



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817819



SoildiverAgro

Soil biodiversity enhancement in European agroecosystems to promote their stability and resilience by external inputs reduction and crop performance increase

D7.4- SOILDIVERAGRO DECISION SUPPORT TOOL

Universidade de Vigo



D7.4. SOILDIVERAGRO DECISION SUPPORT TOOL

Summary

One of the main objectives of Work Package 7 (WP7) of the SoildiverAgro project was the development of a Decision Support Tool (DST), based on the analysis of all data compiled throughout the project. Accordingly, this deliverable (Deliverable 7.4) presents a detailed user manual that provides step-by-step instructions for its use.

The developed DST is a freely accessible web application designed to predict wheat yield and soil biodiversity (bacterial, fungal, and nematode) using easily obtainable input data. The tool employs machine learning models trained on datasets collected from various European pedoclimatic regions. It integrates a wide range of variables, including climatic data, soil texture, pH, and agricultural management practices.

The DST delivers predictions related to wheat yield and soil biodiversity and allows comparative analyses by region or management category. Results are presented through interactive graphical outputs (e.g., boxplots) and percentile tables, facilitating clear interpretation by end-users. The tool is intended for a broad audience, including farmers, technicians, advisors, researchers, and educators, and may also contribute to evidence-based policymaking in support of sustainable agricultural practices.

Deliverable Number		Work Package	
D7.4.		WP7_ Development of strategies and tools for sustainable crop management	
Lead Beneficiary		Deliverable Author(s)	
UPCT		Alberto Garre Pérez [UPCT]	
Versions (updates)		Date	
V1		19.05.2025	
V2		29/05/2025	
Deliverable Quality Check		Date	
David Fernández Calviño [UVIGO]		29.05.2025	
Planned Delivery Date		Final Delivery Date	
31.05.2025		29.05.2025	
Type of deliverable	R	Document, report (excluding periodic and final reports)	X
	DEC	Websites, patents filing, press & media actions, videos	
	E	Ethics	
Dissemination Level	PU	Public	X
	CO	Confidential, only for members of the consortium	



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817819





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817819

Table of content

1 INTRODUCTION.....	4
2 SOILDIVERAGRO DST USER MANUAL.....	5

1.6 A8 & C\$A8 6

Soil plays a critical role as a fundamental resource in agriculture, with its health and biodiversity being key determinants not only of crop productivity but also of the overall sustainability of agricultural ecosystems. Within this context, the project SoildiverAgro has focused its efforts from the outset on promoting innovative and sustainable agricultural practices, drawing on applied research, fieldwork, and the development of technological tools aimed at supporting decision-making by farmers and other stakeholders in the agri-food sector.

Modern agriculture faces numerous challenges, including biodiversity loss, soil degradation, climate change, and the increasing need to reduce reliance on chemical inputs. Addressing these issues without compromising productivity necessitates the adoption of data-driven, evidence-based approaches. In this regard, the digitalization of the agricultural sector offers significant opportunities, enabling users to access predictions, recommendations, and tailored analyses—even in the absence of specialized technical training.

Aligned with these objectives, the SoildiverAgro project has developed a **Decision Support Tool (DST)**, a freely accessible web application designed to **predict wheat yield and several indices of soil biodiversity** (bacterial, fungal, and nematode), based on user-provided, easily obtainable data. The tool has been developed using machine learning models trained on datasets collected from multiple European pedoclimatic regions within the framework of the SoildiverAgro project. It integrates a variety of variables, **including edaphoclimatic data** (e.g., precipitation, temperature, soil texture, pH), **management practices** (e.g., tillage type, fertilization, pesticide use), and **readily measurable soil physico-chemical parameters**. Based on these inputs, the DST provides a range of valuable predictions for agricultural planning, including:

- **Wheat yield:** Based on soil characteristics and management practices, the system estimates expected yield relative to historical data collected during the project.
- **Bacterial, fungal, and nematode biodiversity:** Using the Chao1 biodiversity index, these predictions provide insights into the ecological status of the soil and its potential to support ecosystem services.
- **Comparative analysis by region and category:** Results can be visualized according to specific contexts (e.g., grouped by tillage system, pedoclimatic zone), allowing users to explore how local conditions influence outcomes.

In addition, the tool generates interactive boxplot graphs, which allow users to inspect individual values by hovering the cursor over the graphical elements, along with percentile tables that facilitate the evaluation of the relative performance of the analysed soil. This dual graphical and numerical output enables clear and efficient interpretation by users.

The DST is intended for use by a broad spectrum of agricultural stakeholders, including farmers, technicians, advisors, researchers, educators, and students. Moreover, the DST may play a valuable role in informing public policy by providing empirical evidence on the benefits of specific sustainable practices across various agroclimatic contexts. Accordingly, **this deliverable presents the tool in its current version, accompanied by a detailed user manual that provides step-by-step instructions for its use.**



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817819

2 ?8 .2&.E(> +>8 &(\$?.8 6 ?C; ; 8 >AA8 8 2 C?(>
5 6 C 2

Soildiveragro DST User Manual

May 2025

Version 0.1.0





Table of Contents

Introduction	4
Layout of the Soildiveragro DST	5
Using the Decision Support Tool	5
Contact	13

Introduction

The Decision Support Tool (DST) is a free, web-based software developed through the SoildiverAgro project to help end-users, including farmers and other stakeholders, optimize their wheat cropping systems and management practices. It can be accessed from the following web address:

<https://foodlab-upct.shinyapps.io/biogrowth4/>

The DST uses machine learning models developed from experimental data collected during the SoildiverAgro project to predict agricultural soil properties. It takes into account environmental, physicochemical, and land-use parameters, as well as biodiversity indices. The tool guides users through a step-by-step process, asking for key information such as pedoclimatic conditions, crop location, agricultural challenges, and current cropping systems. Based on this input, the DST provides tailored recommendations to enhance productivity, profitability, and sustainability.

This application runs entirely online, so the user does not need to have the R programming language on her/his computer to run it; the only requirement is an internet connection and a web browser. Indeed, it can even be accessed from a smartphone.

The application is entirely Open Access, with the code being accessible from GitHub:

<https://github.com/albgarre/biogrowth4>

This page includes an “Issues” section that can be used for reporting bugs (<https://github.com/albgarre/biogrowth4/issues>).

The app can also be used on computers without internet connection. In this case, however, the software must be installed locally. Please contact the maintainers of the software as indicated in the section Contact.

Using the Decision Support Tool

The DST can be accessed from the “DST” tab. Figure 1 illustrates its overall layout. It is divided on a navigation bar on the left and a main panel.

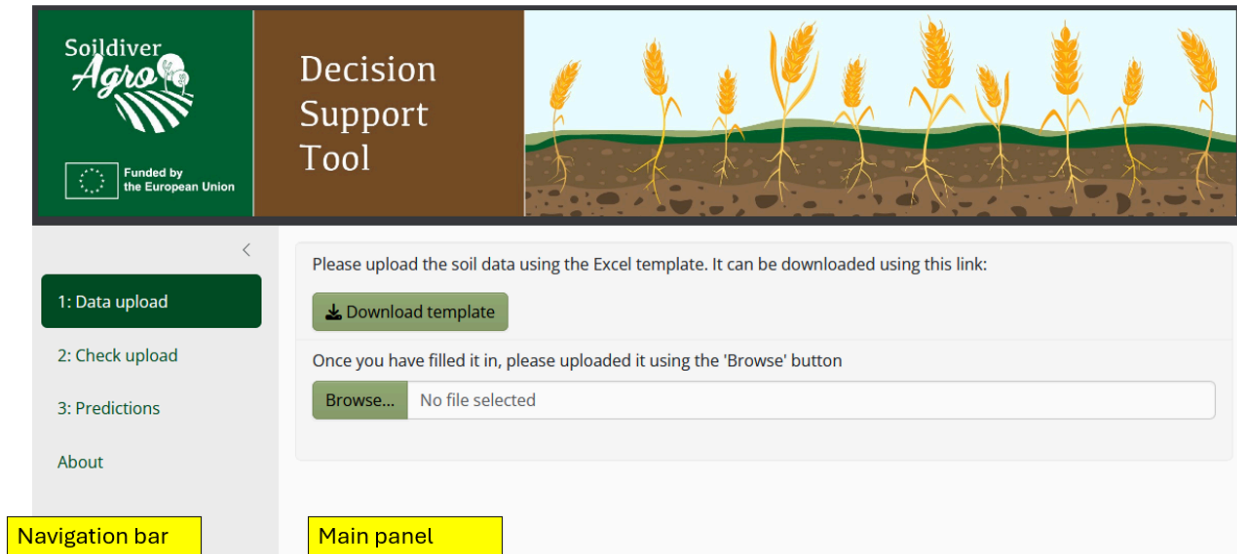


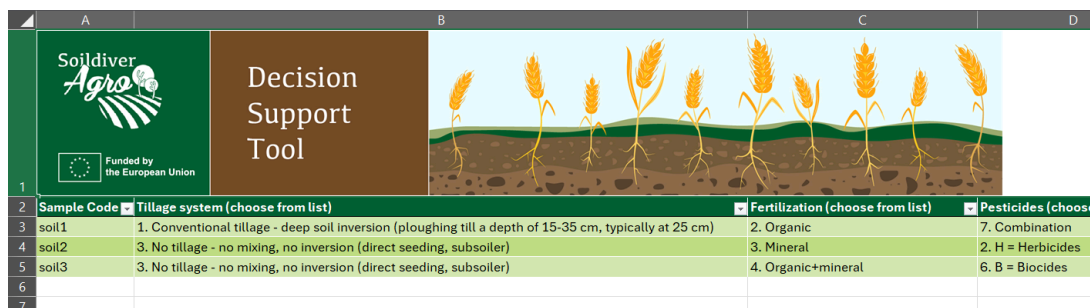
Figure 1: Overall layout of the DST

The DST is used in three steps, as shown in the navigation bar. First, the data must be uploaded using an Excel template. The template can be downloaded using the “Download template” button (shown in Figure 1). The layout of the template is depicted in Figure 2.

Each soil sample must be defined in an independent row. Then, each column represents one variable. They are grouped in three categories:

- **Metadata** includes categorical variables such as the tillage system, the pedoclimatic area, the use of pesticides and the type of fertilization.
- **Physicochemical** includes several properties of the soil. Please check the “Documentation” tab for recommendations on how to take those measurements.
- **Weather** groups variables related to precipitation and temperature in the area. The “Documentation” tab includes sources on where those variables can be obtained.

The Excel file includes three rows that serve as an example. Deleting those row is recommended to avoid confusion.

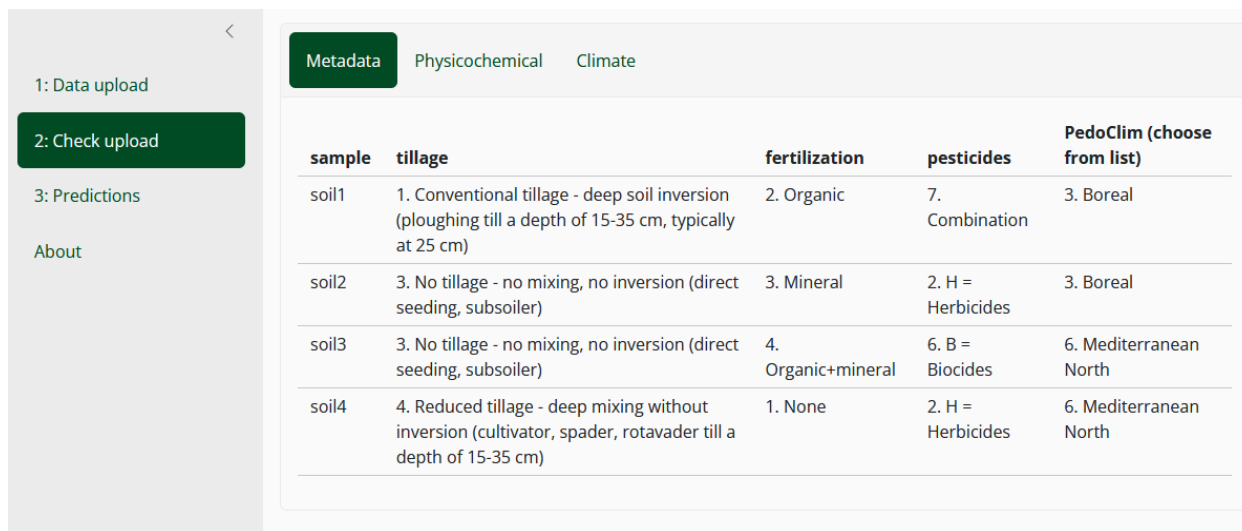


Sample Code	Tillage system (choose from list)	Fertilization (choose from list)	Pesticides (choose from list)
soil1	1. Conventional tillage - deep soil inversion (ploughing till a depth of 15-35 cm, typically at 25 cm)	2. Organic	7. Combination
soil2	3. No tillage - no mixing, no inversion (direct seeding, subsoiler)	3. Mineral	2. H = Herbicides
soil3	3. No tillage - no mixing, no inversion (direct seeding, subsoiler)	4. Organic+mineral	6. B = Biocides

Figure 2: Template for uploading the data for the DST

Once the Excel has been completed, please click the “Browse” button (Figure 1). This will open a window where you can point at the location of Excel file in your computer, which will be uploaded to the application.

Once the data has been loaded, please navigate to “Check upload” (Figure 3) to check that were not any issue during data upload. The information is grouped in three tabs, according to the categories of the input data: metadata (Figure 3), physicochemical properties (Figure 4) and climate-related variables (Figure 5).



sample	tillage	fertilization	pesticides	PedoClim (choose from list)
soil1	1. Conventional tillage - deep soil inversion (ploughing till a depth of 15-35 cm, typically at 25 cm)	2. Organic	7. Combination	3. Boreal
soil2	3. No tillage - no mixing, no inversion (direct seeding, subsoiler)	3. Mineral	2. H = Herbicides	3. Boreal
soil3	3. No tillage - no mixing, no inversion (direct seeding, subsoiler)	4. Organic+mineral	6. B = Biocides	6. Mediterranean North
soil4	4. Reduced tillage - deep mixing without inversion (cultivator, spader, rotavader till a depth of 15-35 cm)	1. None	2. H = Herbicides	6. Mediterranean North

Figure 3: Checking the data upload - Metadata

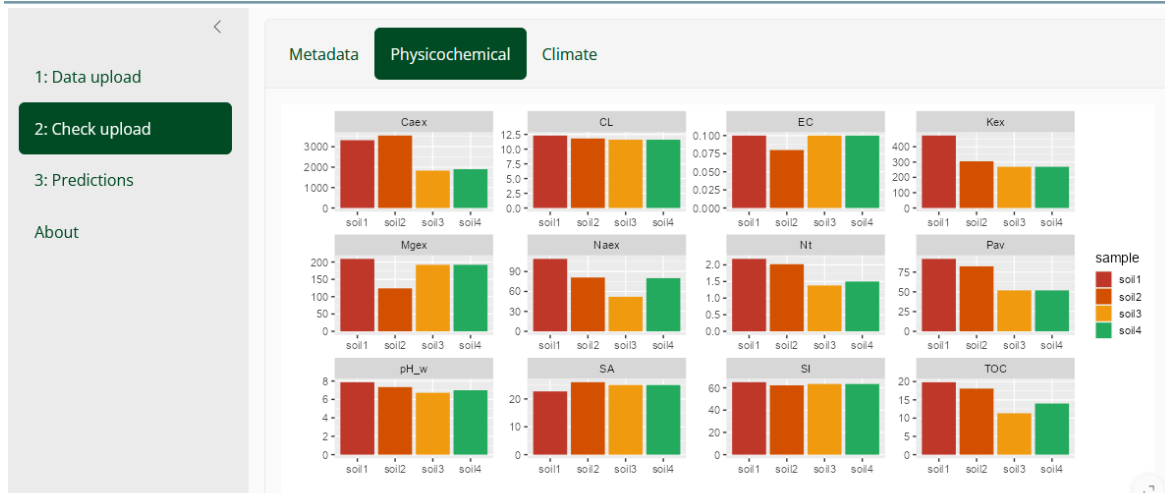


Figure 4: Checking the data upload - Physicochemical

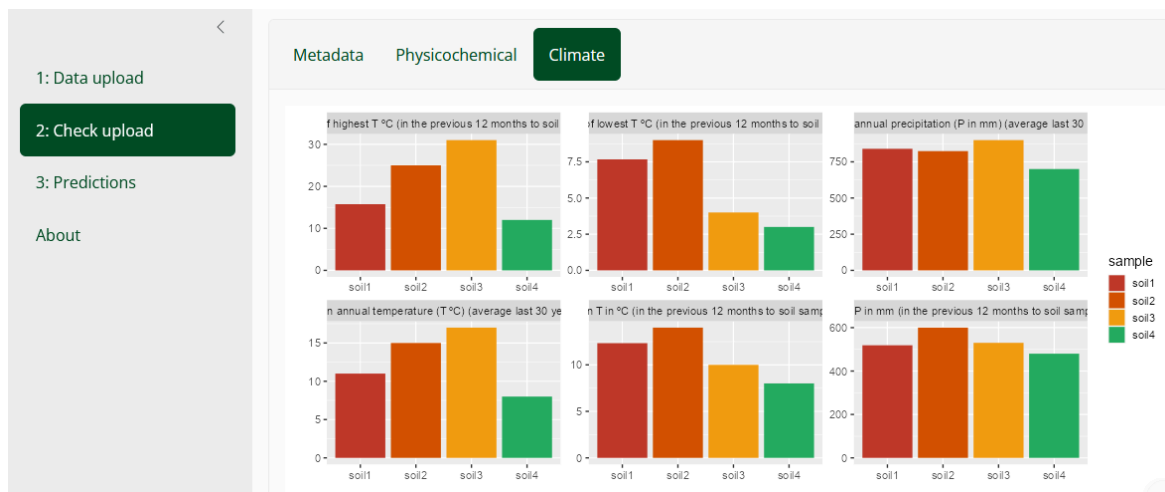


Figure 5: Checking the data upload - Climate

Once the data upload has been checked, you can use the navigation bar to see the model predictions. The DST calculates the predicted yield and the soil biodiversity based on the predictive models built using the data gathered through the SoildiverAgro project. The results are illustrated as depicted in Figure 6. The boxplot shows the yield distribution of every soil studied within the SoildiverAgro project. The model predictions for each soil are shown as vertical dashed lines, with each soil sample uploaded having a different colour. Please note that the plot is interactive, so the numerical values can be obtained by hovering over it.

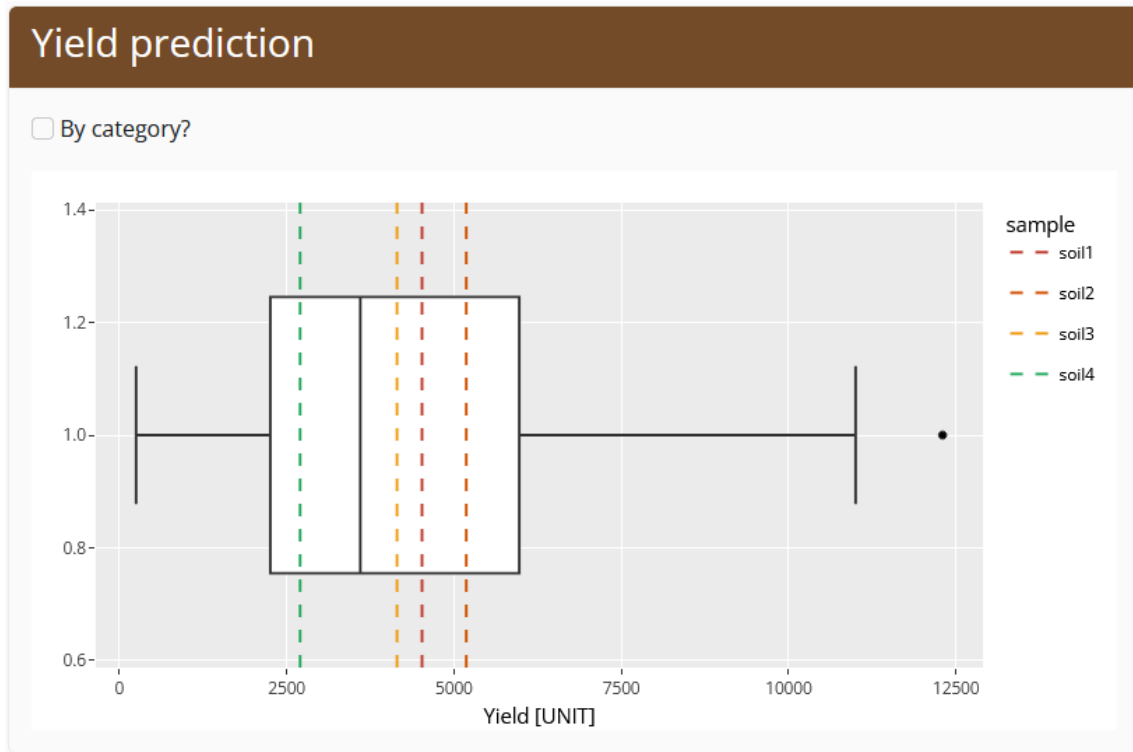


Figure 6: Boxplot of the predicted yield for each soil sample

By default, the DST compares the prediction against every sample gathered during the SoildiverAgro project. By clicking the “By category?” box, the data is grouped by metadata (Figure 7). This allows a more disaggregated comparison of the soil samples uploaded against the SoildiverAgro database.

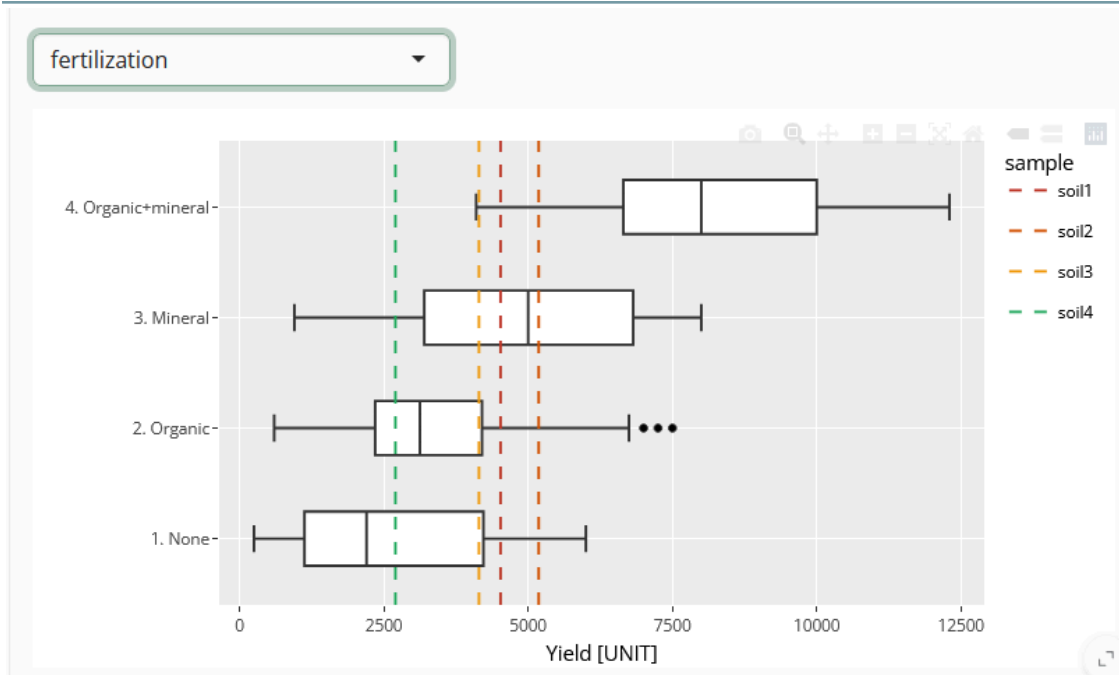


Figure 7: Boxplot of the predicted yield for each soil sample with boxplots by categories

Besides the yield, the application can make similar predictions for the bacterial biodiversity (Figure 8), the fungal biodiversity (Figure 9) and the nematode biodiversity (Figure 10), all of them based on the Chao 1 biodiversity index.

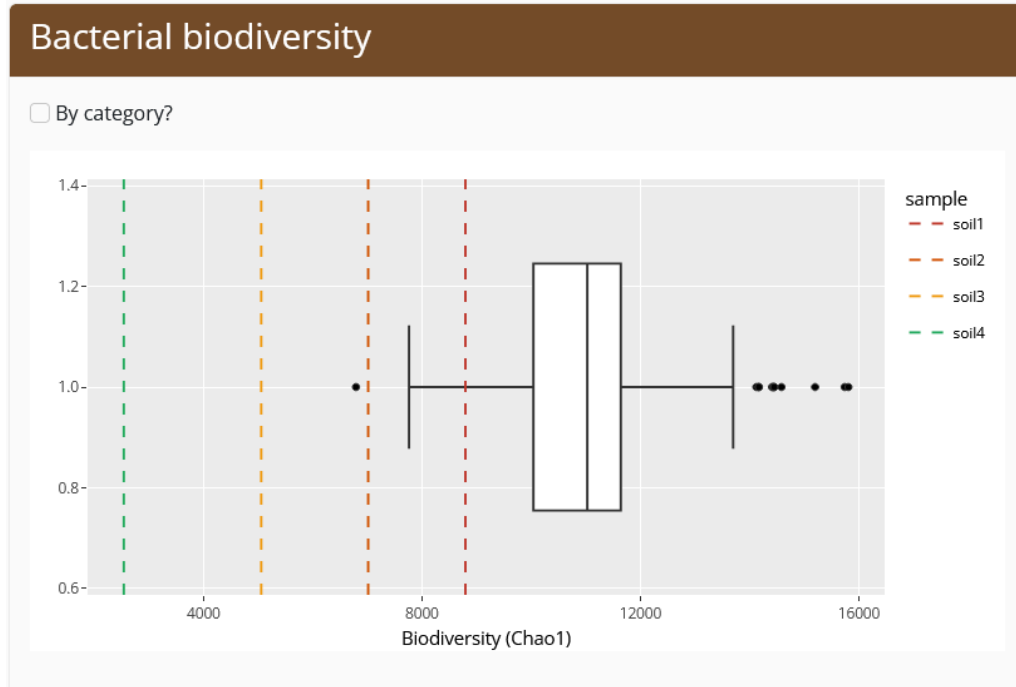


Figure 8: Illustration of the predictions of bacterial biodiversity

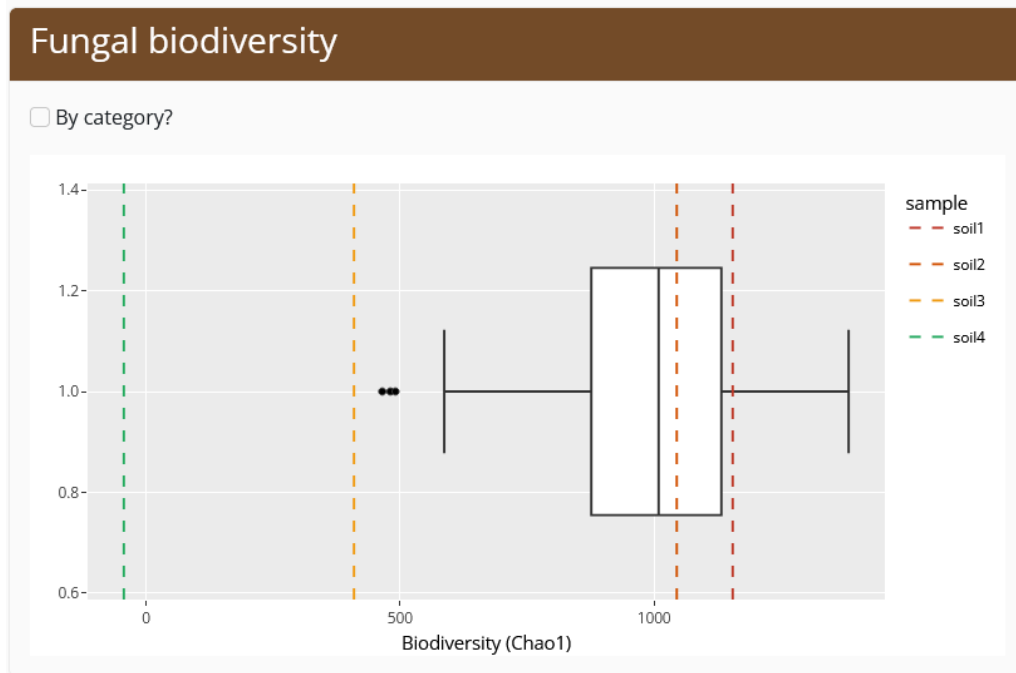


Figure 9: Illustration of the predictions of fungal biodiversity

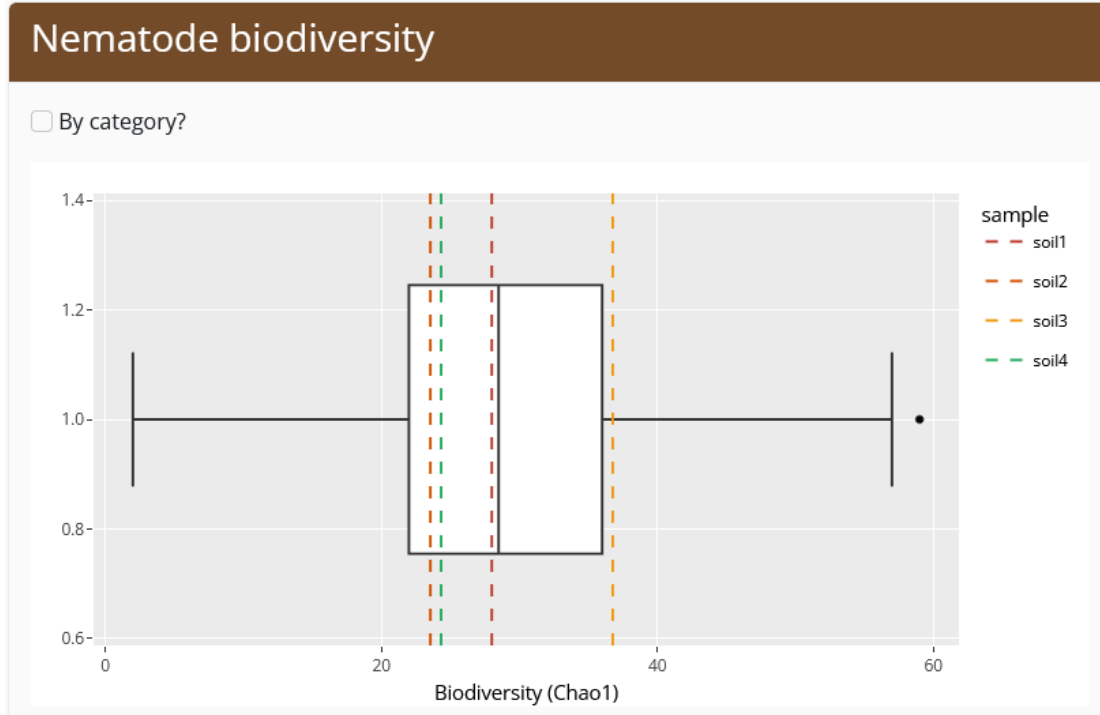


Figure 10: Illustration of the predictions of nematode biodiversity

Besides a graphical comparison, the DST also provides several tables with the numerical values of the prediction. Namely, the application provides the raw predictions (Figure 11), these values represented as percentiles with respect to every sample within the SoildiverAgro project (Figure 12) or as percentiles per pedoclimatic region (Figure 13). The percentiles are grouped the following five categories:

- Low: 0-19%
- Low-medium: 20-39%
- Medium: 40-59%
- Medium-high: 60-79%
- High: >80%

Raw values

Sample code	Bacterial biodiversity	Fungal biodiversity	Nematode biodiversity	Yield [UNIT]
soil1	7607.60	1159.79	27.00	4496.38
soil2	4859.09	1080.76	19.83	5574.90
soil3	8651.35	285.62	42.39	5942.95

Figure 11: Illustration of the raw values output by the application

Percentiles

Sample code	Bacterial biodiversity	Fungal biodiversity	Nematode biodiversity	Yield [UNIT]
soil1	1% (low)	77% (medium-high)	46% (medium)	58% (medium)
soil2	0% (low)	65% (medium-high)	16% (low)	73% (medium-high)
soil3	5% (low)	0% (low)	86% (high)	75% (medium-high)

Figure 12: Illustration of the output of the application as percentiles

Percentiles per region

Sample code	PedoClim region	Bacterial biodiversity	Fungal biodiversity	Nematode biodiversity	Yield [UNIT]
soil1	3. Boreal	0% (low)	75% (medium-high)	35% (low-medium)	74% (medium-high)
soil2	3. Boreal	0% (low)	70% (medium-high)	0% (low)	100% (high)
soil3	6. Mediterranean North	25% (low-medium)	0% (low)	100% (high)	100% (high)

Figure 13: Illustration of the output of the application as percentiles per pedoclimatic region

Contact

For issues not covered in this manual, please contact:

Alberto Garre
 Universidad Politecnica de Cartagena & Instituto de Biotecnología Vegetal
 alberto.garre@upct.es

For bug reports, please use the GitHub page of the application:

<https://github.com/albgarre/biogrowth4>