATs as the DATS farmer has. Such consultation is invaluable for keeping up the motivation of the non-DATS farmer to provide data. 5. **Collaboration with Vattre project on the DATS farm** (a MoU has been prepared but not yet sent to QuantiFarm). Vattre demonstrates and studies the functionality of different water disinfection solutions in greenhouse farms in the study area (https://vakra.fi/vattre). Vattre takes water samples from the DATS farm on nutrient concentration of disinfected water returned to the irrigation system. We plan to combine this sample taking with taking samples also from the non-DATS farm. We also collaborate with Vattre in modelling the flow of water through the Kathari system and the irrigation system on the farm and improving data collection on amounts of different water lots flowing through the system.

	Farmers motivations
	The two farmers differ somewhat in how eager and conscientious regarding data provision. The DATS farmer has very well managed production factors databases, is a pioneer type person in participating in projects and trying new things, and sincerely wants to see what the outcomes of his using the two DATs are. He and his son see clear benefits in participating in QuantiFarm. The non-DATS farmer who represents the current standard of growing tomatoes sees less value in providing data and is also much busier with his time schedules, as he also has agriculture. He is much more careful and contemplative in his decision making and represents a farmer who wants to see the benefits of DATs tried by other farmers before making decisions about them for his farm. This is actually very good for QuantiFarm. He has decided to postpone acquiring water disinfection devices as long as possible and during this time he follows Vattre and QuantiFarm to see how different systems work in other farms. So, the TCL can rely on **not** becoming a DATS farmer in this respect during QuantiFarm! He contemplates a lot on what kind of luminaires to acquire as he must renew his luminaires rather soon. Now he has opted for a hybrid system (a combination of high-pressure sodium lamps and led lights as inter lights). This is also good for QuantiFarm so the comparison of dimmable led lights on TC21-2 and a hybrid system on TC21-2 can continue. The consult from whom Luke buys services for data collection and verification has been a greenhouse farmer himself and he has discussed the above issues quite a lot with the non-DATS farmer. This is one way of supporting the non-DATS farmer and increasing his motivation to provide data and continue in the project. With the consult we also plan to sit down with the 1st round's data with both farmers, so they begin to" see" into each other's production factors and their costs. This hopefully will increase the motivation of both farmers to continue providing data. We will adjust the auxiliary tables for data collection during the 2nd round to tailor-make them for the two farmers' situations. This will hopefully reduce the time of data collection and improve precision, so we do not have to return to the farmers to ask for more or missing details. This should also add to the motivation of the two farmers to participate in the project.
	Recommendations
	Please state clearly somewhere in the KPI table (unless this information is already hiding in there) whether costs must be given with or without VAT. We have now assumed they must be given as VAT 0 %, but still a verification would be good to have. Please instruct in the KPI table directly how to change the variable codes in cases where new rows are added to include new variables in the KPI table. We were not sure whether the code names of the major variables must remain the same as in the

	original table. We are afraid our decision causes confusion to those using the data and we are willing to work further on coding the new variables – just ask, please. **To handle exceptional cases**, like the one associated with expensive electricity in Finland in the fall/winter 2022-23, which greatly influenced farmers' decisions making concerning how long to continue cropping tomatoes. This a situation had strong connections with one of the DATs associated with the use of electricity. We now provided explanations in the Notes of the KPI table. However, are they enough? A somewhat messy situation in terms of transforming the data into information and knowledge but very important in terms of comparing the influence of DATs. **Maybe the solution is to discuss such situations with people who will eventually use the data for further calculations**? **The data now collected would also enable calculations of carbon footprints for the two greenhouse farms. Such a variable is not included in the KPI table of TC21.** It could be included, though, and would be interesting. It would require some additional data from the farmers or the supply chain partners but would be doable. And would result also, with time, to better understanding how DATs could improve carbon footprint and to encourage the farmers and other members of the supply chain to use the index in describing sustainability of production.

5.22. TC22: Cleaning robot for poultry in Atlantic region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: FLOX - TC22
DATS: NetFLOX
Agricultural Sector and Crop: Livestock - Broiler chickens
Biogeographical Region: UK, Atlantic</td></tr>
<tr><td rowspan="9">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 0,5 € / animal</td></tr>
<tr><td>Economical</td><td>Chicken productivity</td><td>+1%</td></tr>
<tr><td rowspan="6">Environmental</td><td>Water consumption</td><td>-3%</td></tr>
<tr><td>Electricity consumption</td><td>-89%</td></tr>
<tr><td>Fuel consumption</td><td>+98%</td></tr>
<tr><td>Fuel GHG emissions</td><td>+97%</td></tr>
<tr><td>Mortality rate</td><td>+19%</td></tr>
<tr><td>Mortality rate at birth</td><td>-25%</td></tr>
<tr><td>Social</td><td>Working time</td><td>-0,03%</td></tr>
<tr><td rowspan="3">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">Some indicators are not relevant for broiler production and/or not relevant for the difference between DATS and non-DATS.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="4">DATS use of NetFLOX reduced callouts because sheds could be remotely monitored if other systems like alarms etc were alerting to an issue (but not what the issue was or how it affected birds). Mortality is higher in DATS sheds right now, but this should be due to chance, and the DATS sheds are new and being managed by a new farmer which may create more variability.</td></tr>
<tr><td rowspan="5">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">No feedback.</td></tr>
<tr><td colspan="3">Training</td></tr>
<tr><td colspan="3">No feedback.</td></tr>
<tr><td colspan="3">Test Case Operability</td></tr>
<tr><td colspan="4">No real feedback</td></tr>
<tr><td></td><td colspan="3">Best practices</td></tr>
</table>

Lessons Learned	Tailoring the DATS setup to each farm's unique layout and operational workflow proved crucial for functionality. Providing training and continuous support for farm staff created efficient use of the system and helped with farmer buy-in (especially staff who are not farm owners or partners). A key learning was that farmer was using NetFLOX right after waking up and identifying which sheds to walk first (can mean the shed with the issues can be walked up to 1.5 hours earlier (each walk is 30 minutes, a stockman manages ~4 sheds, so 3x1/2 hour = 1.5 hours.
	Farmers motivations
	Data collection itself is okay, considering that some indicators are confidential and that some assumptions are taken. Farmers wonder what is happening with their data, e.g. what will be the results/conclusions of the data collection.
	Recommendations
	TCL recommends using units that farmers are familiar with, a lot of the units are very non-standard for poultry (e.g. hours worked per kg of bird produced). Farm staff prioritised their time/effort, so any system that can directly impact this will get more use. Demonstrating tangible benefits in productivity to the farm owners was key to adoption.

5.23. TC23: Feeding robot/ Heat detector/ Calving detectors for cows in continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Idele – TC23
DATS: Feeding robot, heat detection system, calving detection system
Agricultural Sector and Crop: Beef Cattle
Biogeographical Region: Western France (Atlantic biogeographical region)</td></tr>
<tr><td rowspan="11">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 602 € /100 kg live weight</td></tr>
<tr><td rowspan="2">Economical</td><td>Labour productivity</td><td>+38%</td></tr>
<tr><td>Meat productivity</td><td>-16%</td></tr>
<tr><td rowspan="8">Environmental</td><td>Water consumption</td><td>-99%</td></tr>
<tr><td>Electricity consumption</td><td>-29%</td></tr>
<tr><td>Fuel consumption</td><td>-35%</td></tr>
<tr><td>Gas consumption</td><td>+17%</td></tr>
<tr><td>Average daily gain</td><td>+12%</td></tr>
<tr><td>Ammonia emission</td><td>-31%</td></tr>
<tr><td>Mortality rate</td><td>+9%</td></tr>
<tr><td>Mortality rate at birth</td><td>+1%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The content of the assessment framework was ok and already discussed previously to gather the data so there was no real surprise. The data was not collected by Idele but by an adviser from agricultural chamber who is in contact with the farmers. Most of the data required were available except the labour time needed to take care of the animals (monitoring, feeding, reproduction,). The working time assessment was the trickiest to collect.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">There was no real challenge to compare the 2 farms. The main challenge was to find 2 similar farms in the same area. It is hard to find extremely comparable farms.</td></tr>
<tr><td></td><td colspan="3">Calendar</td></tr>
</table>

Common Conclusions	The calendar was ok. The delay was mostly caused by the time needed to find 2 similar and comparable farms (same production, size, farm system, etc.) in the same area.
	Training
	Maybe by using a real test case or using the data already gathered to better assess what is useful or not, what need to be improved, etc. It would be more relevant than theory.
	Test Case Operability
	TCL considers there was good support with the training and with the data collection tools. But there might be need to finetune the process at the end of this first data collection process if anything is missing.
Lessons Learned	**Best practices**
	The best practice was to use farms already involved in an existing network and therefore the data from the farms were more easily available. Using a field adviser who know the farmers. That make the contact easier.
	Farmers motivations
	They accepted to participate and signed a consent. However, now the relevance is still a bit unclear, but it will improve with the farm visits and the first results.
	Recommendations
	One recommendation would be to be careful not to give too many things at the same time to gather. For instance, the templates to gather the technical data, which require to contact the advisers, who will contact the farmers, go on the farm to take some time to collect the data, etc. And a few weeks later there was the social questionnaire which require to start again. It is important to be careful and optimize to time asked to advisors' work.

5.24. TC24: Automated monitoring for pigs in continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: KUL TC24
DATS: Pig counting camera (Farm 3), automated feeding/feed intake measurements (Farm 1)
Agricultural Sector and Crop: Pig Farming
Biogeographical Region: Continental, Belgium</td></tr>
<tr><td rowspan="8">Main results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 23 315 € (at company level)</td></tr>
<tr><td rowspan="2">Economical</td><td>Pigs’ productivity</td><td>-42%</td></tr>
<tr><td>Labour productivity</td><td>-36%</td></tr>
<tr><td rowspan="4">Environmental</td><td>Water consumption</td><td>-78%</td></tr>
<tr><td>Electricity consumption</td><td>-24%</td></tr>
<tr><td>Fuel consumption</td><td>+335%</td></tr>
<tr><td>Fuel GHG emissions</td><td>+650%</td></tr>
<tr><td>Social</td><td>Working time</td><td>-10%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The farmer of DATS farm 1 feared some English text remaining after translation. The contact was not always easy. Difficult to spend time on the project, busy farmer. Non-DATS farm 2 easily provided the data for the Assessment Framework. The farmer of DATS farm 3 was very eager to help with the project. However, he overcomplicated the matter resulting in a long time to provide all information. The farmers in general indicate that it is not always clear for which animals they need to fill out data. Also, the suggested units are unclear, €/kg is not clear kg of what? Offer a fee/reward for the time farmers spend in gathering all the requested information.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">Form the pig farmers it is sometimes difficult to split costs according to life stage (piglets, sows, fattening pigs). The specific DATS is not always applicable for all life stages. Training cost/hours for DATs is not easy to recall for farmers.</td></tr>
<tr><td rowspan="3">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">Data collection started in early summer, during the summertime it was sometimes difficult to contact the farmers since this was typically a time of vacation.</td></tr>
<tr><td colspan="3">Training</td></tr>
</table>

	Training about what specific information on a pig farm is required would be useful. How to calculate certain costs? How to split cost over life stages?
	Test Case Operability
	It was difficult to know which channels were available (and where to find them) or to know what should be filled in where. Therefore, I just contacted Diogo Moniz in case I had questions.
Lessons Learned	**Best practices**
	Contact the farmers regularly to see how they are doing and if they have questions about the project.
	Farmers motivations
	Farmer 1 and Farmer 3 are eager to help with the project and to provide the requested information. Farmer 2 sees the project more as an additional burden taking up some of her time. An additional monetary incentive might be required to keep the farmers motivated. Also making the (preliminary) results of questionnaires or data collection available to the farmers would help them keep interest in the project.
	Recommendations
	I do not have further recommendations.

5.25. TC25: Feeding robot for cows in continental region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Idele – TC25
DATS: Feeding robot
Agricultural Sector and Crop: Dairy Cattle
Biogeographical Region: Western France (Atlantic biogeographical region)</td></tr>
<tr><td rowspan="7">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 306 € / 1000 L of milk</td></tr>
<tr><td rowspan="2">Economical</td><td>Milk productivity</td><td>-9%</td></tr>
<tr><td>Labour productivity</td><td>+73%</td></tr>
<tr><td rowspan="4">Environmental</td><td>Electricity consumption</td><td>+85%</td></tr>
<tr><td>Fuel consumption</td><td>-33%</td></tr>
<tr><td>Fuel GHG emissions</td><td>-33%</td></tr>
<tr><td>Mortality rate</td><td>+4%</td></tr>
<tr><td rowspan="3">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The content of the assessment framework was ok and already discussed previously to gather the data so there was no real surprise. The data was not collected by Idele but by two advisers from agricultural chamber who are in contact with the farmers. Most of the data required were available except the labour time needed to take care of the animals (monitoring, feeding, reproduction, etc.). The working time assessment was the trickiest to collect.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="4">There was no real challenge to compare the 2 farms. The main challenge was to find 2 similar farms in the same area. It is hard to find extremely comparable farms.

Be careful, the difference between the 2 farms is only the feeding robot (Both have heat detection systems so the comparison will only be on the robot).</td></tr>
<tr><td rowspan="3">Common Conclusions</td><td colspan="3">Calendar</td></tr>
<tr><td colspan="3">The delay was mostly caused by the time needed to find 2 similar and comparable farms (same production, size, farm system, etc.) in the same area. One of the advisers has been in sick leave for several weeks, which delayed the work to do.</td></tr>
<tr><td colspan="3">Training</td></tr>
</table>

	Maybe by using a real test case or using the data already gathered to better assess what is useful or not, what need to be improved, etc. It would be more relevant than theory.
	Test Case Operability
	TCL considers there was good support with the training and with the data collection tools. But there might be need to finetune the process at the end of this first data collection process if anything is missing.
Lessons Learned	**Best practices**
	The best practice was to use farms already involved in an existing network and therefore the data from the farms were more easily available. Using a field adviser who know the farmers. That make the contact easier.
	Farmers motivations
	They accepted to participate. However, now the relevance is still a bit unclear, but it will improve with the farm visits and the first results.
	Recommendations
	One recommendation would be to be careful not to give too many things at the same time to gather. For instance, the templates to gather the technical data, which require to contact the advisers, who will contact the farmers, go on the farm to take some time to collect the data, etc. And a few weeks later there was the social questionnaire which require to start again. It is important to be careful and optimize to time asked to advisors' work

5.26. TC26: Milking Robot for cows in Atlantic region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Teagasc, TC26
DATS: Milking robots
Agricultural Sector and Crop: Livestock - Dairy
Biogeographical Region: Atlantic</td></tr>
<tr><td rowspan="2">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 1866 € / animal</td></tr>
<tr><td>Environmental</td><td>Milk productivity</td><td>+197%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The data collection process was understandable although the boundaries set and explanations about ’current’ data were unclear for a time (see Calendar comments). The number of data collection points was perhaps higher than needed considering the volunteer involvement of farmers (see Calendar Comments).

The Assessment Framework was clear in its objectives. The majority of KPIs did relate to our TC farmers, naturally more applied to the farmer with the milking robot DATS than the farmer without.

Our non-DATS farmer indicated a preference for additional social KPIs to measure quality of life (a challenging indicator to measure with different frameworks appearing in the literature). For this farmer, having a smaller herd size increases their ’quality of life’. Perhaps there is room to consider inclusion of a few open-ended or Likert scaled questions about how farmers feel about their quality of life alongside existing KPIs. In comparison, our other TC farmer indicated investment in, and use of milking robots improved his ’quality of life’, reduced his off-farm labour input, and provided improved ’flexibility’. For him, this means more time can be spent doing other farm jobs and he has more time for family.

The addition of such indicators could be a way of developing a more robust measure of social KPIs. ’Quality of life’ factors can impact on-farm, family, and off-farm labour choices which impact other social KPIs like labour input. These types of factors have also been shown to impact DATS adoption decisions, day-to-day farm management practices, motivations/capacity to engage with others and with ever-changing requirements and climate challenges. Resilience literature, for example, shows these types of social factors, along with economic and environmental factors, impact farmer resilience.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">Because TCL received KPI data in October and this was the first year of data collection, there was insufficient time to compare data between our two farms (DATS and non-DATS) and within the farm with two DATS parcels. General farm</td></tr>
</table>

	data was provided by farmers during data collection moments one and two. From these data, TCL can see a potential challenge in direct comparisons because of the differences in herd sizes, parcel sizes, and variations in terms of farm management styles (ways of working; conventional, organic). However, there were some similarities noted at this early stage, gathered during TC visits and communication. Both farmers embraced other digital technologies, regardless of their classification as a DATS (milking robot) user or not. Both farmers use digital technologies such as milk recording from Kerry Business App, pasture management from PastureBase Ireland, and cow health management from HerdWatch. With year-on-year quantitative and qualitative data, a fuller comparison of the impacts of DATS/non-DATS usage should be possible.
Common Conclusions	**Calendar** The rationale for three data collection moments was understood although the benefits were unclear within this first iteration of data collection. Two data collection moments would have sufficed for our TC with descriptive data collected during an initial 'data collection moment'. The 'second data collection moment' would be better aligned with a quiet farming period in a new calendar year. Going forward, perhaps one, yearly data collection moment would suffice. For our TC, a complete picture of the yearly KPI data becomes available several months into the following year. For instance, 'current' National Farm Survey data pertains to 2022 year-end figures, calculated and available in the spring of 2023. Therefore, for the current Assessment Framework, our TC farmers provided year-end data from 2022. TCL aims to gather 2023 data at a suitable quiet farming period in 2024 and will update the Assessment Framework when appropriate. **Training** The 2nd Workshop on data collection training Lisa attended (25 May 2023) was supported by a brief one-on-one call with Francesco and a few emails for clarity which provided sufficient initial training. In October, Trevor and Lisa attended a brief Teams meeting with Francesco and Diogo which provided additional clarity about 'current data' definitions. The later meeting, from Lisa's perspective, was viewed positively by the group and was an efficient way for Teagasc TC leaders, who aren't WP leaders, to catch-up on some developments within and between WPs. A note is provided under 'Recommendations', below, in relation to potential for increasing 'peer-to-peer' exchange between TC leaders and partners across QuantiFarm. **Test Case Operability** To date, TCL has not used monitoring and evaluation tools beyond the Assessment Framework spreadsheet. Communication channels for trouble-shooting and decision-making support were available from WP2 and WP4 partners. These communication channels were positive and supportive. One-to-one communications were professional and group reminders from Diogo about approaching data collection moments were appropriate in number and content.

Lessons Learned	**Best practices**
	Empathetic, respectful engagement with TC farmers continues to be a 'best practice'. Clear, concise, and timely information was provided to farmers. Taking a 'light touch' approach whereby TCL values information/data sharing but didn't overload farmers with emails, calls, or visits was another good practice. Lisa visited both TC farmers in person soon after joining the project in May. Face-to-face visits were opportunities to establish rapport and trust through listening and hands-on learning. These strategies appear to be working as both farmers remain involved. To date, TC farmers haven't complained about the number of interactions or what they are being asked to contribute. However, it will be important to remain attentive to communication signals.
	Farmers motivations
	'Motivation' is a big topic so answering this open-ended question is a challenge. While both TC farmers appeared motivated to participate because of their continued engagement, it is unclear what their level of motivation is and how they would categorise their types of motivations.
	Recommendations
	Refer to comments made under Common Conclusions/Calendar. In sum, for our TC and based on NFS experiences, data is best collected during times aligned with quieter farming periods. Year-end data for one year isn't typically available until the spring of the following calendar year. However, TCL realises this may not align with other sectors/biogeographical regions. The Assessment Framework asks for numerical data for the three domains. Alongside numerical data, and while project questions are fresh in a farmer's mind, perhaps there are opportunities to ask some qualitative questions. These qualitative questions might relate to TC farmer experiences with investing in and using DATs or reasons (economic, social, environmental) for not choosing the TC DATS at this time. TCL realises some quality-of-life questions appear in the recently released 'Social Indicators Questionnaire' for 30 Nov 2023. Reference comments made in the Outcomes/Assessment Framework section. Like the recently established WP4 Q&A sessions for Fridays in November, perhaps there is potential for peer-to-peer learning to take place between TC leaders and project partners across WPs. For example, in the context of another Horizon Europe project currently undertaking a similar data collection task (COREnet), fortnightly 'clinics' are held where data collectors in all partners can join if they wish to ask questions, compare notes, troubleshoot challenges, etc. Teagasc as a COREnet WP Leader organises and leads these 'clinics'. Issues raised and information exchanged at the clinics assists valuably with the task of identifying similarities and differences between cases (for eventual write-up); assists with meeting deadlines; and assists enhancement of data collection processes/templates where necessary. TCL would like to suggest that the WP leader considers such an approach, particularly in early and late stages of data collection when partners are most active and in need of support.

5.27. TC27: Automated monitoring for cows in Continental region

No information was provided.

5.28. TC28: Livestock management for cows in Steppe region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: ANAMOB, TC 28
DATS: Animal tracking systems, Automatic feeding systems, Automatic milking systems
Agricultural Sector and Crop: Livestock - Diary
Biogeographical Region: Steppe / Southeast Romania</td></tr>
<tr><td rowspan="8">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 209 € / animal</td></tr>
<tr><td rowspan="2">Economical</td><td>Cow productivity</td><td>-42%</td></tr>
<tr><td>Labour productivity</td><td>-36%</td></tr>
<tr><td rowspan="4">Environmental</td><td>Water consumption</td><td>-78%</td></tr>
<tr><td>Electricity consumption</td><td>-24%</td></tr>
<tr><td>Fuel consumption</td><td>+335%</td></tr>
<tr><td>Fuel GHG emissions</td><td>+650%</td></tr>
<tr><td>Social</td><td>Working time</td><td>-10%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The data collection process was carefully tailored to fit the needs of our test case in cattle growing. TCL believes that the Assessment Framework was designed to be clear and comprehensive, providing a well-rounded view of the business performance metrics. TCL did identify only minor adjustments needed to better suit the specific characteristics of our test case. Moving forward, TCL recommends the farmer keep an eye on the Assessment Framework and have quarterly reviews of the indicators, in parallel with his usual KPIs. On the other hand, regular training sessions and cross-check of the indicators with sector benchmarks could also improve the process. These steps will ensure smoother and more accurate data collection in future assessments.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">Given that the business utilizes DATS, the non-DATS scenario is not applicable in our specific context. However, it's worth noting that in a broader scenario where both DATS and non-DATS areas coexist, challenges might include disparities in data accessibility, standardization, and integration between the two types of operations. Additionally, ensuring consistent data quality and accuracy across different systems and practices could pose challenges when comparing DATS and non-DATS areas. It's important to highlight that during the initial assessment period, the cow monitoring system experienced a temporary malfunction. As a result, the entire operational process had to rely on manual recordings, which had some impact on business performance. We anticipate that this issue will be</td></tr>
</table>

	resolved in the upcoming assessment, once the cow monitoring system at Fraher's farm is fully operational.
Common Conclusions	**Calendar**
	The data collection took place in October 2023, marking the conclusion of the third quarter. The timing of the data collection process posed no significant challenges, as TCL utilized information spanning the last four quarters to provide an annualized view of business performance. Generally, the patterns observed in the last quarter of each year remained consistent, which will give the comfort of comparability of periods.
	Training
	TCL prepared training sessions to help farmers better understand our analysis framework. TCL assessed these sessions and saw they were increasingly effective in collecting data for the report. They became more engaged and showed a clearer understanding of the framework's requirements. Practical examples and hands-on exercises were particularly helpful. For the future, TCL suggest making the training sessions even more interactive, providing extra resources, and tailoring sessions to address specific challenges. These changes aim to make our reports more effective, giving farmers the knowledge and skills, they need for better interaction with our analysis framework.
	Test Case Operability
	The monitoring and evaluation tool is instrumental in assessing our cattle business. It helps tracking important performance indicators accurately. While the provided tool is helpful, TCL feels that reporting frequency is too rare to allow real-time data analysis to make immediate decisions. For communication, TCL relied on regular physical and online meetings, emails, and access to the project site with additional information. These channels facilitated discussions and issue resolution. In the future, TCL planS to make the interactive reporting of actual data in our toolkit more interactive. This will ensure that everyone involved in the project has access to timely information for better decision-making.
Lessons Learned	**Best practices**
	One of the key best practices that contributed to the success of our Test Case up to the present moment was the thorough planning and tailored implementation of the Assessment Framework. This ensured that data collection was aligned with the specific characteristics of our TC, resulting in accurate and relevant insights. Additionally, regular, and open communication with the farmer played a crucial role. This allowed for a deeper understanding of their needs and concerns, fostering a collaborative approach to problem-solving. Furthermore, the provision of ongoing training and support sessions proved instrumental in equipping farmers with the necessary knowledge and skills to effectively engage with the QuantiFarm tools and resources. Lastly, the integration of real-time reporting features in our toolkit would be a valuable enhancement for immediate decision- making. Overall,

	these best practices have contributed significantly to the success of our Test Case and will continue to guide our approach in future assessments.
	Farmers motivations
	The farmer looks motivated by the practical benefit of QuantiFarm project. He appreciates the tools and resources provided for better decision-making. To further boost motivation, ongoing engagement and training sessions could be organized to ensure he continues to see the value in using QuantiFarm for his business. In addition, it would be beneficial to offer complimentary invitations to events that are relevant and interesting to the farmer and other stakeholders. This would enable them to engage in discussions with fellow farm managers and gain valuable insights from top-tier industry experiences.
	Recommendations
	Improving the processes of data collection, monitoring, reporting, and verification is essential for the continued success of our Test Case. To enhance these processes, TCL has identified several recommendations: a) Increasing the frequency of data collection. This will enable farmers to have more timely insights and make informed decisions. b) Integrate real- time reporting features into our toolkit to enable immediate updates, analysis, and decision-making. This will provide stakeholders with up-to-date information for more effective monitoring. c) Further customize the Assessment Framework for reports, allowing stakeholders to focus on specific metrics or indicators that are most relevant to their operations. This can enhance the comprehensiveness of our assessment. d) Incorporate visual representations of data to make it more accessible and easier to interpret. e) Consider implementing an independent validation process based on industry benchmarks to ensure the accuracy and reliability of collected data. This can help build trust in the assessment results. f) Actively seek feedback from farmers and stakeholders on the data collection process. Their insights can provide valuable context and improve the quality of qualitative data. g) Implement a structured feedback mechanism where stakeholders can provide input on the data collection process and suggest improvements. By implementing these recommendations, the effectiveness of our data collection, monitoring, reporting, and verification processes should be increased.

5.29. TC29: Automated monitoring for bees in boreal region

<table>
<tr><th colspan="2">Test Case Evaluation Report</th></tr>
<tr><td colspan="2">Partner Name and TC number: TC29
DATS: Beehive monitoring system
Agricultural Sector and Crop: Apiculture
Biogeographical Region: Lithuania, Boreal</td></tr>
<tr><td rowspan="4">Outcomes</td><td>Assessment Framework</td></tr>
<tr><td>The data collection process was established after DATS presentation to farmer and installation in his farm.
The first session was initiated by sending xlsx tables and asking to fill and provide the information. It was difficult to get fully filled tables.
The second session was established during the phone call.
The third session was established by asking specific questions by email which were related to the data collection table.</td></tr>
<tr><td>Comparison between DATS use and non-DATS use</td></tr>
<tr><td>In our TC29, both DATS and non-DATS users are farmers from the same beekeeping farm. TCL attempted to compare various beehive parcels using both DATS and non-DATS data. However, comparing different farms across regions may yield data unrelated to the presence of DATS or non-DATS.</td></tr>
<tr><td rowspan="6">Common Conclusions</td><td>Calendar</td></tr>
<tr><td>The data collection moments were suitable, because the season for beekeeping is from May to end of September.</td></tr>
<tr><td>Training</td></tr>
<tr><td>Basic training about how to login and see data after installation. Farmer no need to do any additional task.</td></tr>
<tr><td>Test Case Operability</td></tr>
<tr><td>TCL sees that DATS (beehive monitoring system) mostly could affect labour productivity data.</td></tr>
<tr><td rowspan="2">Lessons Learned</td><td>Best practices</td></tr>
<tr><td>Data collection goes better via phone calls and/or via emails but not by filling the provided table.
Farmers motivations</td></tr>
</table>

	It is hard to explain farmer why they should be involved for free and share their private data for project purpose. They want to see clear benefits for them. There is a risk to worsen relations with them if the project is too intrusive and they won't see a clear benefit.
	Recommendations
	So far, the process itself looks clear. But TCL needs to discuss what to do if farmer will not provide enough data. Maybe to do some additional simple questionnaire about how other farmer see if our DATS (or similar) could save some resources and try to collect answers.

5.30. TC30: Sensors for quality assessment for oyster in Mediterranean region

<table>
<tr><th colspan="4">Test Case Evaluation Report</th></tr>
<tr><td colspan="4">Partner Name and TC number: Benco Baltic d.o.o, TC30
DATS: FTIR-ATR-based oyster quality monitoring tool
Agricultural Sector and Crop: Aquaculture, Oysters
Biogeographical Region: Mediterranean, Croatia</td></tr>
<tr><td rowspan="4">Main Results</td><td>Cost benefit</td><td>Net benefit</td><td>+ 12 500 € (at company level)</td></tr>
<tr><td rowspan="2">Economical</td><td>Oyster productivity</td><td>+14%</td></tr>
<tr><td>Labour productivity</td><td>+20%</td></tr>
<tr><td>Environmental</td><td>Mortality rate</td><td>-0.1%</td></tr>
<tr><td rowspan="4">Outcomes</td><td colspan="3">Assessment Framework</td></tr>
<tr><td colspan="3">The data collection is performed via inquiries to the farmer. The farmer fills the assessment table and provides comments on the specific items. If needed a discussion follows.

However, the data-gathering process on the farm needs to be more cohesive and well-structured. Therefore, there is a challenge to collect intermediary data and the data assessment table can be efficiently filled only yearly.

It must be noted that there are data items that cannot be evaluated. Precisely, water and drug usage cannot be estimated since no water or drug usage is used.</td></tr>
<tr><td colspan="3">Comparison between DATS use and non-DATS use</td></tr>
<tr><td colspan="3">The same oyster farm provides the data on the DATS and non-DATS usage. The farm is spread out in a vast area (located on both banks of the Krka River estuary) and has multiple parcels where oysters are grown.

The DATS and non-DATS parcels are in different regions of the farm and, therefore, different environmental conditions of the specific farms can be estimated.

The data collection is, as already mentioned performed and aggregated to provide a yearly summary. The same parameters are estimated for the DATS and non-DATS parcels.</td></tr>
<tr><td></td><td colspan="3">Calendar</td></tr>
</table>

Common Conclusions	The intermediary data collection is almost impossible since it creates difficulties for the farmer. The farmer is willing to provide yearly aggregated data.
	Training
	Currently, minimal training is carried out, and more emphasis is given to the manual of the DATS usage. Training sessions would not facilitate the data collection.
	Test Case Operability
	The DATS provides an insight into the current state of quality of the oysters. The quality is a changing parameter even within the yearly season and the growing stage of oysters. Having a tool to estimate the quality of grown oysters periodically can provide farmers with information on the state of the produce and infer the required actions.
Lessons Learned	**Best practices**
	Farmers are busy, and all additional work creates a burden for them. Therefore, to keep them interested and cooperative, it is best to relay questions and tasks only when there is a real need and to get most of the needed information at one time.
	Farmers motivations
	The farmer is relatively motivated. They are eager to use the DATS and provide the assessment of DATS and non-DATS usage. However, as mentioned this already creates additional tasks for the farmer. Since the farmer is doing the work on its good it should be kept in mind that the farmer should not be pressed to do many tasks or information often.
	Recommendations
	If the yearly data collection for the assessment of DATS were sufficient, this would reduce the farmer's burden, and he would be much more willing to participate and communicate. TCL has received comments from the farmer that the assessment table still includes items that, upon discussion with the farmer, were omitted from the table as irrelevant. Therefore, the farmer was annoyed to comment on these sections that they were irrelevant.

6 Discussion on outcomes, common conclusions, and lessons learned from the first annual cycle of testing

Each of the 30 TCs in QuantiFarm is unique in several ways. The TCs operate in different countries with different DATSs on different crops. Meaning there are not a lot of agronomical conditions overlap. The versions of the list of indicators developed under the scope of the AF are embedded in the same three pillars of sustainability analysis – economical, environmental, and social –, and in the cost-benefit analysis but are also TC specific. This means the detail description of the quantitative analysis of results from the TC's indicators template is off the scope of this deliverable but are discussed in D2.2.

"The data collection process was carefully tailored to fit the needs of our test case in wheat cropping as part of raw vegetal farming business."

It is however possible to ask feedback from TCLs about the main outcomes of their own TC focusing on the relatability of the AF to their TC, and about some level of the empirical knowledge gathered from farmers, sometimes more than one, about the comparison between DATS use and non-DATS use. This feedback is significantly TC specific because it depends on several factors like local climacteric phenomenon, local policies, rotational crops, the farmer decisions on taking specific action (e.g., when to spray, amount of fertilizer, etc.). For these reasons, WP4 refers to the Evaluation Reports of each TC in section 5 for further detail.

"One farmer did little spraying resulting in crop damage."

6.1. High-level results for TCs

Table 6 outlines the 30 TCs with the respective net benefit resulting from using DATS under real conditions and analysed by the QuantiFarm Assessment Framework. The majority of the TCs present a positive net benefit with a wide dispersion of the net benefit value.

Nonetheless, there are five TCs presenting net loss (negative net-benefit values). Although the detailed discussion of these results is made individually in D2.2, along with the economic, environmental, and social indicators, the contextualization in section 5 enables a deeper and wider understanding of these values. For example, TC6 explains that the rotational crop system in this farm is the main responsible for the net loss result in this first testing cycle since the crop under analysis (wheat) is not a cash crop and typically has low financial returns. The following testing cycles in TC6 will use potato and sugar beet that should bring the net benefit to positive values. Another case presenting net loss is TC9, where TCL and farmer found the estimation of some indicators challenging. Namely, the time dedicated to each task and fuel consumption. Blueberry production in TC14 registered significantly net loss results, these may be outliers given the challenges in farm relatability in TC14 (blueberries). This TC need deeper reflection to produce more realistic outputs. TC15 also faced several challenges regarding the precision of estimated data. Energy cost estimations and irrigation dependent on boreholes are significantly difficult to estimate. Additionally, there were some challenges about the parcel relatability. So, in this case the TCL suggested using a benchmarking tool to compare the TC's results with the country's averages in this sector.

The data provided by TC12, TC27, and TC29 was not enough to produce a significant quantitative analysis. TC12 did not register different agronomical practices between DATS use and non-DATS use. TC27 faced several challenges in internal communication falling to submit the Evaluation Report in

time to include in this deliverable. TC29 reported low level of farm data and most data reported came from literature making it irrelevant to calculate the net benefit registered.

Sector	TC	Crop / Animal	DATS Net Benefit (or Net Loss)
Arable	1 Neuropublic	Potatoes	+ 3 816 € / ha
	2 Agromais	Corn	+ 917 € / ha
	3 ITACyl	Wheat	+ 151 € / ha
	4 Augmenta	Cotton	+ 148 € / ha
	5 Horta	Wheat	+ 306 € / ha
	6 Delphy	Wheat, onion, potato	- 37 € / ha
	7 FFP2	Potatoes	+ 140 € / ha
	8 AgroSmart	Wheat	- 1 € / ha
	9 KGZS	Barley, Corn, Wheat	- 23 € / ha
	10 ANAMOB	Wheat	+ 427 € / ha
Fruit	11 Neuropublic	Olives	+ 3 467 € / ha
	12 Delphy	Apples	-
	13 Horta	Grapes	+ 683 € / ha
	14 Terra	Blueberry, Strawberry	- 53 285 € / ha + 59 047 € / ha
	15 Filagro	Olives	- 1 062 € / ha
	16 Delphy	Apples	+ 5 934 € / ha
	17 ANAMOB	Grapes	+ 4 402 € / ha
	20 Anysol	Bananas	+ 20 570 € / ha
Vegetables	18 Horta	Tomatoes	+ 3 172 € / ha
	19 Delphy	Tomatoes	+ 36 793 € / ha
	21 LUKE	Tomatoes	+ 680 023 € / ha / 6 months
Meat	22 FLOX	Poultry	+ 0,5 € / animal
	23 IDELE	Cows	+ 602 € / 100 kg live weight
	24 KU Leuven	Pigs	+ 23 315 € (at company level)
Dairy	25 IDELE	Cows	+ 306 € / 1000 L of milk
	26 Teagasc	Cows	+ 1 866 € / animal
	27 KU Leuven	Cows	-
	28 ANAMOB	Cows	+ 209 € / animal
Apiculture	29 ART21	Bees	-
Aquaculture	30 Benco	Oyster	+ 12 500 € (at company level)

Table 6 - Summarization of the net benefit results.

On the other hand, according to the Assessment Framework analysis, twenty-four TCs reported a positive net benefit value for using DATSs. These values also require proper contextualization.

It is also worth noticing the significantly high net benefit values for TC14, TC19, and TC24. The second crop of TC14 (strawberries) presented a highly positive value and, most likely, may be linked with the same reasons regarding the farms' relatability between the use and non-use of DATS. TCL from TC19 mentions that the Assessment Framework indicators are not fully tuned with greenhouse activities. This feedback is also aligned with the results from TC21. This means WP4 and WP2 must meet with Delphy and LUKE to understand how the indicators selection may be finetuned to improve the Assessment Framework for the following testing cycle.

Finally, TC24 also reflects a high net benefit for its DATS. This could be related with the challenge in finding pig farms with similar conditions that use DATS and that do not use DATS. Usually, there is a significant different on the *modus operandi* in both this farms which may difficult the analysis. Nonetheless, more information to contextualize the results will be asked to the TCL.

6.2. Calendar

Regarding the calendar most TCLs agree that it is well designed, within the current frames of the project, referring to the last moment to collect data in October. But some TCLs already know they will need more time because of growing season constraints. The consortium has reflected on this topic upon the 4th project meeting held between 12th and 13th December 2023 and one repeated comment received was the confidence that the next two reporting periods will be more aligned with the plan because of the experience gather in first year between TCLs and farmers. In fact, 44% of the inquiries mentioned feeling significantly confident that they will be able to submit at least two full indicators sets (economic, environmental, or social) before October 31st next year. The rest of enquires mentioned they might struggle or that they really do not know. This analysis shows that TCLs really hope to have data on time, but some are worried that unforeseen events like climate conditions or farmer involvement, may delay data submission. This is behind the reason why it is quite important to have more time between the data submission and the presentation of the overall analysis.

"Some of the data was only available at the end of November."

After careful deliberation of the challenged faced (and detailed in section 4.1), the General Assembly of the project was deemed it necessary to request a 3-month extension of the project duration. This extension would allow for timely data submission by TCLs, data verification by WP2/WP4, clarification of data at the TC level if necessary, analysis by WP2, feedback on analysis provided by TCLs contextualizing results using WP4's evaluation report, and the final drafting of deliverables containing all relevant information and results.

6.3. Training

The feedback on the overall training provided was considered suitable, by most TCLs, to learn how to use the monitoring reporting and evaluation tools, and to learn the procedure to complete the data collection template (list of indicators). However, it was also mentioned that the training on how to complete the template can only help so far, as to most questions arise upon going to the farm and discussing it directly with the farmer. Some suggestions were made in the sense of improving farmers' engagement. The DIA activities, staring in next year (2024) will significantly help TCLs in that regards. Nonetheless, farmers' engagement will be one of the agenda points of the reflection workshop to held in February 2024. There were also suggestions in line with creating a case study to serve as practical learning for both advisors and farmers. Finally, and in line to what was mentioned before, some TCLs mentioned they would like to meet with WP2 and 4 right before submitting data to ask questions directly and perform a first pre-verification of the template*.

*On October 31st, 2023, an email was sent to all TCLs expressing the availability to meet every Friday morning, until the de facto data submission, for a Q&A session. But only three TCLs opted to meet.

6.4. Farmers' motivations

The overall farmers' current motivations in QuantiFarm were also accessed by TCLs and on a scale from 0 to 4 the score was set at 3.2 and is represented in Figure 6. This score is subjectively made by

the classification of each testimony given in the TCs' Evaluation Report. The TCs with less motivated farmers reported that the data collection process was tedious and somewhat invades their business privacy and mentioned that some of them are not aware of the main outcomes of the project's analysis. This means there is an opportunity to fairly improve the communication with farmers about the main concepts and outcomes of QuantiFarm through communication materials and training TCLs if necessary. On the other hand, farmers that feel more motivated reported they are eager to learn more about their DATS and insight on the comparison between digitalize agriculture and non-digitalized. Some TCLs have reserved a some of their budget, as foreseen in the application stage, to compensate farmers for their work and data. Also, the project results and Toolkit are of great interest to help and support decision-making.

"How do you keep a grower involved in this project?"

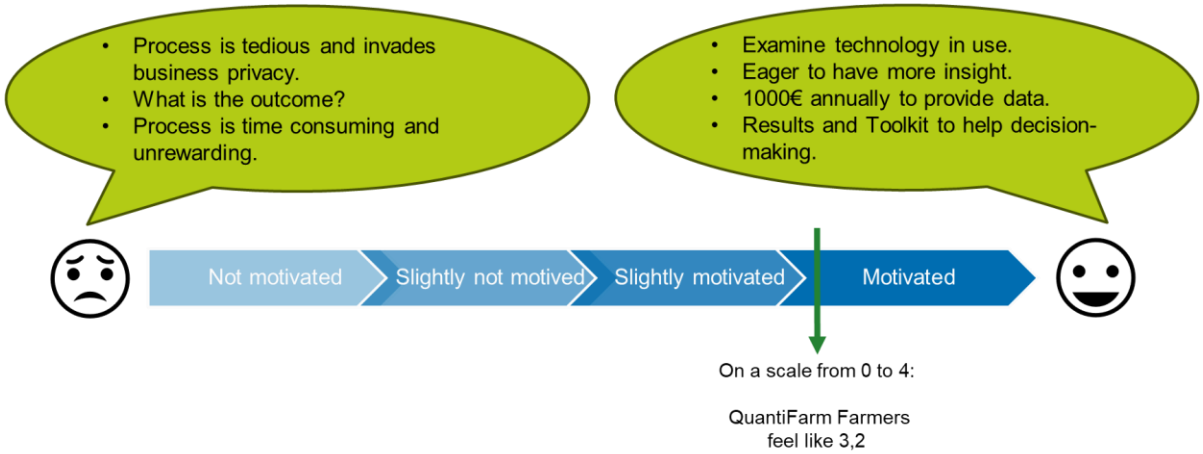

Figure 6 - Diagram of the subjective quantification of farmers motivation that work in the TCs.

"Our farmers are motivated, because we installed the tracking systems, and provided the app that they can use to see the data from tracking system."

6.5. Recommendations

As described in section 5, the final part of the Evaluation Report asks TCLs leave recommendations based on their first-year experience managing their TC. As expected, some of the feedback is quite TC specific, but there are also general recommendations that can be highlighted in this section, like the wish to meet WP2 and 4 leaders before submitting the first version of the completed list of indicators to make a pre-verification and to do a Q&A. It was also frequently mentioned that it is important to further contextualize the results in the list of indicators. This contextualization could be done by describing events or circumstances that made the farmer choose a particular line of action, or it could be supported by further empirical measurements to be added to the list of indicators.

"Handle exceptional cases, like the one associated with expensive electricity in Finland in the fall/winter 2022-23."

Another common recommendation made is to consolidate the results gathered was related with having a quantitative reference. Different benchmarks were suggested, either common from industry or type of crop.

"Consider implementing an independent validation process based on industry benchmarks to ensure the accuracy and reliability of collected data."

This first reporting period was significantly demanding for farmers, TCLs, and WPs. It was the first time all partners went through the process that was commonly designed, but in the end, the project made it across. The consortium gathered important information and quantitative data to assess the real impact of DATS in commercial farms. Digitalization is constantly evolving and the rapid speed at which it does leaves the project facing the serious risk of losing site of the desired positive impact that DATSs have. To help make sense of it all, QuantiFarm aims to have a strong quantitative and qualitative assessment of a significantly spread of types of digital technologies and applications. The monitorization and reporting activities here described are instrumental to improve our methodology and guarantee that all involved partners and stakeholders are synchronized to achieve the project's ambitions.

7 Conclusions and next steps

The first year of testing in QuantiFarm (2023) met initial expectations, handled as meticulously as possible, and concluded with a significant level of success. This level of success is based on the data collection from 30 TCs, the analytical results presented for 29 TCs, the evaluation reporting of 29 TCs, and the detailed record of activities during the first testing cycle. The project faced many challenges along this cycle, but the relevant partners of the consortium worked together constantly to co-design solutions to overcome those problems. There are identified points of action to implement improvements in our methodology for the next two testing cycles (2024 and 2025) at both TC level and WP level. The TC specific points of action are identified in section 5. Some of the main points of action at WP level are:

- Prepare the workshop with TCLs and prepare the reflection on the quantitative results.
- Discuss, at project level, the calendar adjustment necessary to enable a comprehensible TCL evaluation of quantitative results to include in the next deliverables.
- Draft an updated version of the Evaluation Report to include a section to comment on the analytical results collected during the following testing cycles.
- Include in the reflection the qualitative results of the analysis and promote the social indicators relevance in the assessment.

It is also important to mention that these results are an interesting prove of concept that it is possible to quantify, in a meaningful way, the cost benefit relation of using DATS in agriculture. There is not yet enough room for broader conclusions about a certain sector or a certain DATS since this would require a pronounce statistical relevance that cannot be achieved with 30 TCs as sample. However, the methodologies implemented that are discussed here, along with the analytical results provided, lay the foundations for an ever detailed and valid analysis of the use of DATSs in agriculture in Europe.

8 Annexes

Annex A - Example of completed Checklist.

No	Requirements	Check Box
1	All technological farmers have been identified, contacted, and agreed to participate in QuantiFarm project.	TRUE
2	All technological farmers understand the need to share the data requested by the Assessment Framework to take part on QuantiFarm.	TRUE
3	To compare DATS use vs non-DATS use, different farms (or at least different parcels within the same farm) are identified and selected.	TRUE
4	Non-technological farmers have been identified.	TRUE
5	Non-technological farmers are willing to talk to the partners responsible for the Behavioural Engagement in WP1, and share their testimony.	TRUE
6	Strategy for contacting non-technological farmers to later contribute with testimony for the project.	TRUE
7	Farms are located within the borders of the biogeographical region assigned.	TRUE
8	Farmers are aware of the 3 year long duration of the project.	TRUE
9	Farmers are aware of the type of data they will share for the duration of the project.	TRUE
10	The Assessment Framework is clear, and it applies to the TC.	TRUE
11	The TC monitoring tools are available, as well as the online general issue report tool.	TRUE
12	All changes to the TC (crop, DATS, farmer/ farms, or any other) have been reported to WP4 Leader CONSULAI	TRUE
13	There has been no change regarding the TC crop since last report.	TRUE
14	There has been no change regarding the TC DATS since last report.	TRUE
15	There has been no change regarding the farmers participating in the TC since last report.	TRUE

Table 7 - Example of completed Checklist.

Annex B - Example of the Issue reporting tool.

Type of issue	Please provide details on the issue you wish to report	Possible solution
Organizational		
Communication / Reporting		
Assessment Framework	Upon the feedback from the TCL on the Assessment Framework KPIs, it become clear the end-users selected (tech adopter vs	A new set of end-users were selected and the new feedback on the AF was validated by WP2. The

Type of issue	Please provide details on the issue you wish to report	Possible solution
	non-adopter) were not suitable for data comparison.	TC will still focus on precision irrigation for the same crops but will not include root pruning technology.
Quantitative data collection	For blueberry farm we've compared different levels of digital technology application in which both farms have some kind of DATs. One parcel has analogue control of pH values in irrigation and fertilization system and meteorological stations.	
Qualitative data collection		
Farmer		
Farm	For the strawberry farm without DATs, the producer faced complete destruction of his greenhouse construction because of storm and therefore it is questionable his involvement in future production of this fruit.	We collected data from him but now we are (again) looking for alternative solution
Crop		
DATS		
Biogeographical Region		
Any other		

Table 8 - Example of the Issue reporting tool.

Annex C - Klaxoon board to store Q&A during data collection training.

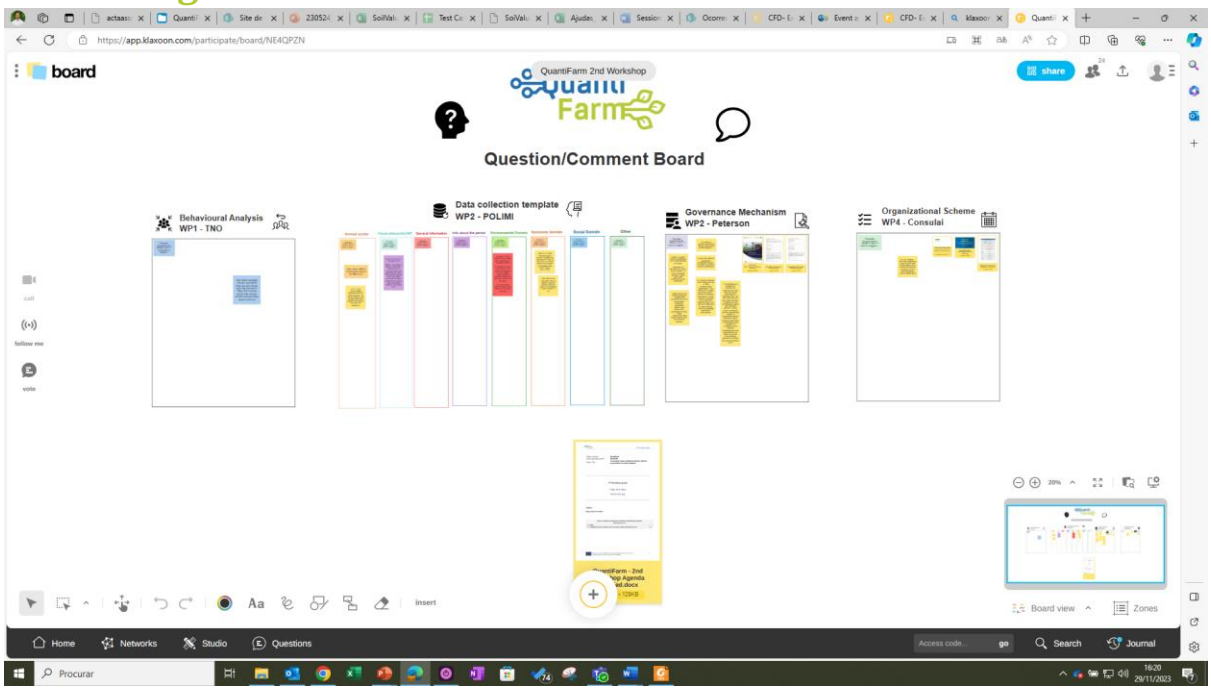

Figure 7 - Klaxoon board to store Q&A during data collection training.

Annex D - Agenda of the data collection training session. QuantiFarm 2nd Workshop.

Time	Thursday 25/05
13:45-14:00 (15 minutes)	**Testing connectivity: All partners must log in and verify the link & sound to avoid technical problems**
14:00-14:10 (10 minutes)	**Welcome – Introduction (GAIA and CONSULAI)** • Welcome - setting up • Log in to Klaxoon.
14:10-14:40 (30 minutes)	**WP1 Behaviour Innovation and Stakeholder Engagement (TNO)** • Presentation on the preliminary results on the behaviour analysis based on the work done up until now. • Q&A
14:40-15:10 (30 minutes)	**WP2 Governance Mechanism (Peterson)** • Presentation on the Governance Mechanism procedures, rolls, responsibilities, forms, and deadlines. • Q&A
15:10-15:20 (10 minutes)	**Break**
15:20-15:50 (30 minutes)	**WP2 Assessment Framework (Polimi)** • Training session on how to use the data collection template
15:50-16:30 (40 minutes)	**WP2 Assessment Framework (Polimi)** • Q&A session on the data collection template usage
16:30-17:00 (30 minutes)	**WP4 Testing and Assessment of DATs: Organizational Scheme (CONSULAI)** • Calendar for data collection • Evaluation Report • Closing statements

Table 9 - Agenda of the data collection training session. QuantiFarm 2nd Workshop.

Annex E - List of participants of the data collection training session. QuantiFarm 2nd Workshop.

Name and surname	Organization name
André Rodrigues	Agromais
Linas	AgroSmart
Mihaela Cutica	ANAMOB

Viorel Marin	ANAMOB
Adina Cristea	ANAMOB
Kęstutis	Art21
Vlasis Maggidis	Augmenta
Nick Georgiadis	Augmenta
Martynas Velička | Benco Baltic	BENCO
Diogo Moniz	CONSULAI
Hemel, M.D. van den (Max)	Delphy
Kiers, J.R. (Jan)	Delphy
Os, C. van (Christian)	Delphy
Alina Menżyńska	FFP2
Savvas	Filagro
Imtiaz Shams	FLOX
Nikos Marianos	GAIA
Valentina Manstretta	HORTA
Guy Zoe	IDELE
Allain Clement	IDELE
Vanessa Paredes Gómez	ITACyL
Lara Resman	KGZS
Jens Slootmans	KU Leuven
Vänninen Irene	LUKE
Pesonen Liisa	LUKE
Marianna Gkavrou	Neuropublic
Nikolaos Kalatzis	Neuropublic
Sarah Yates	Peterson
Francesco Parigi	POLIMI
Sandra Cesari De Maria	POLIMI
Chiara Corbo	POLIMI
Maria Pavesi	POLIMI
Lisa Parce Teagasc	TEAGASC
Aine MackenWalsh	TEAGASC
Nikola Kopilović	Terra
Weerdt, C.A. (Caroline) van der	TNO
Brewster, C.A.W. (Christopher)	TNO

Table 10 - List of participants of the data collection training session. QuantiFarm 2nd Workshop.

Annex F - Instructions for TCLs and WPLs to log in NextCloud server to submit and consult data according to user access restrictions.

From this moment onward we will ask you to store the data in Nextcloud. To do that, Nikos has kindly prepared a **procedure to enable your access to Nextcloud**.

1. Please visit https://kydbox.neuropublic.gr. And check the **file attached** with your provisional credentials to create a new password.
2. Please insert only your registered email and then will click on **"Forgot Password"**. (See red boxes in image)

3. The user will receive an email with a link that will redirect her/him/it in a page where they can set a new password using the provisional credentials.
4. The user will login with the new password.

Figure 8 - Instructions for TCLs and WPLs to log in NextCloud server to submit and consult data according to user access restrictions.

Annex G – Email template upon each data collection moment

The following text is an example of the email sent to TCLs with instructions about the data collection and submission procedures. This email was sent before the arrival of the 3rd and final moment of data collection.

Dear Test Case Leaders,

I hope you are well.

The time is approaching for our **3rd and final moment of data collection** in the present year 2023, the due date has been **set to October 31st**.

Some of you have mention in passing that your TC will have to adjust to the date above for operational reasons. To centralize this information in a single document, **I kindly ask you, if that is your case, that you reply to this email with a brief statement on the reasons behind the delay and the earliest availability of all the indicators in your template for the present year**.

Just like the previous data collection moments, and after you've successfully access Nextcloud (see the email below for clarification), please follow the procedure.

Step-by-step:

0. (Optional, but recommended) Go to your google drive folder containing your **feedback** on the data collection template and check your replies concerning the KPIs and the calendar availability of the data.
1. Please go to your TC designated google drive folder containing your **template** and download your data collection template.

2. Complete the template with the earliest available data considering the template must be completely filled-out by October 31st.
3. Save and name the data ready document as follows (replacing the missing information in bolt): "QuantiFarm_Assessment_Framework_TC**X**_FARM**X**_**OrganizationName**".
4. Open the excel file attached to this email and check your credentials to log in NextCloud.
5. Log in and upload the document in your designated TC folder.
6. Fill proud and enjoy this well-deserved sense of accomplishment 😃

On another topic, we are also approaching the date for the **submission of the Evaluation Report (November 3rd).** Brief recommendations and notes:

- This report is aimed at TC Leaders and your experience. But please feel free to gather input from the farmers when relevant.
- Keep it simple, keep it real. We are not expecting big dissertations on the report, but all the relevant outcomes, lessons learned, and recommendations are important so that all of us may improve our work.
- Please submit this report on your folder in NextCloud with the name "QuantiFarm_EvaluationR1_TC**X**_**OrganizationName**".
- These reports will feed deliverable D4.2 - Test Case evaluation report for reporting period 1, to be submitted in December 2023.

Thank you all in advance!

I remain one email away from assisting you in what I can.

Annex H - TCs ability to meet the last data submission date.

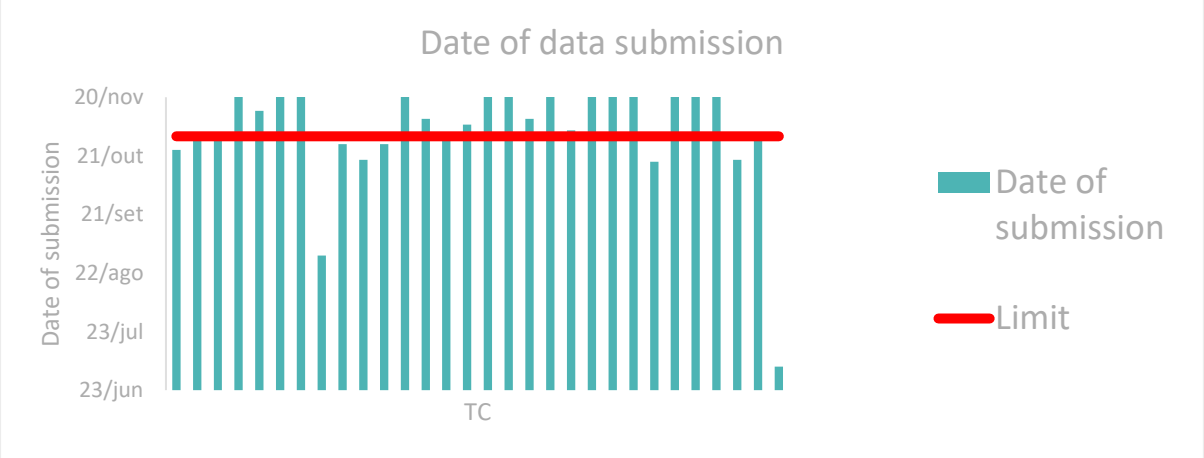

Figure 9 - TCs ability to meet the last data submission date.

Annex I - Number of TCs submitting data on time and delayed.

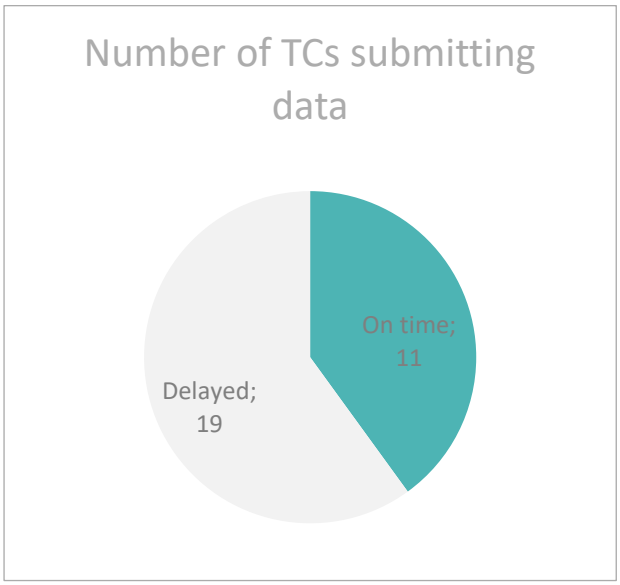

Figure 10 - Number of TCs submitting data on time and delayed.

Annex J - Number of TCs that submitted data on time and the first review process outcome.

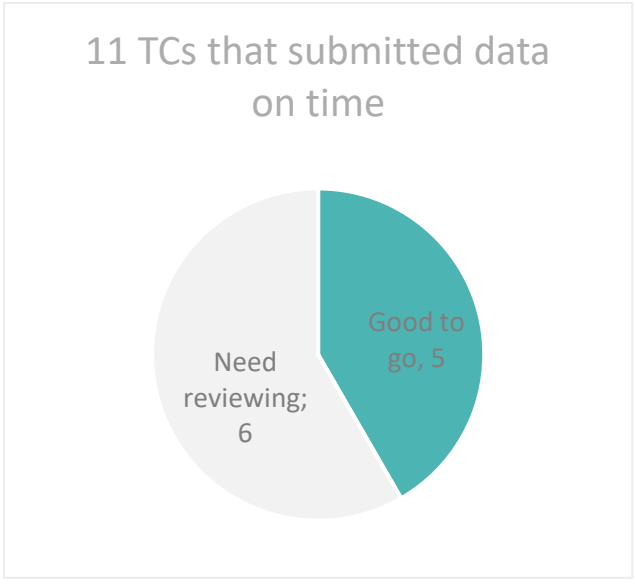

Figure 11 - Number of TCs that submitted data on time and the first review process outcome.

Annex K - Inquiry made to TCLs during the 4th annual meeting between 12th and 13th December 2023.

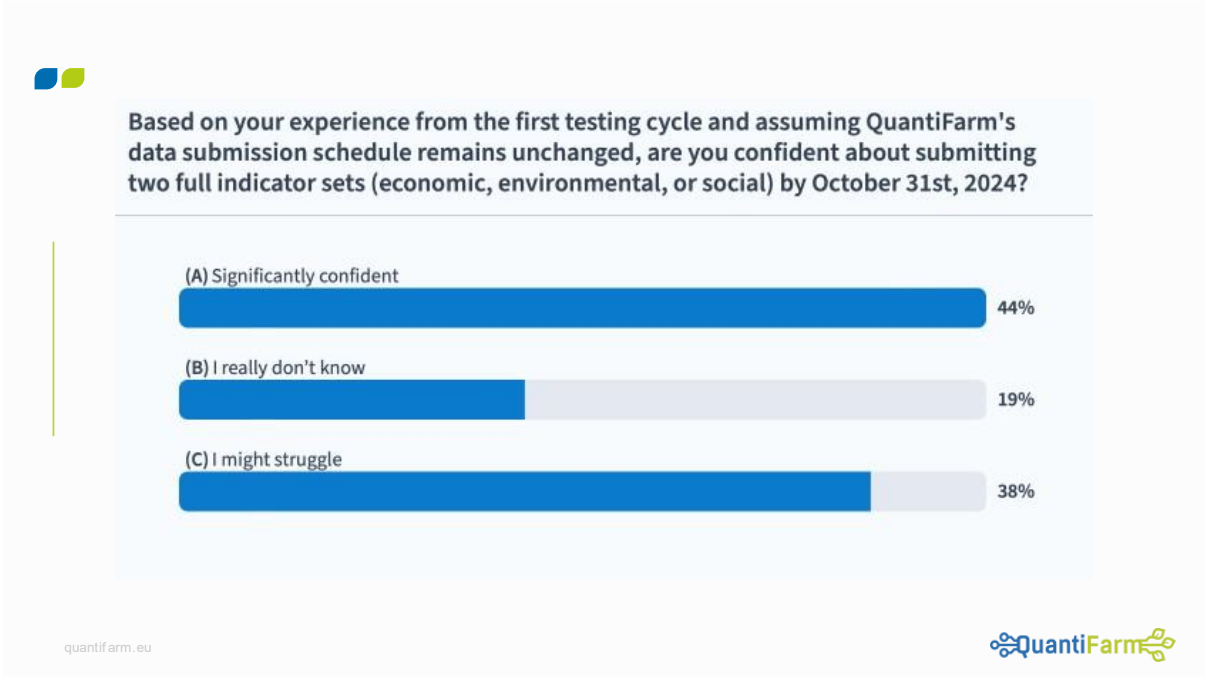

Figure 12 - Inquiry made during the 4th annual meeting between 12th and 13th December 2023.

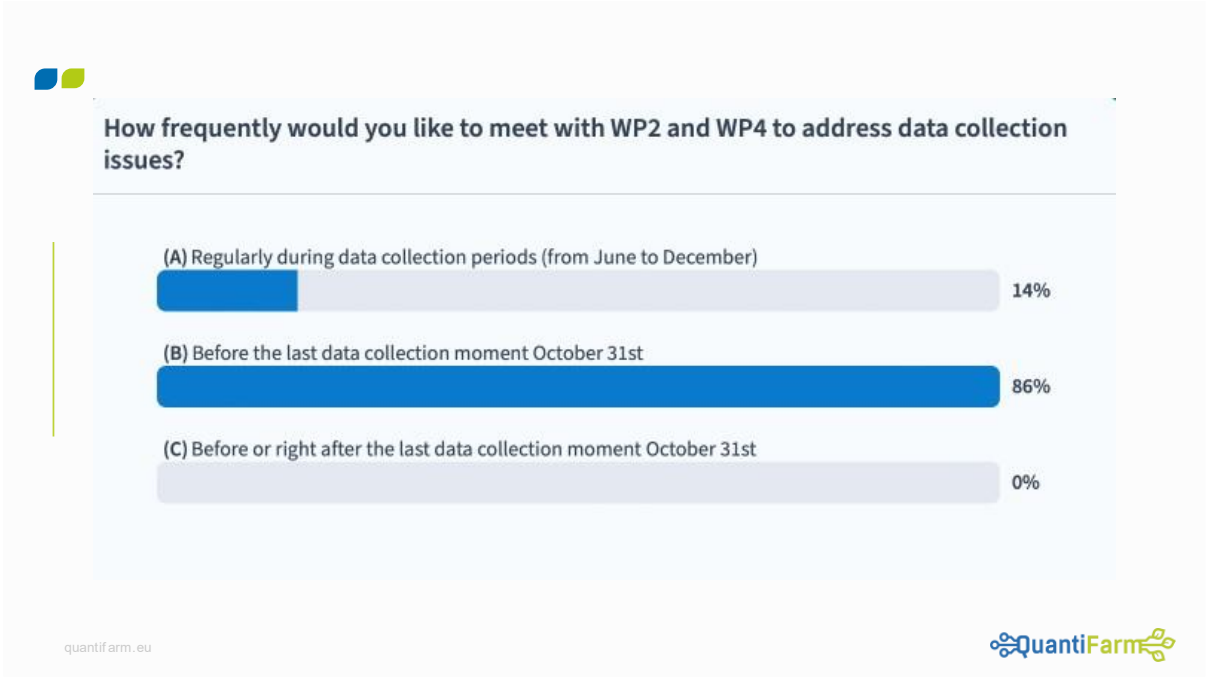

Figure 13 – TCLs' response on how frequently they would like to meet with WP2 and 4 apart from the regular monitoring.

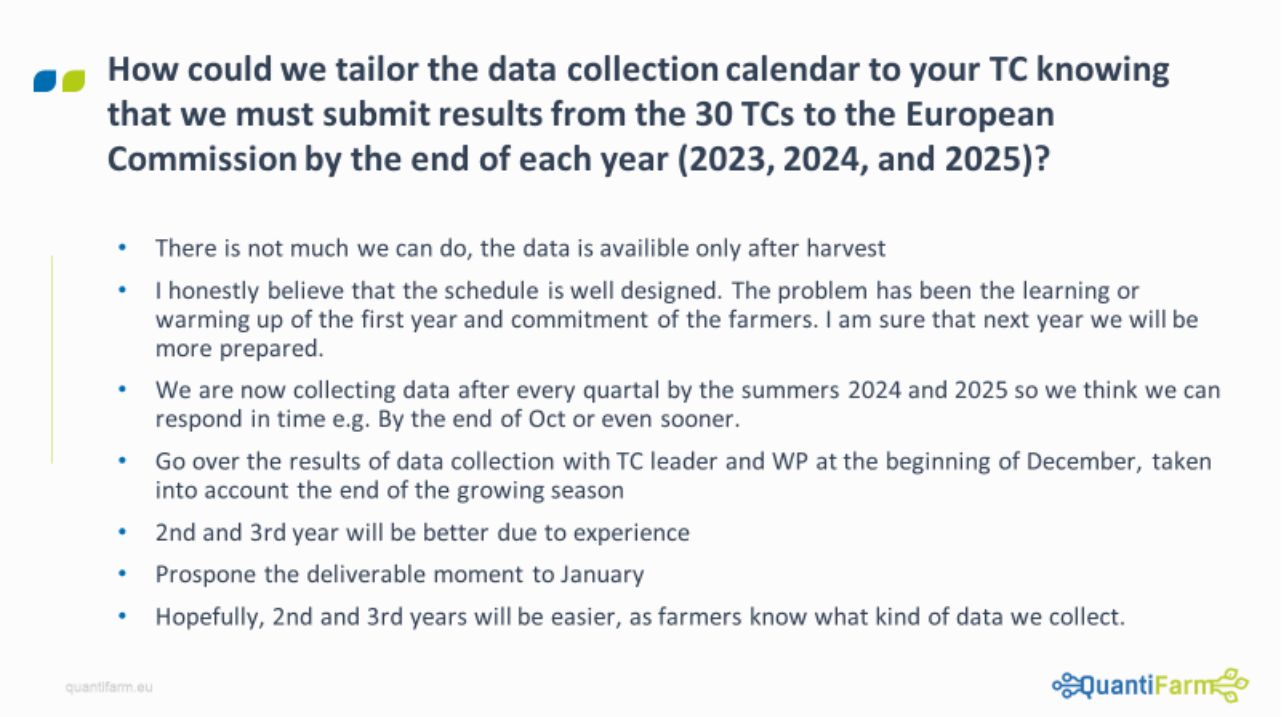

Figure 14 – TCLs' feedback on tailor made options for governing their TC.

Annex L – Meeting minutes template

Meeting Between:			
Date of Meeting:		**Time:**	
Minutes Prepared By:		**Platform:**	
Facilitator:		**No. of attendees**	
1. Meeting Objective			
2. Attendance at Meeting			
3. Preparation (documents/handouts to bring, reading material, etc.)			
Description			**Prepared by**
4. Agenda and Notes, Decisions, Issues			
Topic: <<<first one>>.			
Text of the topic…. Identification			
Topic: <<<second one>>			

Text of the topic…. Identification
6. Next Meeting