D3.6. QuantiFarm Toolkit – initial version

quantifarm.eu

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Abstract:	This deliverable describes the technical specifications and the implementations of the QuantiFarm Toolkit. The Toolkit is available for use as a web-based dashboard (https://quantifarmtoolkit.eu/) and offers controlled access to various functionalities elaborating on the assessment of Digital Agricultural Technology Solutions (DATS). Each user type (farmer, advisor, policy maker) has different type of access to the dashboard with dedicated visualisation tools, and an option to create a user profile associated with parameters such as crop types, DATS of interest, geophysical region, etc. which can be used to influence the outcomes provided by the various tools. The toolkit currently provides access to 5 tools entitled: "DATS Recommendation-tool", "DATS Cost benefit calculator", "Farming activities benchmarking tool", "DATS advanced decision support", and the "Policy monitoring". The toolkit also visualise assessment outcomes for the DATS that are evaluated in the context of QuantiFarm Test Cases. Finally, this deliverable should be considered as a complementary document along with the QuantiFarm Toolkit source-code available in code repository: https://gitlab.com/QuantiFarm/uiproto.

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List of Abbreviations and Acronyms	
API	Application Programming Interface
AKIS	Agriculture Knowledge and Innovation Systems
CAP	Common Agricultural Policy
DATS	Digital Agriculture Technology Solution
DB	Database
DIH	Digital Innovation Hub
DMP	Data Management Plan
EDIH	European Digital Innovation Hubs
EIP-AGRI	European Innovation Partnership for Agricultural productivity and Sustainability
EC	European Commission
EO	Earth Observation
EU	European Union
EUPL	European Union Public Licence
FMIS	Farm Management Information System
GDPR	General Data Protection Regulation
ICT	Information and Communications Technology
IPR	Intellectual Property Rights
JRC	Joint Research Centre
QA	Quality Assurance
QC	Quality Control
RDF	Resource Description Framework
TC	Test Case
USGS	United States Geological Survey
VRA	Variable Rate Application
WP	Work Package

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1. Introduction

1.1. Project Summary

The QuantiFarm project focuses on supporting the further development of Digital Agriculture Technology Solutions (DATS) in order to improve the sustainability (economic, environmental and social) and competitiveness of the EU's agricultural sector. To this end, QuantiFarm develops a comprehensive Assessment Framework for independent qualitative and quantitative assessments of the costs and benefits of digital agriculture technologies. The project will support the uptake of digital technologies by providing innovative tools and services and will provide practical recommendations of relevance and practical utility to farmers, advisors, and policy makers across Europe. QuantiFarm is building its assessment and recommendation tools using data derived from 30 Test Cases (TCs) which span over 20 countries in 10 Biogeographical regions across Europe, thereby capturing multiple social, environmental, and economic parameters. More than 100 farms of different types, sizes, ownership and operating conditions, have committed to participate in the project, both directly and through cooperatives and large umbrella organisations. In addition, the QuantiFarm Digital Innovation Academy will provide capacity building capabilities for advisors and other Agriculture Knowledge and Innovation Systems (AKIS) actors, by providing data on the various types of digital technologies available, their costs, benefits and impact on sustainability. QuantiFarm involves 32 partners, representing a variety of stakeholders, including 8 scientific organisations and 12 farmer representatives and consultants.

1.2. Document Scope

This deliverable describes the technical specifications and the implementations of the QuantiFarm Toolkit. The Toolkit is available for use as a web-based dashboard (https://quantifarmtoolkit.eu/) and offers controlled access to various functionalities with regards to DATS assessment. Each user type (farmer, advisor, policy maker) has different type of access to the dashboard with dedicated visualisation tools, and an opportunity to provide user profile properties (e.g. crop types of interest, DATS of interest, geophysical region) which can be used to influence the rankings of the advisory services. The toolkit currently provides access to 5 tools entitled: "DATS Recommendation-tool", "DATS Cost benefit calculator", "Farming activities benchmarking tool", "DATS advanced decision support", and the "Policy monitoring". The toolkit also provides assessment outcomes for selected DATS that are evaluated in the context of QuantiFarm test cases. This deliverable is mainly a short report that provides essential descriptions on the use of the actual Toolkit. The design specifications, utilisation scenarios and installation directions for the individual tools are available in "D3.3. Tools for DATs Assessment and Policy Monitoring – initial version". More technical details on the utilisation of the tools, including the source code and detailed technical specifications are available in QuantiFarm code repository: https://gitlab.com/QuantiFarm.

This is the first release of the "QuantiFarm Toolkit" where its core structure and overall user-experience to be offered have been finalised. In the following weeks extended user testing will be realised and the provided services will be further refined. The functionalities offered by the different tools are expected to be more sophisticated as the volumes of data handled by the QuantiFarm (back-end) platform are increasing. A major push is expected when the assessment of the various DATS in the context of QuantiFarm Test Cases is completed, and the respective outcomes will be made available for reuse by the QuantiFarm tools. All future updates to be realised will be bundled and documented in two major future releases on M30 and M42 of the QuantiFarm project.

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1.3. Document Structure

This report is structured as follows:

- **Chapter 1** provides a summary of the project, the document's scope and its overall structure.
- **Chapter 2** provides details on the implementation technologies of the QuantiFarm toolkit available as a web-based Dashboard. Screenshots and directions of use for each tool are provided in dedicated subsections.
- **Chapter 3** conclusions and next steps are provided.

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2. QuantiFarm Dashboard

2.1. Development Technologies

The QuantiFarm Toolkit is available for use through a web based and user-friendly Dashboard. The overall architecture follows an API gateway pattern which is a common architectural pattern in which an API gateway sits between the client and a collection of microservices. The API gateway acts as a single-entry point for clients to access the microservices, allowing clients to interact with the microservices as if they were a single service. The API gateway perform tasks such as authentication, rate limiting, and caching to improve the performance and security of the microservices. This pattern is often used in microservice-based architectures to help manage and route requests to the various microservices.

In the case of QuantiFarm Toolkit the microservices are the different tools that are specified in "D3.3. Tools for DATs Assessment and Policy Monitoring – initial version". The generic engines, tool services and user interface are together deployed on the QuantiFarm server located at the URL https://quantifarmtoolkit.eu. The code of the toolkit is available in a dedicated Gitlab code repository (https://gitlab.com/QuantiFarm/uiproto)

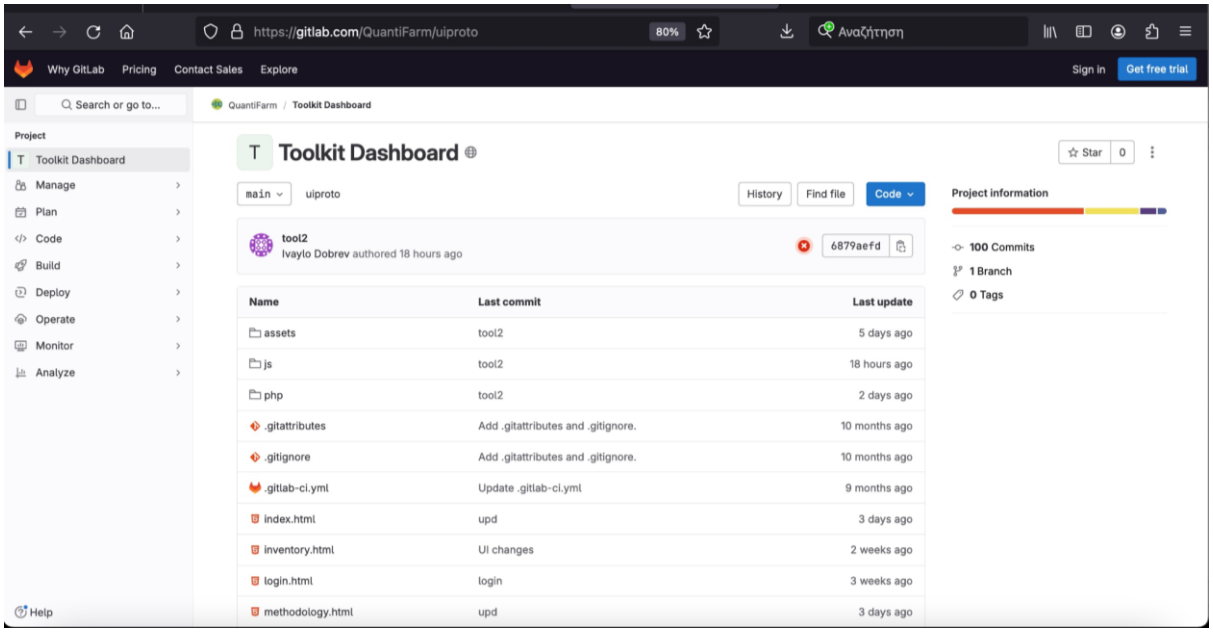

Figure 1 The code repository of the QuantiFarm Toolkit

2.1.1 Server technology

QuantiFarm server is a Virtual Private Server (VPS) hosted in a Tier 3+ datacenter, physically located in EU - Sofia, Bulgaria. VPS specifications: 6 vCPU, 12 GB RAM, 300 SSD. These specifications may be extended depending on the server workload. Operating system is Ubuntu, the web server is Apache HTTP Server and the containerization engine is Docker. It should be noted that all technologies (Ubuntu, Apache, Docker) are Open Source.

2.1.2 Development framework

The tools are developed as standalone applications deployed as Docker containers on the VPS. The Toolkit Dashboard is a web application developed with php, javascript and HTML5. The Dashboard communicates with the tools via a REST API.

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2.1.3 Security mechanisms

Two independent and complementary security mechanisms are implemented. User registration and login is required for the tools that process sensitive data. Registration requires minimum user data - name, email and password. User data is stored in a database on the server. User's passwords are encrypted. Second security mechanism is based on the architecture of the Quantifarm Toolkit. All tools and Toolkit Dashboard are deployed on the same VPS. Tools backend APIs are invoked internally from the Toolkit Dashboard backend and are not accessible to the public. Connection to the website is secured by SSL certificate. SSL certificates ensures the verification of the owner of a website and implements encryption on the web traffic with SSL/TLS, including the public key, the issuer of the certificate, and the associated subdomains.

2.2. QuantiFarm Dashboard structure

This section will present a brief overview of the QuantiFarm web-based dashboard. It should be noted that the Dashboard is designed to maintain dynamic content that will be refined and improved accordingly when additional results and functionalities are available. The objective of presenting the following screenshots and descriptions is to document the initial release of the toolkit. The most up-to-date version will always be available by visiting the actual Dashboard: https://quantifarmtoolkit.eu/

The Dashboard follows a responsive design and it is optimised for use from devices of different screen size.

2.2.1 Home page

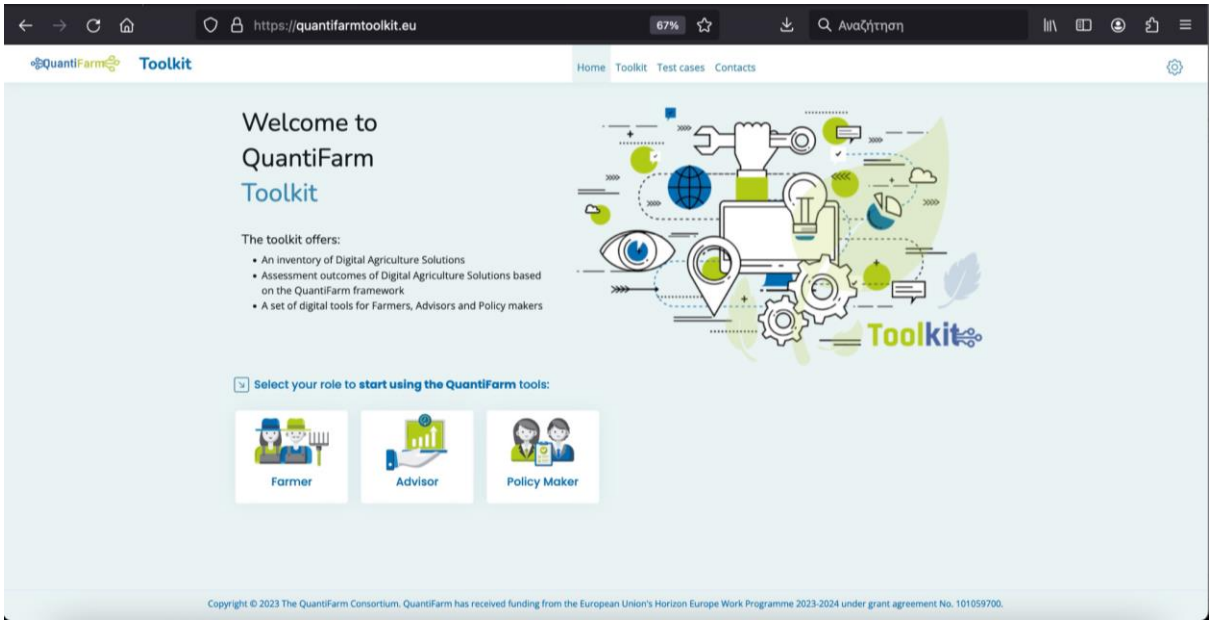

Figure 2. The landing page of QuantiFarm Toolkit

The QuantiFarm Dashboard maintains a horizontal menu bar with the following menu items: "Home", "Toolkit", "Test Cases", "Contact" (see figure 2). The landing page provides a welcome note and generic information on how to use the various services.

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2.2.2 QuantiFarm toolkit

By selecting the "Toolkit" menu item the user can view all the available tools, each accompanied by a brief description, and can select one of them for use.

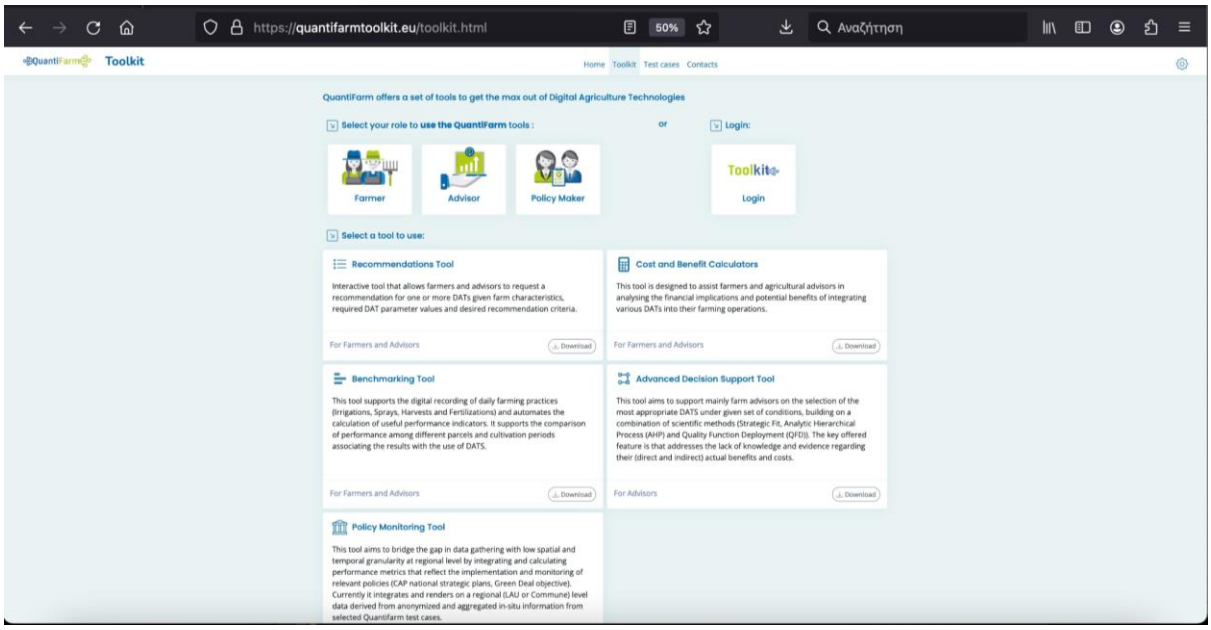

Figure 3. The "QuantiFarm" Toolkit page

For each tool a "Download" link redirects the user to the respective code development repository pages:

- https://gitlab.com/QuantiFarm/benchmarking-tool
- https://gitlab.com/QuantiFarm/recommendation-tool
- https://gitlab.com/QuantiFarm/cost-benefit-calculator
- https://gitlab.com/QuantiFarm/policymonitoring-tool
- https://gitlab.com/QuantiFarm/advanced-decision-support-for-dat-selection-tool

At the code repository's page directions for download and installing the backend services are provided.

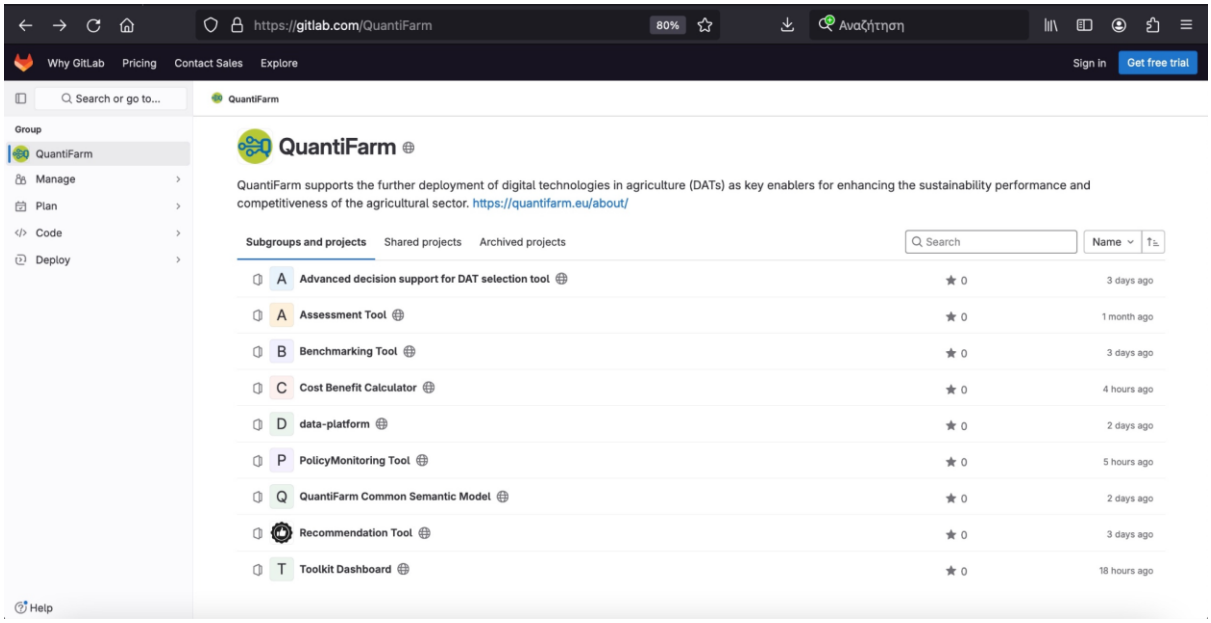

Figure 4. The QuantiFarm Tools available for download and reuse.

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A detailed description on how to use each tool is available in Section 3.

2.2.3 QuantiFarm Test Cases page

The QuantiFarm dashboard also offers detailed descriptions and DATS assessment outcomes generated through the assessment process. The user can select from the main menu the respective option entitled "Test cases" and view the respective list of test cases in a table view. (Figure 5)

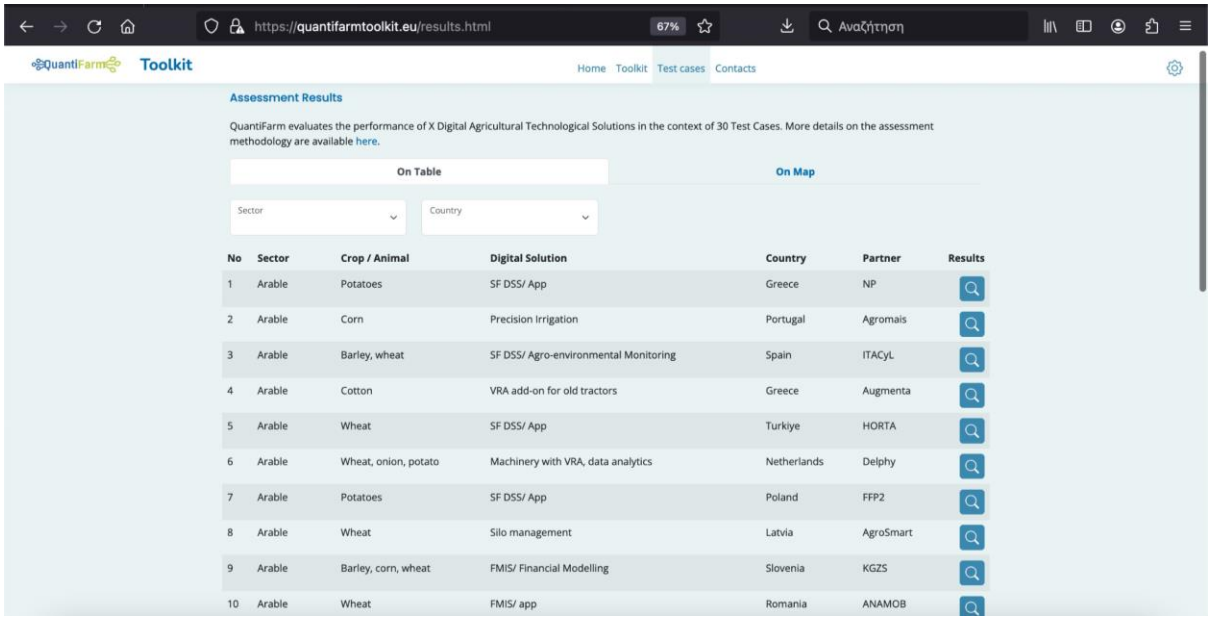

Figure 5. The full list of QuantiFarm's Test Cases

To make this process more intuitive the Test Cases outcomes are also available with the use of a map with pins indicating the country where the test cases was realised.

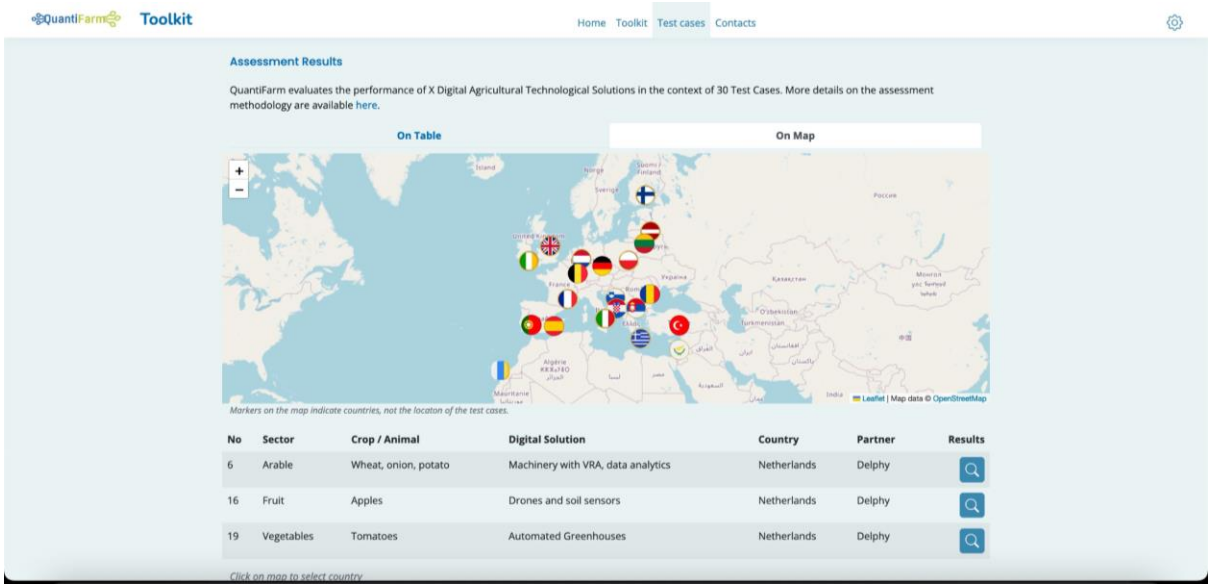

Figure 6. The QuantiFarm's Test Cases presented through a map.

The user can select to view the detailed outcomes from a specific test case (Figure 7).

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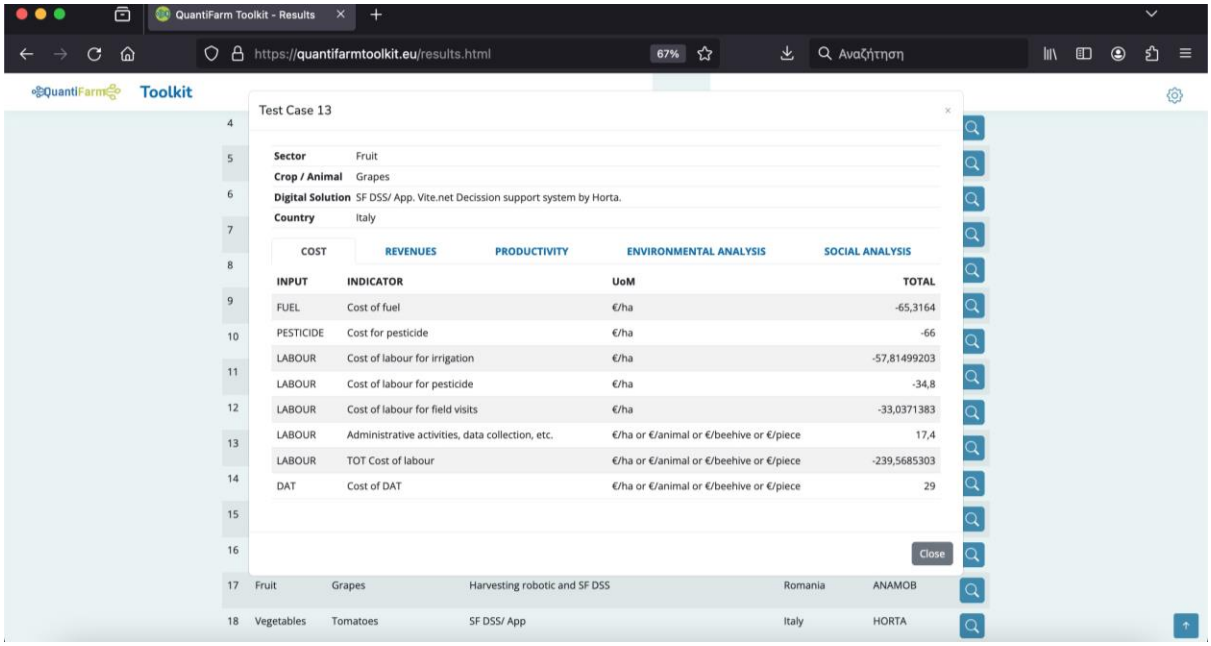

Figure 7. Example of DATS assessment outcomes for Test Case 13.

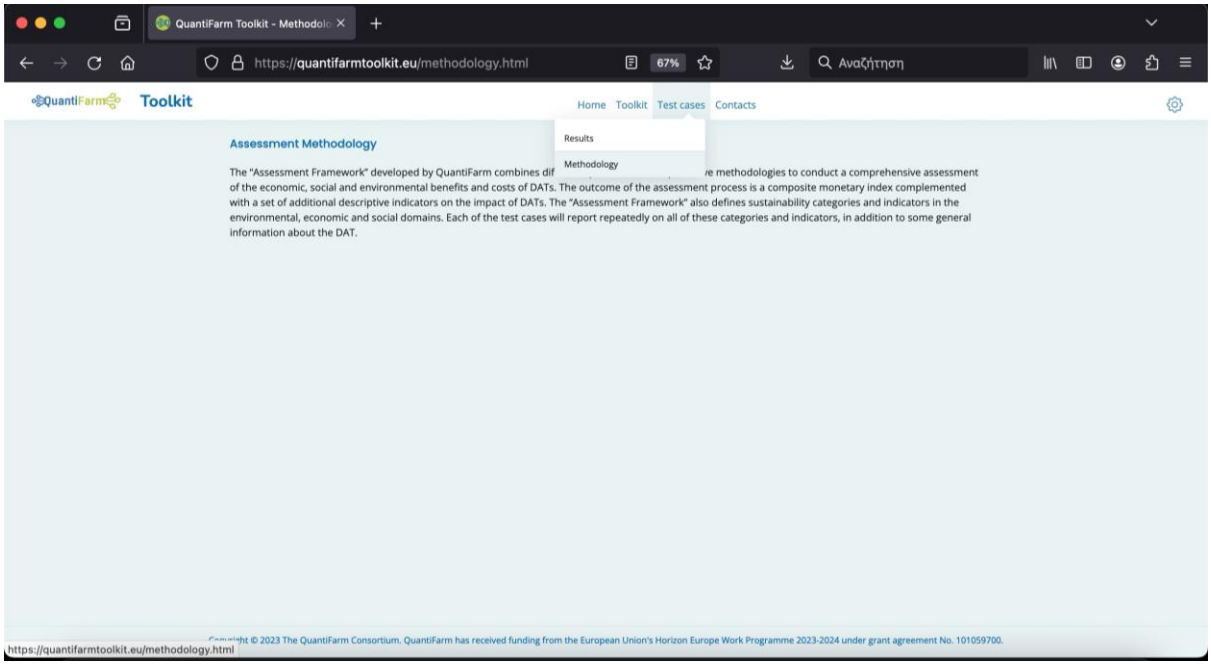

Figure 8. A short overview of QuantiFarm's DATS assessment methodology.

The "Test Cases" menu item also provides more information on the Assessment Framework and methodology utilised for extracting the respective results. The respective text will state that the DATs evaluation results presented refer to the context (parcel, year, cultivation type, etc.) of the assessment process that took place in the specific test cases. In addition, it will present more information and a process to be followed in case DAT providers (not part of the QuantiFarm consortium) would like to join and have their DAT evaluated according to the QuantiFarm assessment framework. These descriptions are under finalisation and will be uploaded the following days.

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3. QuantiFarm Toolkit

This section presents a high-level description of each QuantiFarm tool's functionality as well as directions of use.

3.1 Recommendation tool

3.1.1 Description

The first release of the Recommendation Tool that has been developed during 2023 is an interactive recommender tool that allows farmers and farm advisors to (1) search through a large set of available Digital Agricultural Technology Solutions (DATSs) using filters for available DATS parameters and (2) ask for a recommendation for one or more DATs that match specific characteristics of the farm and farmer. For each selected DATS, a list of parameters and their values is presented to show more details about the DATS. This includes the cost structure of using or purchasing a DAT and when available also the actual costs, e.g. initial investment costs and yearly maintenance costs.

3.1.2 Recommendation tool Dashboard/GUI

When a farmer or farm advisor is interested in which DATSs are available that might be of use to reach specific goals with the farm, he or she can use the QuantiFarm toolkit as a supportive means, available at: https://quantifarmtoolkit.eu.

One of the available tools in the "Toolkit" page is the "Recommendation Tool" that can either be selected directly or can be reached via the "Farmer role" button, after which the farmer will see a welcome page with a description of the tool. The "Results" tab can be used to do either a "Search DATSs" based on select filters for DAT parameters in the left-hand column or a "Recommend DATSs" using farm characteristics entered in the top-part. The remainder of the user interface is used to present the selected DATs and a short list of their parameters. When clicking on one of the DATSs a pop-up window will appear that shows a longer list of DATS parameters and their values. See Figure 9 for a screenshot of the main page of the recommendation tool.

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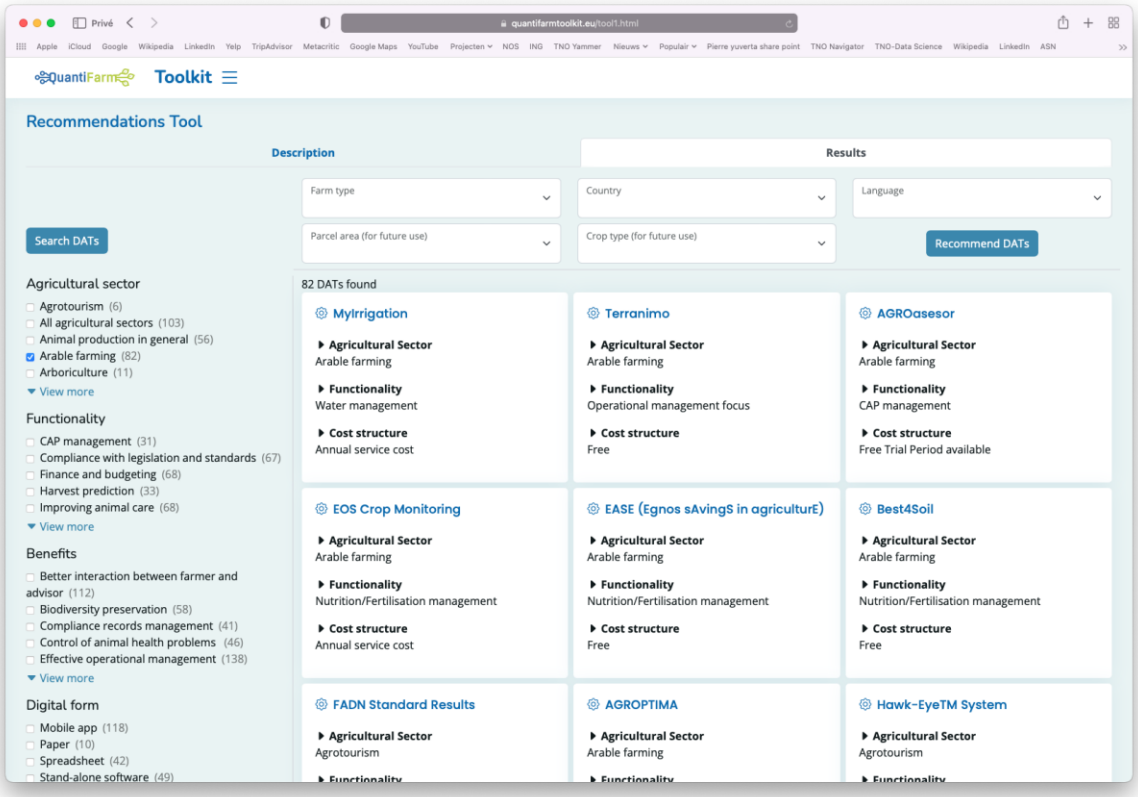

Figure 9. Screenshot of the main page of the QuantiFarm Recommendation Tool.

3.2 Benchmarking tool

3.2.1 Description

The "Benchmarking tool" aims to assist farmers and advisors in recording digitally the cultivation practices and to automate the calculation of important and useful performance indicators. It also offers the option to compare calculated indicators from different farms and/or for different cultivation periods. The tool also includes information about the DATSs that have been utilised and are associated with specific farming activities allowing the user of the "Benchmarking tool" to correlate performance with agricultural technology solutions. This allows the extraction of conclusions on the usefulness and the applicability of DAT in specific contexts.

3.2.2 Benchmarking tool Dashboard/GUI

This tool requires the user to create an account and to specify username and password. This is a necessary step because this tool maintains sensitive data about the farming practices (farm calendar) that have been applied and because data persistence significantly improves the utilisation efficiency of the tool. After login the first step for using this tool is the user to create a parcel by providing the appropriate info in the system through the "Parcels" Tab. This is realised by providing:

- Parcel Name
- Parcel Polygon

The Polygon must be expressed in GeoJSON coordinates format. An easy way to create this type of geometry/coordinates is available here. In the future updated releases of this tool geometry's coordinates extraction will be further automated.

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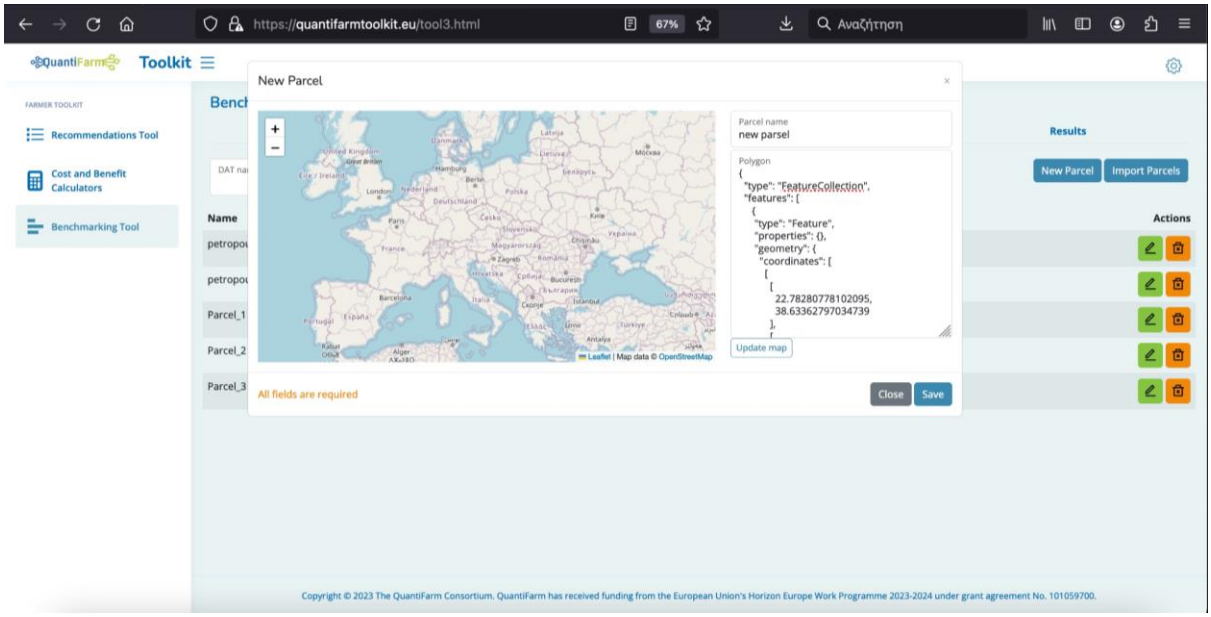

Figure 10. Create a new Parcel

After the creation of the tool the full list of available Parcels are listed. The user can either Edit or Delete an existing parcel.

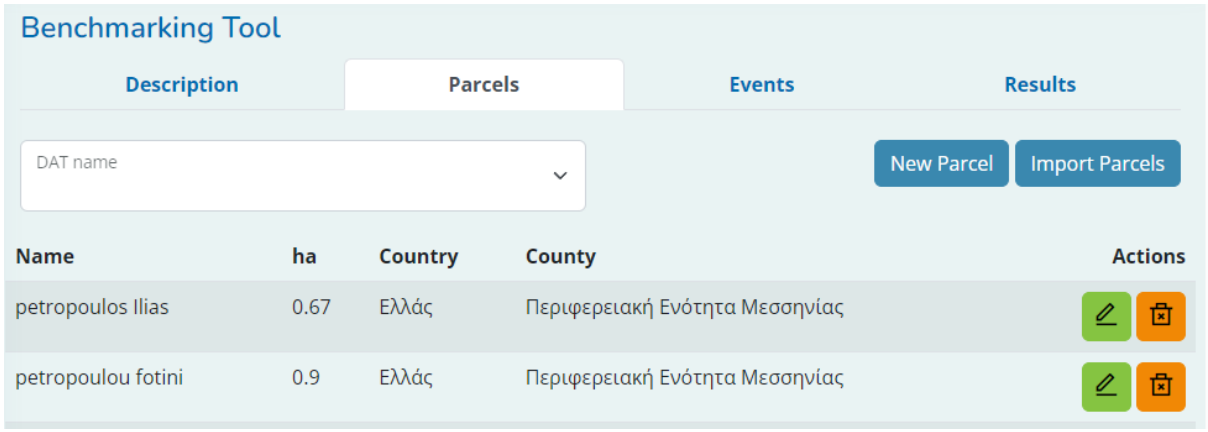

Figure 11. List of available parcels.

The next step is that the user must add "Calendar Events" through the "Events" Tab referring to farming activities performed in a specific parcel. Data input is realised through a form where various fields are required Figure 12. It is also feasible the user to import a list of events by uploading a CSV file. This allows the "Advisors" to use their own system (e.g. a digital farm book using a spreadsheet like MS Excel), export the list of performed faming activities in CSV and upload to the "Benchmarking Tool".

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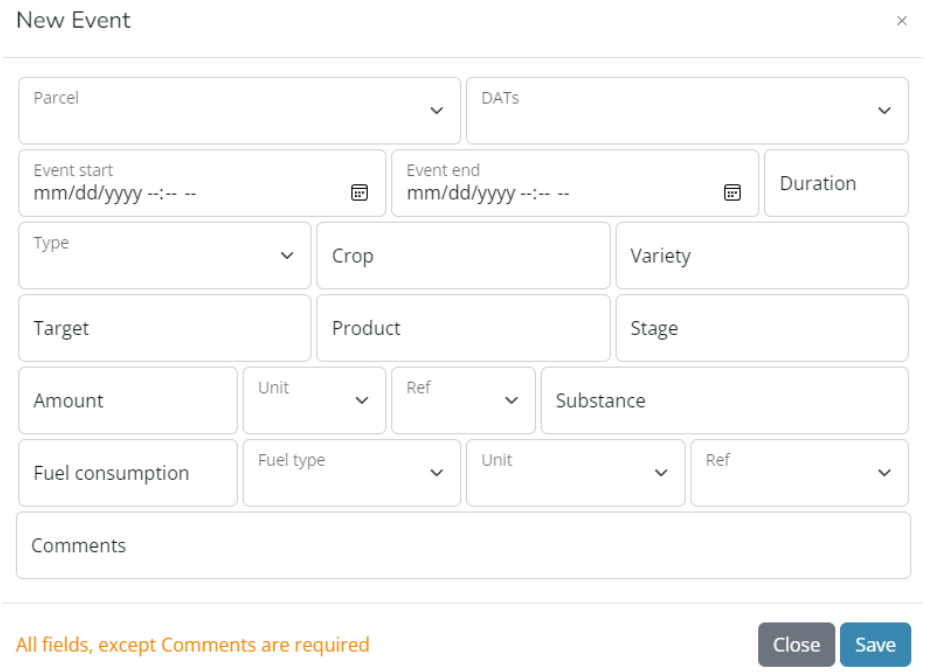

Figure 12. Adding entries to the digital farm calendar.

After successfully filling the events, they will also be displayed in a List and the user will again be able to Edit or Delete them at will.

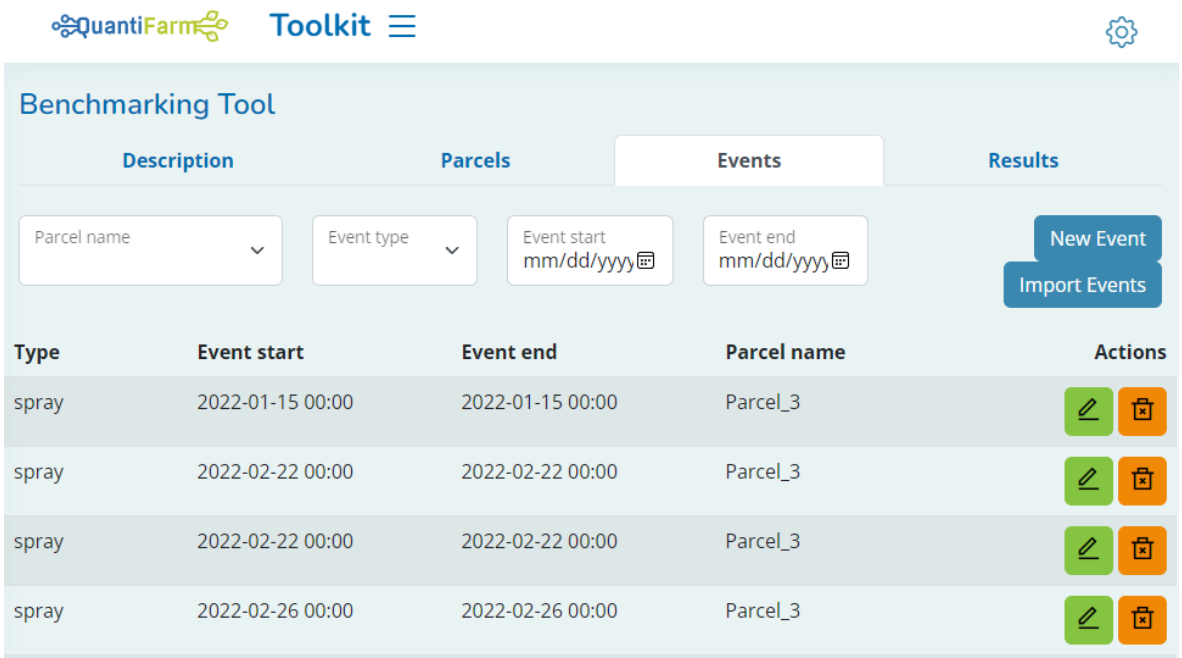

Figure 13. A list of performed farming activities.

When all data are present in the system the user can proceed with initiating the calculation of the benchmarking results by navigating to Tab "Results". Aggregation Results can be one of the following:

- **SUM** (Summary of the Values provided for specific Calendar Event)
- **MIN** (Minimum of the Values provided for specific Calendar Event)
- **MAX** (Maximum of the Values provided for specific Calendar Event)
- **AVG** (Average of the Values provided for specific Calendar Event)

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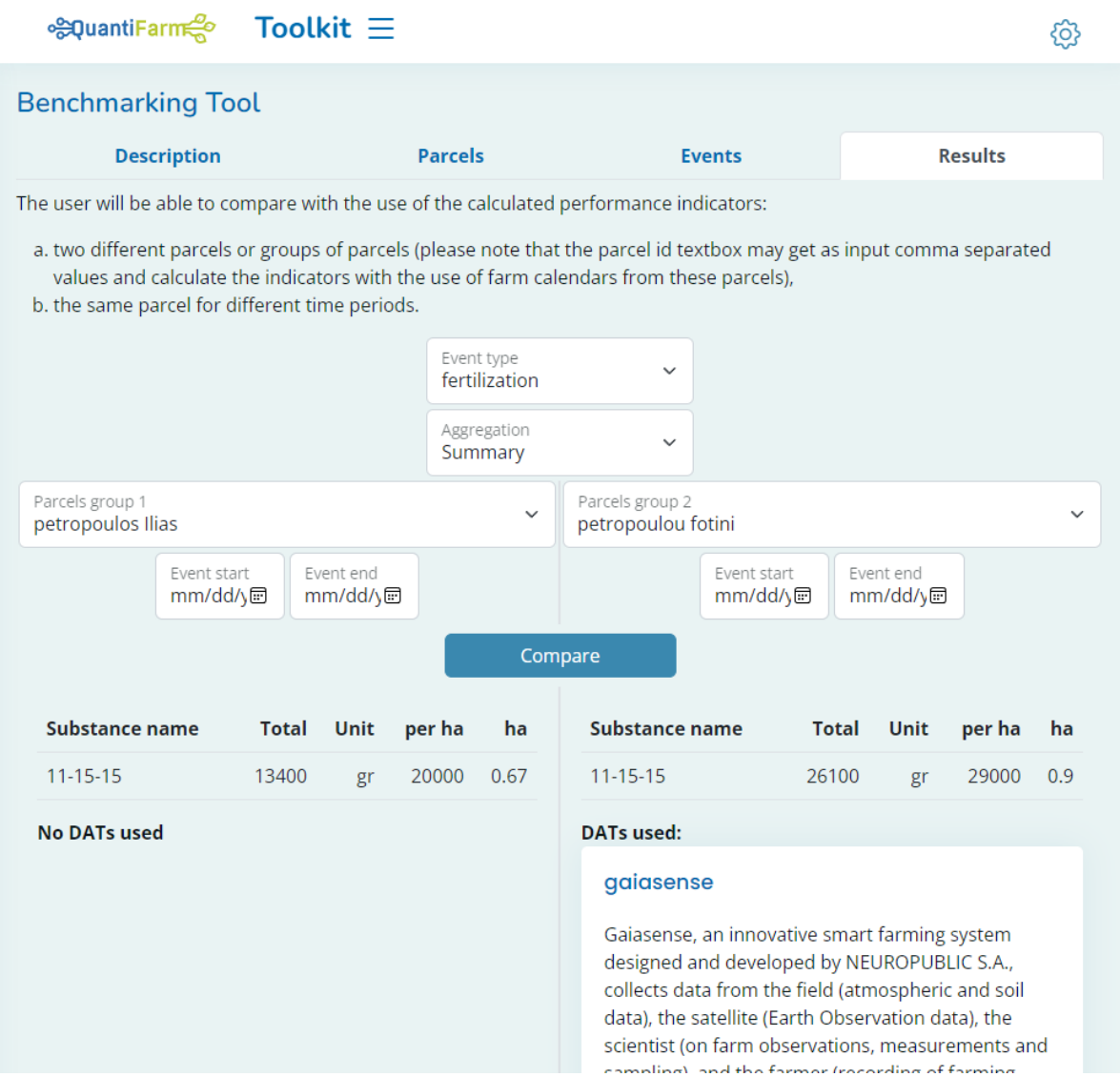

Figure 14 Calculated farming performance indicators

3.3 Cost benefit calculator tool

3.3.1 Description

The 'Cost & Benefit Calculator' tool is designed to assist farmers and agricultural advisors in analysing the financial implications and potential benefits of integrating various DATs into their farming operations. This integrated tool adeptly meets the diverse requirements of both crop and livestock farming systems, featuring specific calculator modules tailored for each. Within the tool, users can explore a comprehensive repository of DATs, select one, and upon completing the necessary inputs for the calculator modules, the tool provides vital information such as Return on Investment (ROI) and Net Benefit. This aids end-users in gaining a realistic understanding of their potential investment in a DAT. As a crucial component of the QuantiFarm Toolkit, the "Cost & Benefit Calculator" serves as an essential, indicative guide for farmers and advisors, aiding them in understanding the economic feasibility and potential profitability of DATs throughout their operational life cycle.

The "Cost & Benefit Calculator" tool, as described, offers a comprehensive approach to understanding the financial aspects of DATs in both crop and livestock farming systems. While this tool provides

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significant insights, it is equally important to consider certain limitations and practical aspects of its usage. To this end, we have outlined a series of key considerations and disclaimers. These are presented in the Table 1 below and cover a range of important factors including average pricing, data sources, and the exclusion of specific costs. This information is crucial in ensuring users have a realistic expectation of the tool's capabilities and can interpret its results within the correct context. It is recommended that all users familiarise themselves with these considerations and disclaimers to enhance their understanding and application of the "Cost & Benefit Calculator" tool as part of their decision-making process.

Considerations and Disclaimers for the Cost & Benefit Calculator Tool Usage	
Consideration/Disclaimer	Details
Average Prices	The purchase costs presented are average prices and should not be considered fixed or guaranteed. End-users should seek actual quotations from DAT providers or retailers.
Source of Benefit Data	Economic and environmental benefits are based on scientific publications or assertions by providers from specific conditions and locations. They may not apply universally and actual benefits can vary.
Exclusion of Taxes/Fees	The calculator does not include taxes or other specific fees that may be applicable to the end-user's location.
Tool's Purpose	The calculator is an indicative tool that provides insights into potential costs and benefits, complementing the main recommender tool based on the QuantiFarm Assessment Framework.
Decision-Making	This tool offers valuable information to support decision-making in the adoption of DATs, helping stakeholders to identify options that best fit their specific needs.

Table 1. Considerations and Disclaimers for the Cost & Benefit Calculator Tool Usage.

3.3.2 Cost benefit calculator tool Dashboard/GUI

The "Cost & Benefit Calculator" tool is specifically designed to support farmers and agricultural advisors in evaluating the financial impact and benefits of incorporating DATs into farming operations. It adopts a structured, user-centric approach for this purpose. Initially, users select their farming system—either Crop or Livestock—through a dropdown menu, which guides them to the relevant DAT categories. (Figure 15)

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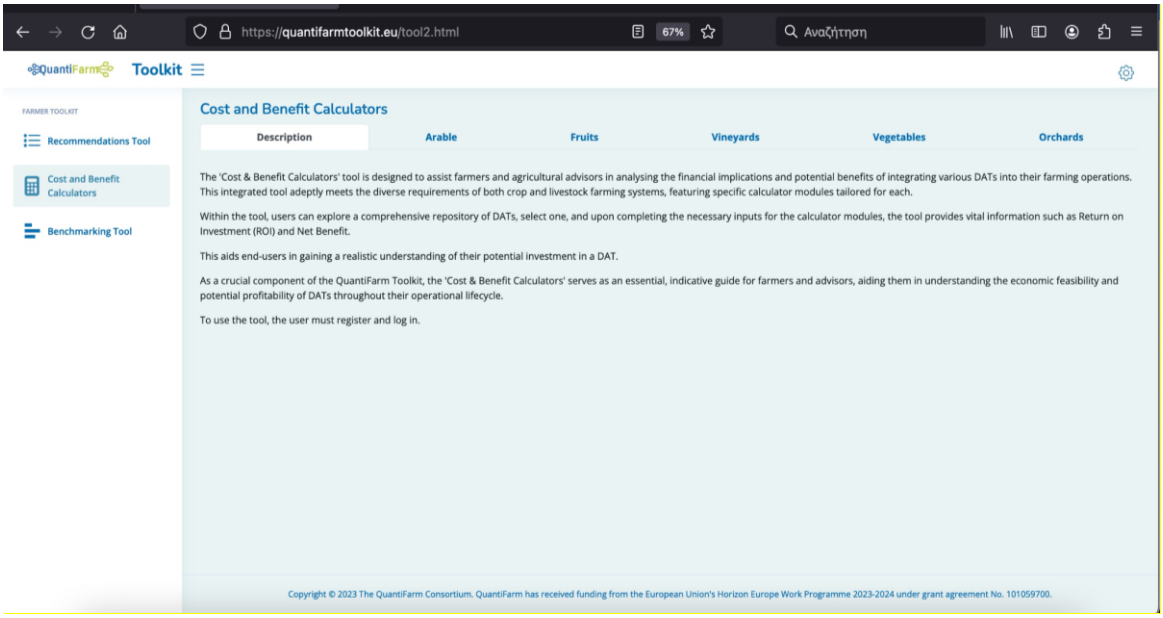

Figure 15. Description of use for the "Cost Benefit Calculator" tool.

Following this, users can choose a specific DAT category and then a particular DAT, with access to detailed information including the DAT name, provider, purpose, and an average estimate of the investment cost. This step ensures a focused and informed selection process.

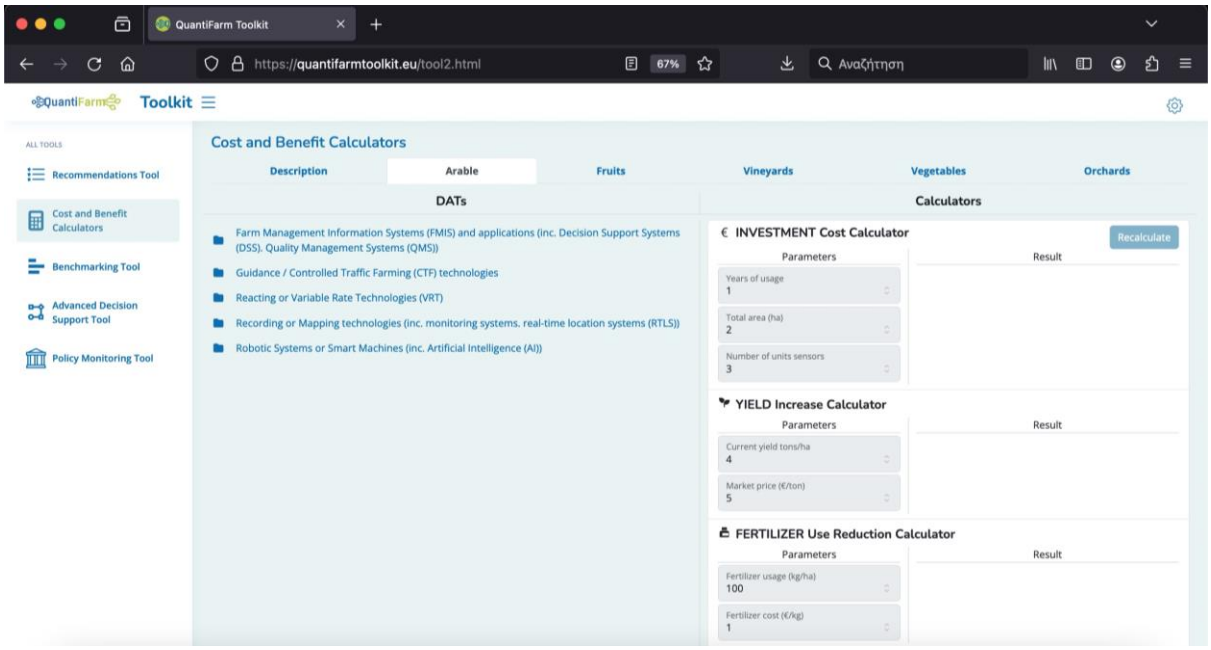

Figure 16. The "Cost Benefit Calculator" Tool focusing on Arable cultivation type.

Once a DAT is selected, users initiate the evaluation process by activating the calculator modules that are customised for crop or livestock systems. The tool prompts users to input essential data such as years of usage, number of units, and various operational metrics like area, yield, and costs. This data is crucial for the calculator modules to conduct an accurate and detailed analysis. The tool processes this information through specific modules, each aimed at evaluating different aspects of the selected DAT. These modules calculate potential costs, savings, and revenue, culminating in key outputs such as Return on Investment (ROI) and Net Benefit. The results of this analysis are then presented in a format that is easy to understand and actionable, with guidance provided to aid users in interpreting the results.

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This includes the option to dynamically adjust parameters like 'Years of Usage' to explore various scenarios and outcomes. Looking ahead, future iterations of the tool will integrate data from Test Cases involving specific DATs, further enhancing the tool's precision and relevance in real-world agricultural contexts.

3.4 Advanced decision support tool for the selection of Digital Technologies for agriculture

3.4.1 Description

The objective of the tool is to help advisors support their customers in deciding which DAT is most appropriate for their farm, through a robust decision-making process.

The "Advanced decision support tool" aims to support advisors and farmers on the selection of the most appropriate DAT under each given set of conditions, building on a combination of Strategic Fit, Analytic Hierarchical Process (AHP) and Quality Function Deployment (QFD) methods[1]. It was designed to address one of the key barriers in adopting digital technologies, which is the lack of knowledge and evidence regarding their (direct and indirect) actual benefits and costs. The first step of the tool uses strategic fit as a filter to exclude the services that do not comply with the farm's strategic goals. The second step uses QFD to evaluate the services based on customers' and partners' needs. The third step uses AHP to break down the problem to a hierarchical model which includes several criteria identified using the Technology, Organization, Environment (TOE)[2] framework in the agri-food value chain.

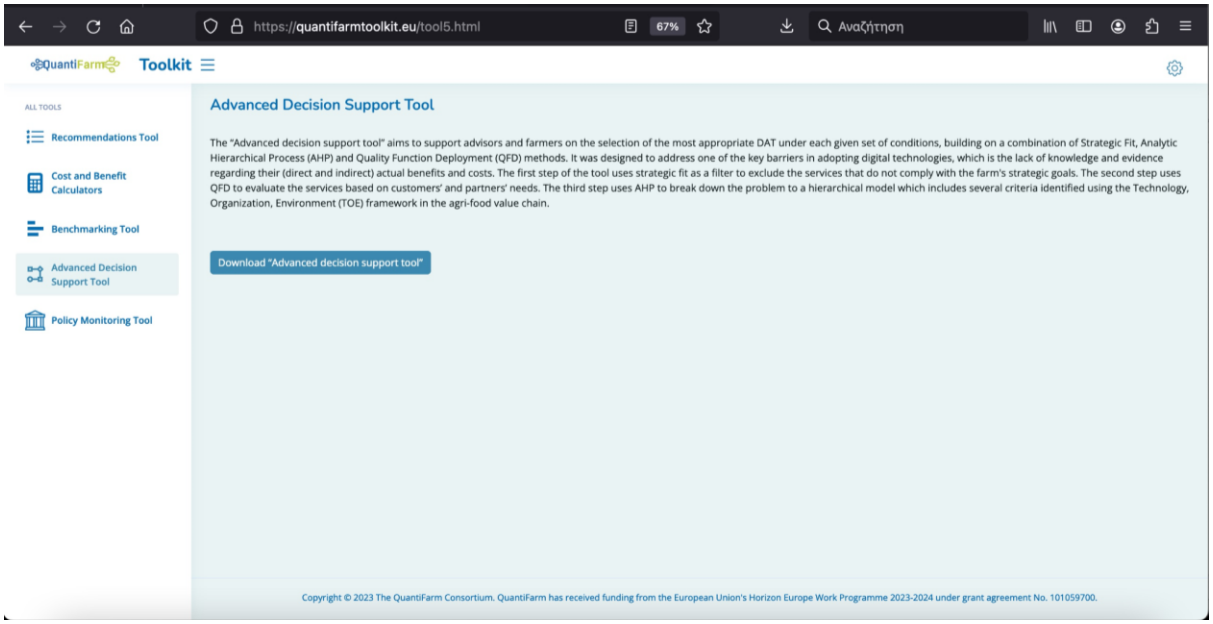

Figure 17. The «Advanced decision support tool» page.

Two versions of the tool are available to the advisor. The first version is a more complicated version that uses the full power of AHP method and provides the best possible results but it's more difficult and

[1] Marianos, N., Lambrou, M.A and Spyrou, D. (2011), "Evaluating electronic port services for container terminals: the PPA case", Int. J. Decision Sciences, Risk and Management, Vol. 3, Issue 3/4, pp. 347-368

[2] Tornatzky, L. G. and Fleischer, M. (1990) The Process of Technology Innovation, Lexington, MA: Lexington Books.

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time consuming to complete. This version is available in xlsx format and available for offline use. The excel file is available for download and use through the tool's page (figures 17).

The second version of the advanced decision support tool is based on a simpler process that is easier to be completed but creates somewhat less accurate (but still absolutely valid) results. This version that will be implemented as a web app in the Toolkit and that can be used online is under development.

3.4.2 Directions of use

The problem to be solved by the tool is defined as the selection of the DAT with the biggest value to the farm. To select the best solution, all the possible alternatives have to be identified first. Based on the farmer's profile and location, the available possible alternative DATs are presented to the advisor by the system. The alternatives that are not suitable with the business strategy, the organisational goals and the needs of the farmer, must be eliminated. The strategy of the examined farm/farmer is broken down to a set of specific organisational strategy goals that have to be defined in order to be used to evaluate the alternatives. This is done by selecting from a list of pre-defined criteria that were defined in the tool, i.e. 1) Cost Reduction, 2) High Quality Products, 3) Competitive Advantage, 4) Farm Growth/Development, 5) Economic Sustainability, 6) Environmental Sustainability, 7) Risk Reduction, 8) Ecosystem Services/Added Value Services, 9) Succession and 10) Innovation. Then, with the help of the advisor, the farmer assigns relative weight to each selected goal (where the relative weights of all goals sum to 1). Each alternative is then evaluated using a scale from 1 to 5 (where 1= very poorly and 5=very well) according to how well it fulfils each strategic goal (this is done by the advisor supporting the process, who has the appropriate knowledge). The final strategic fit score of an alternative is measured as the sum of the score on fulfilment of each of the strategic goals multiplied by the relative weight of this goal (e.g. SFA = 0,25*4 + 0,25*3 + 0,1*3 + 0,1*3 + 0,15*4 + 0,15*2 = 3,25). Alternatives with a score equal or better than 3, are qualified to the next phase. Alternatives with scores less than 3 are disqualified.

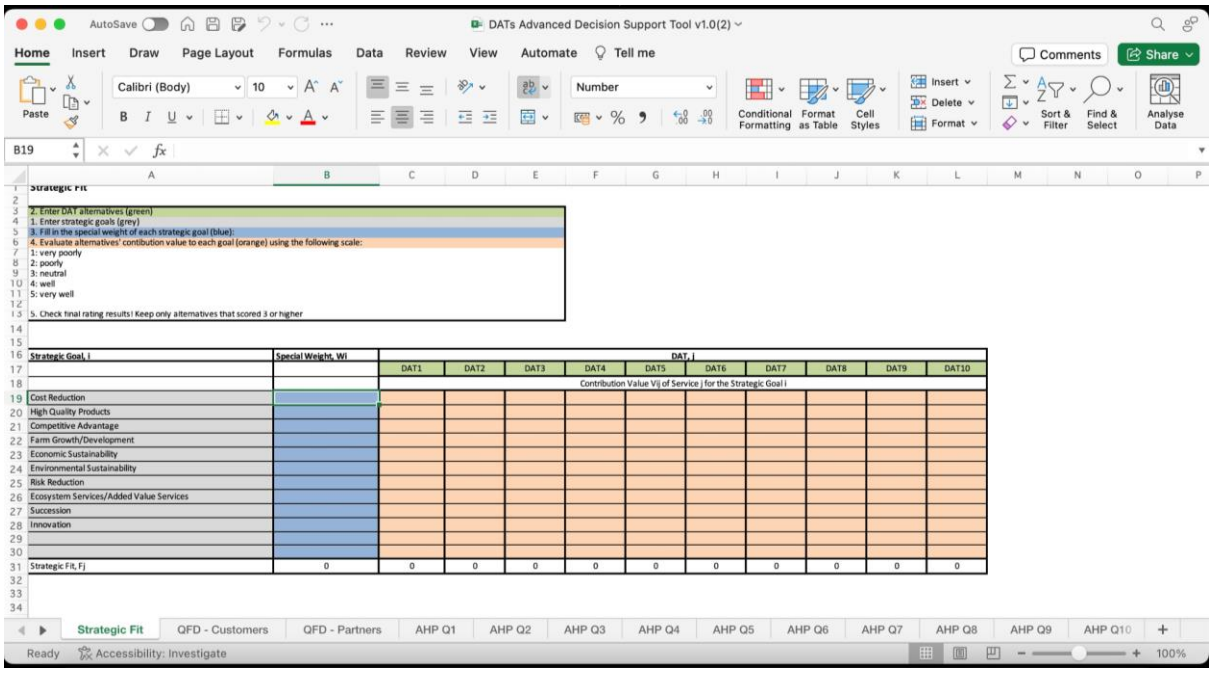

Figure 18. The «Advanced decision support tool» available in Excel.

In the second step, a light version of QFD is used to let the farm's customers and partners (including retailers, food processing companies, intermediaries and/or consumers) evaluate the services and to correlate their needs with the needs of the farmer. This is done by selecting from a list of pre-defined needs that were defined in the tool, i.e. 1) Product Cost Reduction, 2) Yield Quantity Consistency, 3)

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Information Accuracy/ Traceability, 4) High Food Quality/Specific Quality Characteristics and 5) Sustainability. A 3 point scale (strong (5), average (3) or weak (1)) is used to evaluate the customer satisfaction for each of the documented needs/demands. The evaluation scores are used in the next phase and used as input for the calculation of the AHP model.

In the third step, the final step of the evaluation of the selected alternative solutions is being completed with the use of AHP. In this step, the system (or the advisor supporting the process) selects the appropriate evaluation pre-defined criteria which cover all aspects of the problem (i.e. "Technology Characteristics", "External Environment", "Organizational Maturity/Internal Environment", "Perceived Benefits" and "Costs") and the farmer (with the help of the advisor that supports the process) assigns special weights to each criterion in order to evaluate each alternative. To achieve that, the farmer performs pairwise comparisons to examine the relative priority of each criterion of a level regarding the higher level of the model. Based on these comparisons, the system produces a final score. The solution with the highest score is the most appropriate one for the farmer.

3.5 Policy Monitoring Tool

3.5.1 Description

The Policy Monitoring tool provides policy makers with a visual policy monitoring dashboard, allowing the generation of analytical reports based on queries, including summary tables as well as graphical charts. Through an incremental and iterative methodological approach, the tool will continuously incorporate more data and update the existing with more accurate datasets wherever feasible, ensuring that policymakers have access to up to date and comprehensive information. This evolving data landscape enhances the tool's ability to support a well-grounded link between agricultural policies and a spatially and temporally heterogeneous set of data, enabling policymakers to make decisions that are both data-driven and closely aligned with the dynamic nature of agricultural ecosystems. In detail, we integrate and render on a regional (Local Administrative Unit - LAU or Commune) level data derived from anonymized and aggregated in-situ information from 12 selected QuantiFarm test cases. This includes information from parcels utilising Digital Agriculture Technology Solutions (DATSs), parcels not employing DATSs, farm calendar exports, and digital logs. EO data products (e.g. crop type, land use), open European GIS datasets (e.g. GISCO[3], EEA[4]) and open data from EU policy monitoring services (e.g. FADN[5], Eurostat) have been used as inputs to calculate indicators (KPIs), variables or setting thresholds for subjective qualitative and quantitative comparisons of regional performance related to local and EU policy implementation.

3.5.2 Policy Monitoring Tool Dashboard/GUI

Users can access the policy monitoring tool via the QuantiFarm toolkit main page as depicted below (figure 19) by clicking the "Policy maker" icon or the "toolkit" tab.

[3] https://ec.europa.eu/eurostat/web/gisco
[4] https://www.eea.europa.eu/en
[5] https://agriculture.ec.europa.eu/data-and-analysis/farm-structures-and-economics/fadn_en

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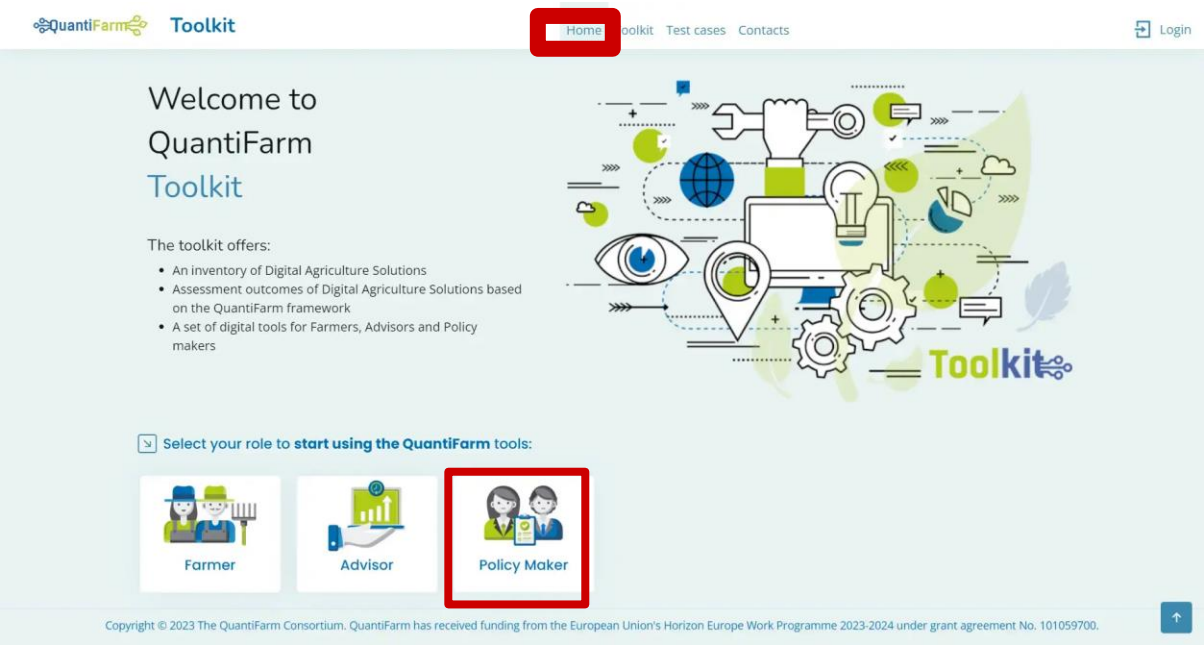

Figure 19. The QuantiFarm toolkit main page

The 'toolkit' tab redirects to the page https://quantifarmtoolkit.eu/toolkit.html that all tools are listed as shown below (figure 20).

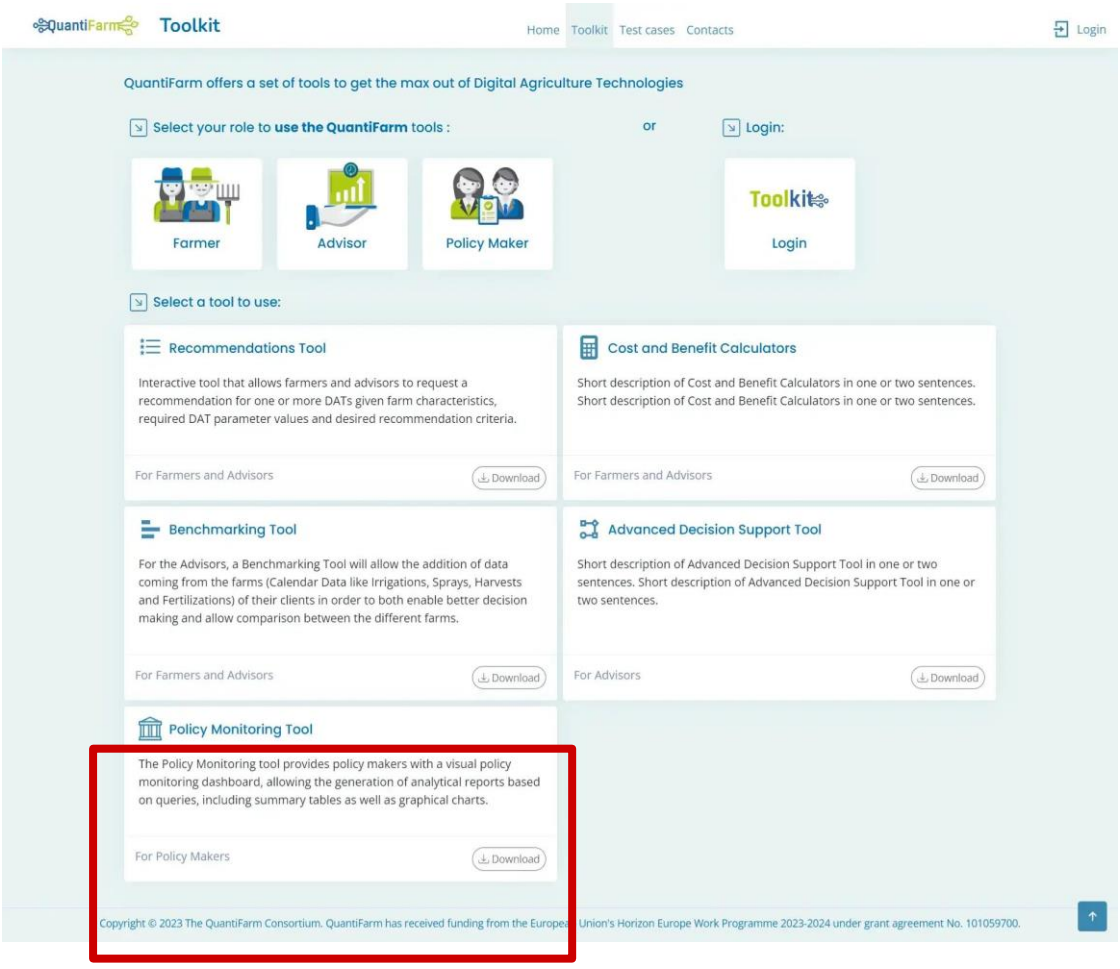

Figure 20. The toolkit tab" (https://quantifarmtoolkit.eu/toolkit.html).

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Upon clicking on the "Policy monitoring tool," the user is redirected to the URL: https://quantifarmtoolkit.eu/tool6.html, which leads to the page providing a detailed description of the tool, while the corresponding button (figure 21) redirects to the actual dashboard.

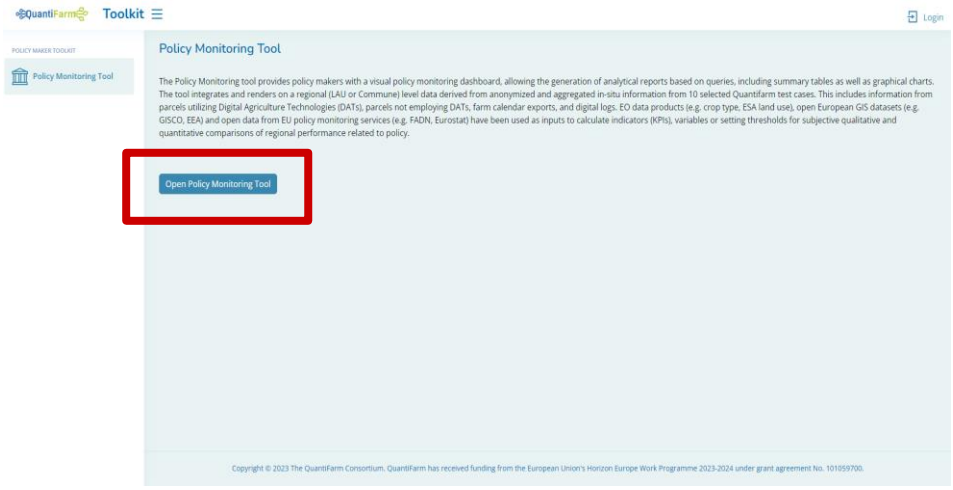

Figure 21. The «Policy Monitoring Tool» page

Regarding the Policy Monitoring Tool v1.0, the dashboard front page allows the user to filter selected content by selecting country, region, year, and crop type, along with a map viewer to meet user requirements (figure 22). Details regarding the selected region are loaded along with various tabs that categorise agricultural statistics and indicators. For the execution of the Use case scenario example described in D3.2 we select Greece>DIMOS OROPEDIO LASITHIOU>2023>Potato. The "finish" button confirms the selection and when pressed, it proceeds with the filtering selection and the zoom on the interactive map over the area of interest.

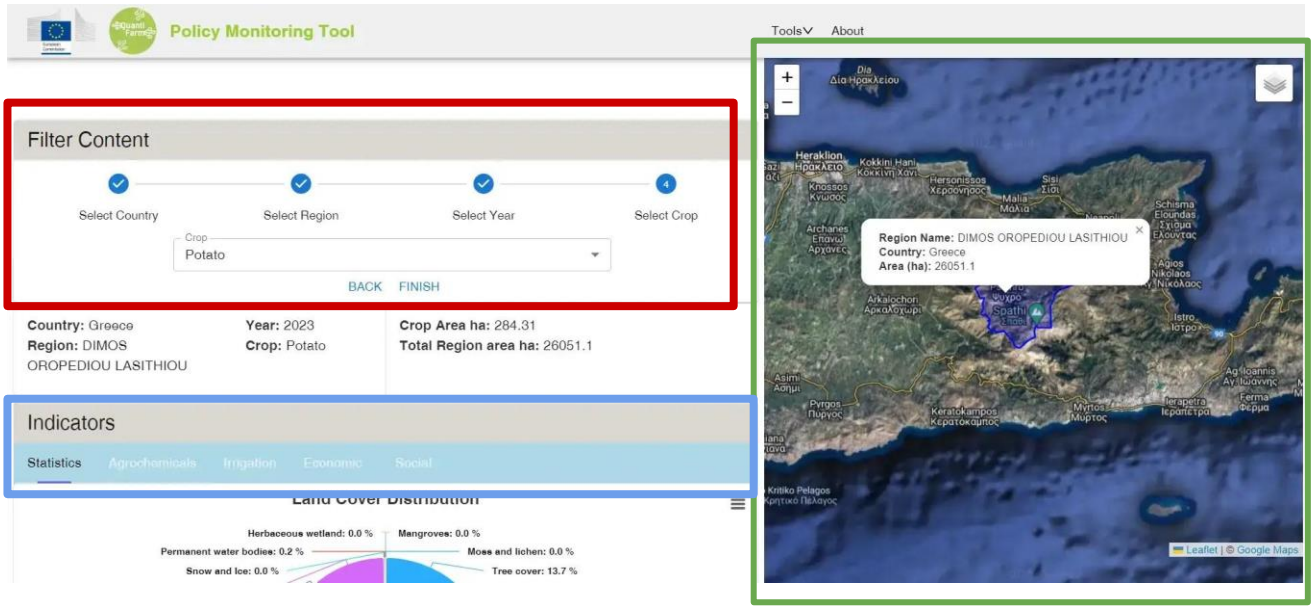

Figure 22. The Policy Monitoring Tool v1.0 dashboard front page

The basic GUI elements of the dashboard front end consist of:

- A multi-step selection menu (figure 21, red box)
- Interactive map (figure 21, green box)

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- Indicator category tabs (figure 21, blue box)

The "statistics" tab (figure 23) displays a pie chart of land cover distribution, bars for protected areas under Natura 2000, and corresponding values and legends that the user can inspect by scrolling down.

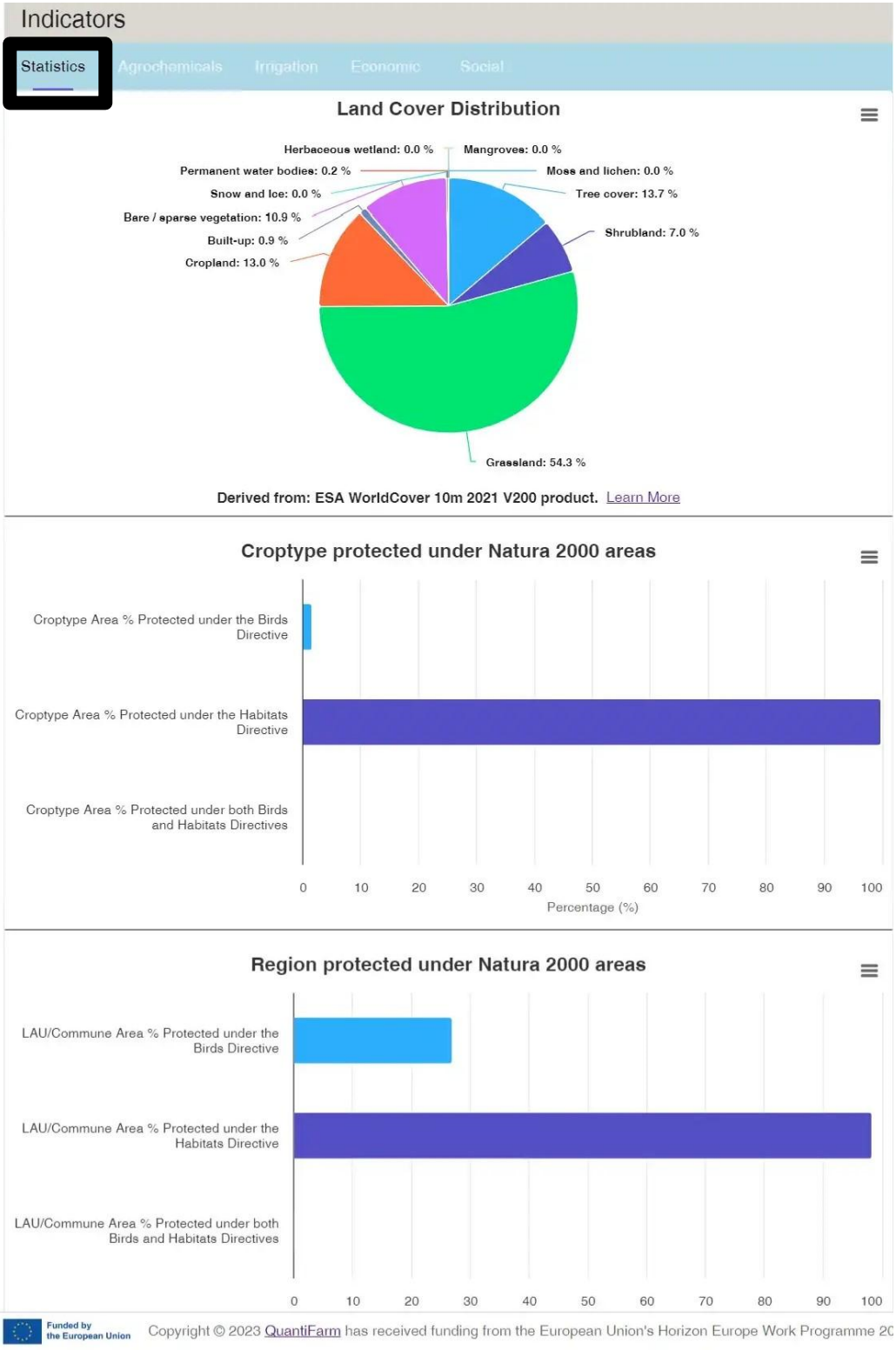

Figure 23. The 'statistics' tab contents include a pie chart regarding land use in the selected region and bars regarding the coverage of the region and the croptype

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The "agrochemicals" tab (figure 24, black box) features tables comparing agrochemicals used if all crop areas of the region are implementing the relevant DAT versus not implementing a DAT. The regional average, maximum, and minimum usage of parcels are visible along with coloured "benefit" columns (figure 24, orange boxes) that show the average benefit or deficit (depending on the sign character and colouring) for available pesticides and fertilisers indicators. Units are kg/ha.

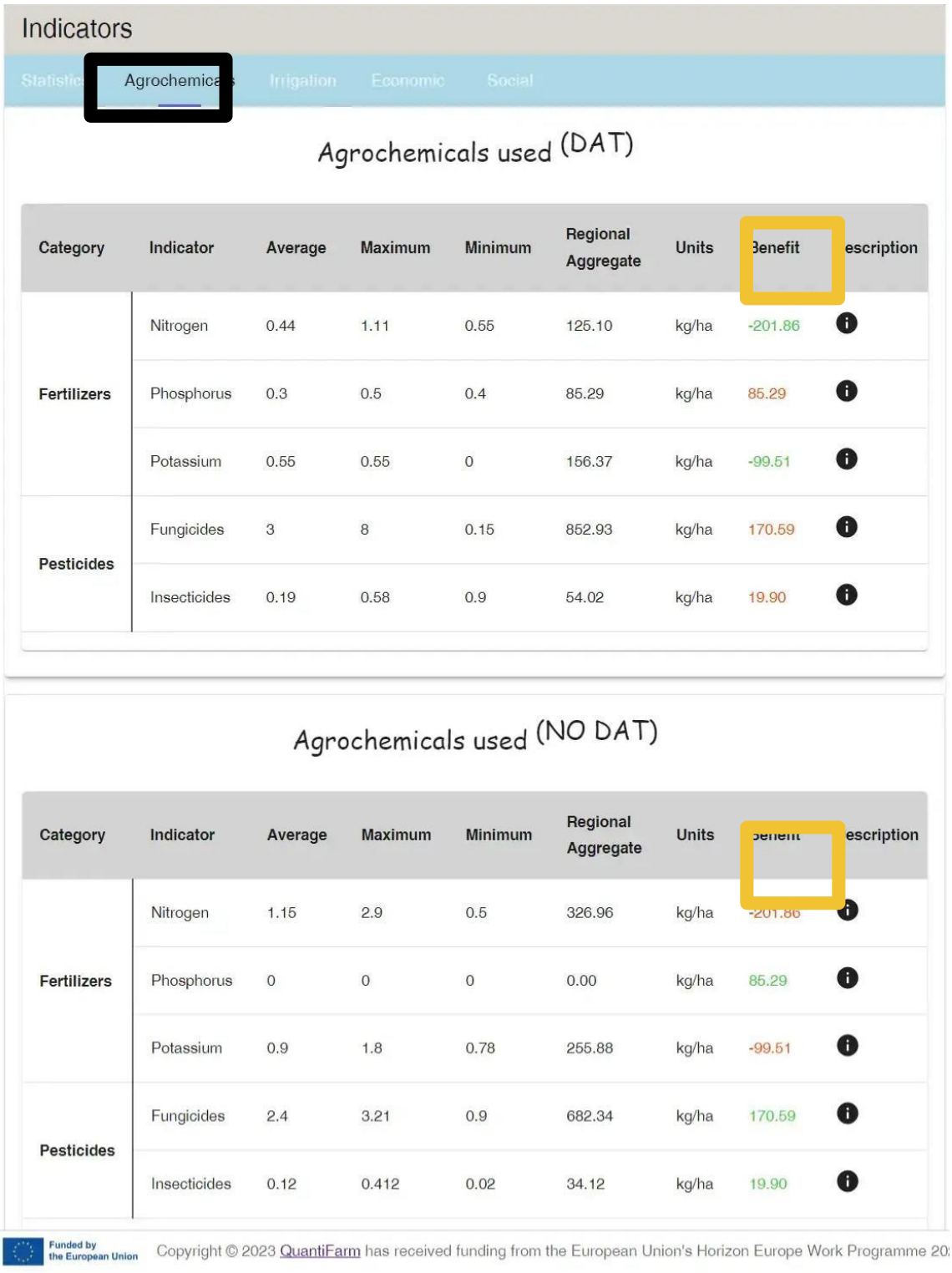

Figure 24. The "agrochemicals" tab features tables that display relevant indicators along with their corresponding values, based on whether they are associated with DAT use or non-DAT use.

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In the top right 'tools' option (figure 25, black box) the user can access the visualization dashboard where interactive graphs can be created and exported to various formats.

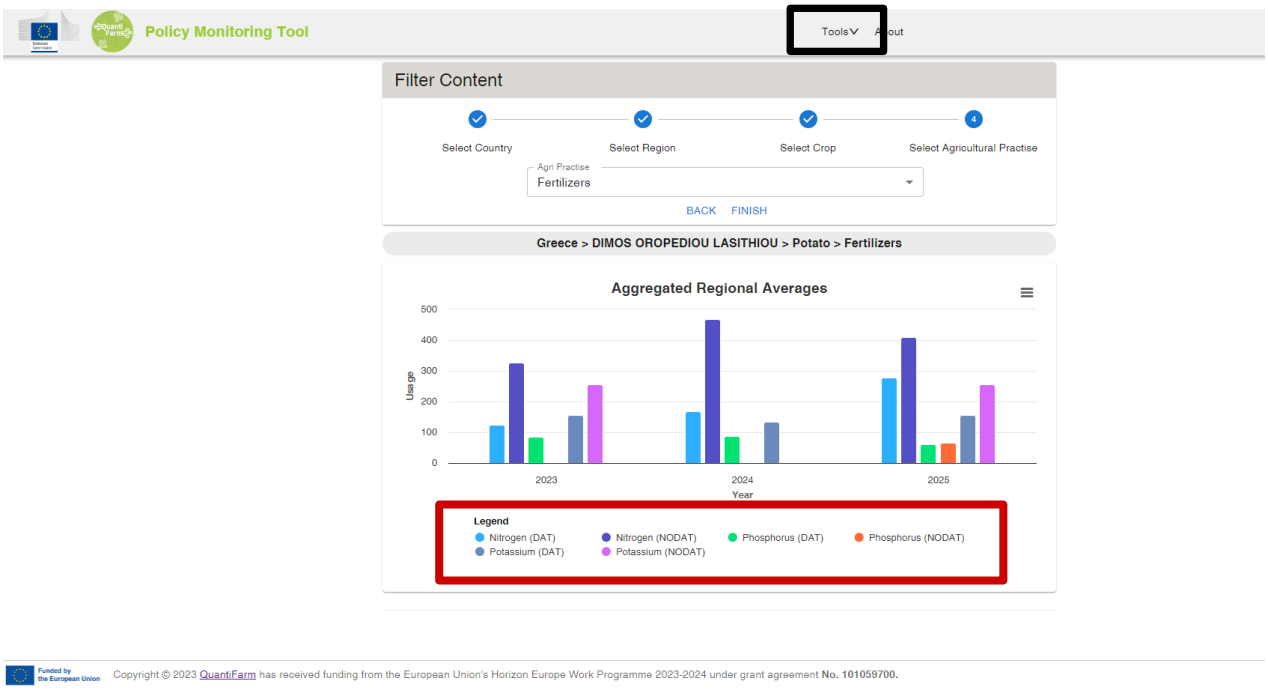

Figure 25. Interactive graphs available under the "Tools"> "monitoring dashboard" offer the ability for customised comparisons

By clicking in the variables under the legend (figure 25, red box) the user can include/exclude the relevant values in the graph. The corresponding changes are immediately updated (Figure 26).

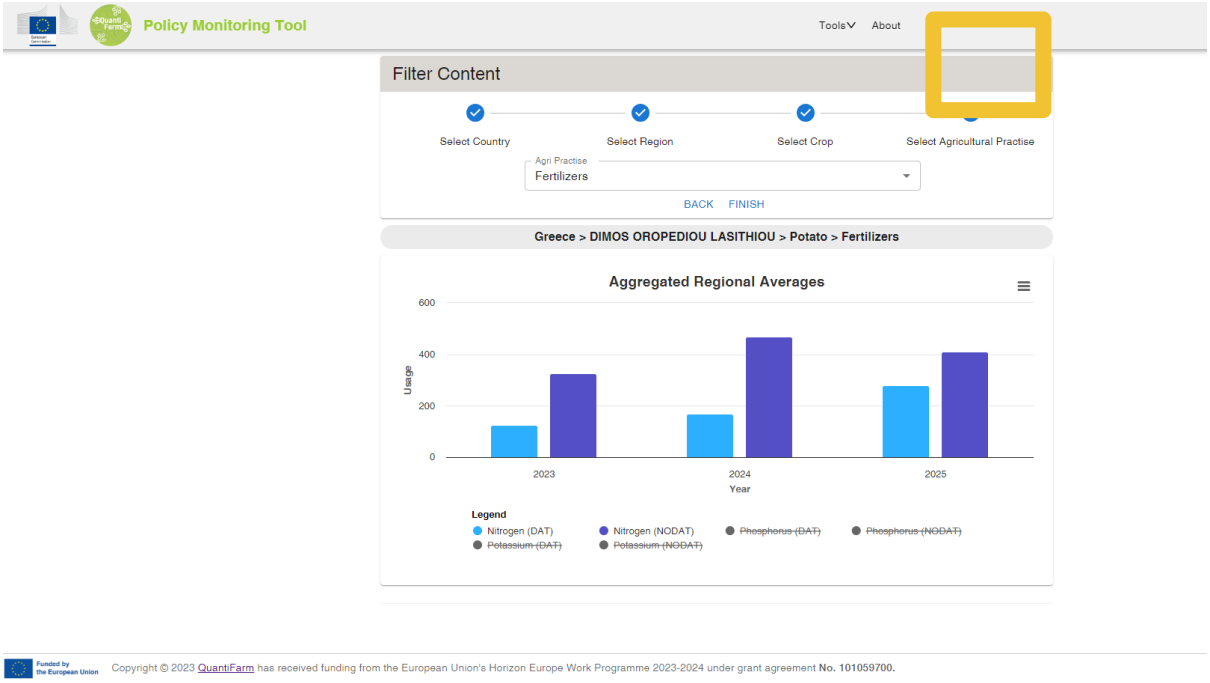

Figure 26. Interactive graph changed according to the user variable selection

By clicking in the graph options a list of possible exports is visible for download (figure 27 and 28).

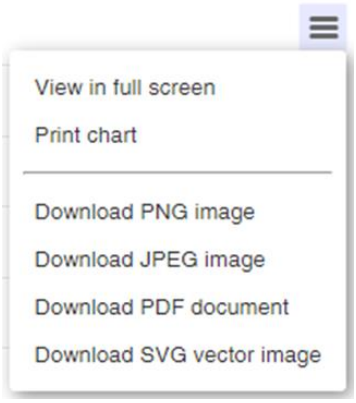

Figure 27. Available graph export options

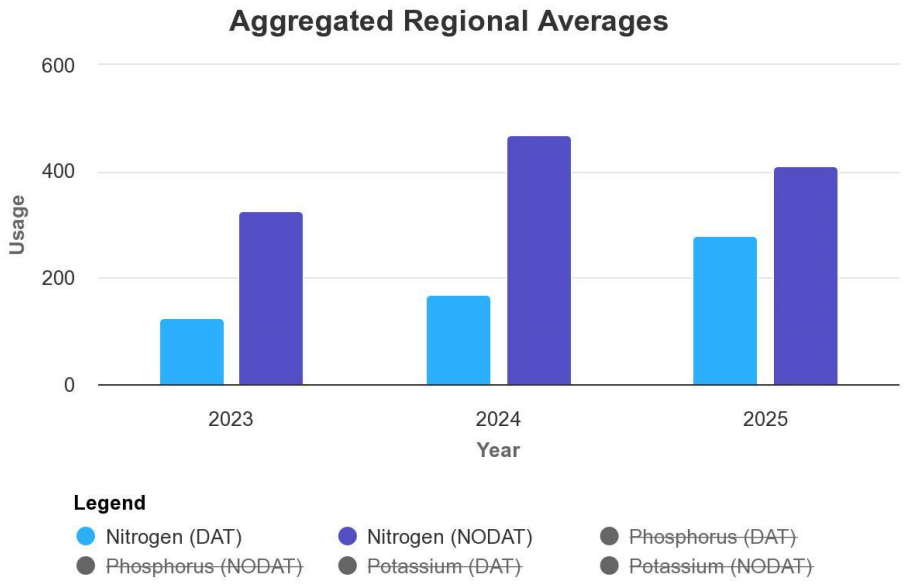

Figure 28. Example of the exported graph as .jpeg image

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4. Conclusions

This short report escorts the first integrated release of QuantiFarm toolkit which is available for use through a web-based dashboard https://quantifarmtoolkit.eu/

Next steps include extensive testing and utilisation of the QuantiFarm toolkit by a controlled set of users, collection of their feedback and refinement of the offered functionalities. The development of the QuantiFarm toolkit will be a continuous process and various improvements will be integrated when available. The next major release will be delivered in December 2024. The QuantiFarm Toolkit will be updated on a regular basis with data generated from the QuantiFarm assessment process.

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