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SOILPROM

D1.1 Report on SOILPROM specifications and requirements

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SOILPROM

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EXECUTIVE SUMMARY

SOILPROM aims to deliver upgraded and integrated models for the transport and fate of a variety of pollutants through work on 9 use-cases across Europe, and also to create a Modelling Platform (MP) and a Decision Support Tool (DST) for soil pollution process modelling. WP1 is designed for setting the scene for whole project. This report describes the activities conducted in task T1.1 of WP1, i.e., specifications of the use-cases and requirements for the MP and the DST. Specifically, the report includes first a description of the general specificities of the 9 use-cases. The second part elaborates the results of a review on the existing MPs and DSTs. Finally, the functional and non-functional requirements for the MP and the DST of SOILPROM are specified.

General information, environmental context and local policy context for all the SOILPROM use-cases are summarized in individual spreadsheets of an excel file (a pdf version was created as Appendix 1). The use-cases are in Spain, the Netherlands, Belgium, Germany, Poland and Norway, with varying climates and soils. Seven of them are located on agricultural fields/catchments, and two others are former mining and industrial sites. The size of the use-cases varies from 0.2 to about 20,000 ha. The pollutants studied are microplastics, pesticides, metals, PFAS, and nutrients (phosphorus and nitrogen). A total of 13 processes will be studied in the environmental compartments of soil, vegetation, atmosphere, surface water, and groundwater. Furthermore, several ecosystem services (ES), including food production, air quality and regulating and purifying water, will be assessed in the project.

The review of existing MPs showed a lack of MPs that could offer online functionalities for soil pollution process modelling. Thus, the review work was extended to include other relevant disciplines, such as environmental monitoring, hydrological modelling, and agricultural decision support systems. This extended review added valuable insights into various modelling approaches and revealed other functionalities that could be adapted for soil-related applications in SOILPROM. Using a structured protocol, the DST review identified 23 existing DSTs. Various characteristics of the DSTs, including primary purpose and audience, modelling capacity, data source and integration, user interface and experience, technical architecture, and cost and licensing, are summarized in Appendix 2.

The combined findings of the reviews serve as the foundation for further specifying the functional and non-functional requirements of the MP and DST of SOILPROM. By integrating insights from existing solutions and investigated user needs, the report will contribute to the development of a robust and efficient platform that effectively supports stakeholders in soil pollutant management and decision-making processes.

I. SPECIFICITIES OF SOILPROM USE-CASES

i. THE DATA COLLECTION FRAMEWORK

The methodology and data collection framework has been developed in the form of an Excel file, with individual spreadsheets for collecting use-cases' specifications. The full table is given as a pdf file in Appendix 1. The Excel file includes a first sheet with instructions on how to use and fill the tables, and nine individual sheets for collecting relevant information from the use-cases (each per use-case). Researchers who are responsible for the use-cases (i.e., use-case leaders) in each country were asked to gather its general information such as: (a) the environmental context, with data related to soil properties, land use, soil management practices, pollution sources, etc.; and (b) data about the local policy context to contribute to the scenario development in WP3. The sheet for each use-case is therefore organised in three parts, with the following structure:

GENERAL INFORMATION

- Use-Case
- Site name
- Location
- Land use
- Pollutant(s) of concern
- Soil processes
- Environmental compartments (soil, water, air, etc.)
- Ecosystem services provided
- Institution
- Contact person
- Email
- Language of documentation (article, report …)

(A) ENVIRONMENTAL CONTEXT

- Site characteristics
- Meteorology
- Soil
- Crop
- Land management
- Water management
- Monitoring data availability
- Ecosystem services assessed
- Pollution impact

(B) LOCAL POLICY CONTEXT

- Policy details needed for modelling/scenario development
- Policy details needed for the qualitative governance analysis

The use-case leaders provided the required information directly in the table for static data or a link to the data in the case of for instance time series of data. Not all data were available for the parameters listed in the table, and some parameters will be measured in the field later during the course of the project (WP2&WP3). Some parameters are generic for multiple use-cases, and others might be relevant for only a particular use-case. The list of parameters in each sub-category is not exhaustive either and can be completed according to its specifications and needs. The section ECOSYSTEM SERVICES is intended as a preliminary mapping of ES in the use-cases, which will be studied in more detail in T3.4. Therefore, this first screening of the ES reflects only the use-case leaders' current knowledge of the use-cases.

The structure of the data collection framework was validated by all SOILPROM consortium partners in M3 of the project (Milestone MS1.1). The available information for each use-case by M8 has been filled out by the use-case leaders (Appendix 1). Here, we can provide some general information about the use-cases.

ii. General information about SOILPROM use-cases

The 9 use-cases are spread over six countries, i.e., Spain, the Netherlands, Belgium, Germany, Poland and Norway, with coverage from southern, central to northern Europe (Figure I.1). Seven use-cases concern agricultural fields/catchments, while the other two are former mining and industrial sites (Use-case 7 and Use-case 6, respectively). Two of the agricultural sites also include forestry activities (Use-cases 5 and 8). The size of the use-cases ranges from 0.2 ha to about 20,000 ha. The altitude of the use-cases ranges from -0.5 m to 165 m a.s.l., with a relatively flat topography in most of them.

Climate. Long-term mean annual daily temperature varies from 5 °C in the Norwegian site, to around 10 °C in the central European sites, and to 19 °C in the Spanish site. The magnitude of precipitation showed an opposite trend as compared to the temperature. Annual precipitation ranges from 200–500 mm in the Spanish site, to 700–900 mm in the central Europe sites, and to 500–900 mm in the Norwegian site.

Soils. The use-cases cover a large diversity of soils, from Calcisols in Spain, Luvisols and sandy and sandy peat soil in the Netherlands, silt loam soils in the Polish and German use-cases, Planosol in the Norwegian use-case to loamy sand Retisol at the Belgian use-case.

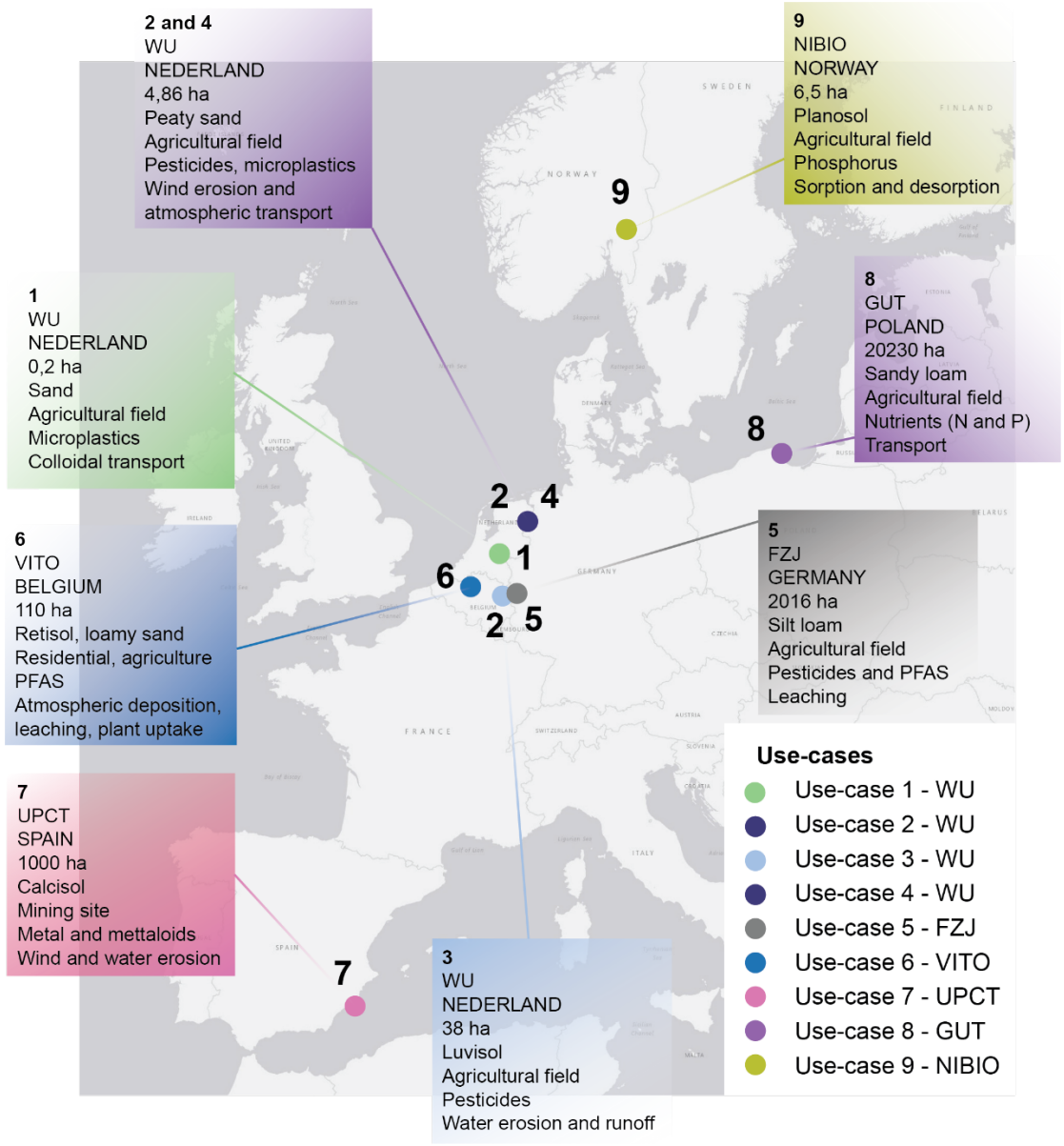

Figure I.1. Map of the locations of SOILPROM use-cases in Europe. Note that use-cases 2 and 4 are located at the same site but for different pollutants.

iii. DESCRIPTION OF THE 9 USE-CASES

The list of the nine use-cases is presented in Table I.1 with their specific pollutants and soil processes to be addressed. Note that use-case 2 and use-case 4 correspond to the same site, but they are dedicated to study different pollutants.

Table I.1 List of the 9 use-cases of SOILPROM.

Pollutant	Use-Cases		Use-Case Leader Organisation	Location
Microplastics	1	Colloidal transport of microplastics in soil	WU	Wageningen, The Netherlands
	2	Wind erosion and atmospheric transport and deposition of dust and microplastics	WU	Valthermond, The Netherlands
Pesticides	3	Water erosion and runoff of dissolved and sediment-bounded pesticides	WU	Limburg, The Netherlands
	4	Wind erosion and atmospheric transport and deposition of dust-bounded pesticides	WU	Valthermond, The Netherlands
	5	Flow of water and transport of pesticides in soils and groundwater	FZJ	Jülich, Germany
PFAS	6	Atmospheric PFAS deposition to soil, and plant uptake of PFAS	VITO	Willebroek, Belgium
Metals	7	Biogeochemistry of metals, and fate and transport of metals due to infiltration and water and wind erosion processes	UPCT	Cartagena-La Unión Mining District, Spain
Nutrients	8	Transport of nutrients in soil, groundwater, and surface water with marine discharge	GUT	Puck bay, Poland
	9	Sorption and desorption of phosphorus in soil, and transport of phosphorus to surface water	NIBIO	Nes, Norway

Use-case 1 – WU

Colloidal transport of microplastics in soil

Use-case 1 is located in the centre of the Netherlands and will focus on colloidal transport of microplastics in an agricultural field. The soil is sandy and not drained, with a quite low pH; and used in rotation with maize and winter wheat, delivering high yields. The soil is ploughed (30 cm) in spring and autumn and fertilized with mineral fertilizer or green manure. The most important ecosystem service for this site is food production.

Use-case 2 – WU

Wind erosion and atmospheric transport and deposition of dust and microplastics

Use-case 2 is located in the northeast of the Netherlands and will focus on wind erosion and atmospheric transport of microplastics in an agricultural field. It will

also be used to study wind erosion and atmospheric transport of pesticides (use-case 4). The soil is organic rich (peaty sand) and used in crop rotation, generally providing high yields. It is ploughed in spring and autumn to 30 cm depth. The most important ecosystem service is air quality.

Use-case 3 – WU
Water erosion and runoff of dissolved and sediment-bounded pesticides
Use-case 3 is located in the southern part of the Netherlands in an agricultural field, and will focus on water erosion and runoff of dissolved and sediment-bounded pesticides. The soil is silty Luvisol with a pH of 6.5 and around 3.6% of organic matter content. The most important ecosystem services are food production, and regulation and purification of water.

Use-cases 4 – WU (same site as use-case 2 but for a different pollutant)
Wind erosion and atmospheric transport and deposition of dust and dust-bounded pesticides
Use-case 4 is located in the northeast of the Netherlands and focuses on wind erosion and atmospheric transport of pesticides. The soil is organic rich (peaty sand) and used in crop rotation, delivering high crop yields. It is plowed in the spring and autumn to 30 cm depth. The most important ecosystem services are food production, and air quality.

Use-case 5 – FZJ
Flow of water and transport of pesticides in soils and groundwater
Use-case 5 is a catchment located in Germany that will focus on the leaching of pesticides in soil and groundwater. The land use is mainly agriculture but with some forest patches. The agricultural soil is a silty loam with 1% of organic matter content. Crop rotation is the main cultivation system, and the soil is generally ploughed until around 30 cm depth. The most important ecosystem services are food production, and regulation and purification of water.

Use-case 6 – VITO
Atmospheric PFAS deposition to soil, and plant uptake of PFAS
Use-case 6 is a former paper factory in Belgium. The site is used in SOILPROM to study the pollution distribution of PFAS. The soil is loamy sandy Retisols with pH of around 6.2. The surroundings consist of residential, agricultural, and natural. The most important ecosystem services of these soils are food production, regulation and purification of water, and pollution attenuation.

Use-case 7 – UPCT
Biogeochemistry of metals, and fate and transport of metals due to infiltration and water and wind erosion processes
Use-case 7 is a former mining site located in Southern Spain and will focus on biogeochemistry of metals and fate and transport due to infiltration and water

erosion processes. The original soils are Calcisols with pH >7. The soil texture is sandy loam to sandy clay loam. The most important ecosystem services of these soils are air quality, regulation and purification of water, and pollution attenuation.

Use-case 8 – GUT

Transport of nutrients in soil, groundwater, and surface water with marine discharge

Use-case 8 is a quite large catchment in Poland with agricultural lands (65%), forested lands (23%), urban areas (10%) and wetland (2%). It is used to study the transport of nutrients (N and P) in soil, surface water and groundwater. Soils are sandy loam. The main crop in this area is winter wheat. The most important ecosystem service of the soils is the purification and cycling of the water.

Use-case 9 – NIBIO

Sorption and desorption of phosphorus in soil, and transport of phosphorus to surface water

Use-case 9 is an agricultural field located in Southeastern Norway that will focus on the sorption and desorption of phosphorus in soil. Soils are Planosols with a silty clay loam texture and pH of around 6.2. The soil is drained and used to grow cereals. The most important ecosystem services of the soil are food production, and the regulation and purification of water.

II. Existing Modelling Platforms (MPs) and Decision Support Tools (DSTs)

i. Introduction and review criteria

As part of the review process for existing MPs and DSTs, AUA and GUT teams analysed available solutions.

For the MP review, the initial search within the soil domain yielded limited results, as no platforms were identified that offered online modelling functionalities. As a result, the scope of the search was broadened to include platforms from other relevant disciplines, such as environmental monitoring, hydrological modelling, and agricultural decision support systems. This expanded investigation provided valuable insights into various modelling approaches, revealing functionalities that could be adapted for soil-related applications. Given this shift in focus, the initial research protocol was redefined to align with the broader evaluation criteria. In parallel with reviewing existing MPs and their technical requirements, a detailed analysis of the essential technical requirements for SOILPROM's MP was conducted. This analysis was informed by an investigation of relevant models and use-cases, ensuring that the platform's specifications are tailored to real-world applications.

The DST review followed a structured protocol and identified 23 existing DSTs. The criteria used for the review are summarized in Table II.1 and the reviewed results are documented in Appendix 2. Specifically, the criteria included primary purpose and audience, modelling capacity, data source and integration, user interface and experience, technical architecture, and cost and licensing, etc. This systematic approach enabled a thorough assessment of the DST landscape, ensuring that the selection of functional and non-functional requirements of the DST is well-informed and aligned with user needs identified in Task 5.1.

The combined findings from both reviews serve as the foundation for specifying the functional and non-functional requirements of the MP and DST. By integrating insights from existing solutions and user needs, the report will contribute to the development of a robust and efficient platform that effectively supports stakeholders in the soil management and decision-making process.

Table II.1 Review criteria for existing MPs and DSTs.

General information	• Platform Name • Developers/Organizations • Platform's purpose and primary audience (e.g., researchers, policymakers, agricultural experts) • Available models (e.g., soil models like HYDRUS, MODFLOW)
Data Sources and Integration	• Type of data used (soil properties, pollutant levels, climate, hydrology, etc.). • Data input formats supported (CSV, shapefiles, GeoJSON, netCDF, etc.). • APIs or external database integration capabilities (Connection to local, national, or European databases). • The ability for users to input their data (manual upload or API-based).
Modelling Capability	• Soil models supported on the platform and requirements? • How does the platform run and process models (cloud-based, server-side, desktop)? • Customization: Can users define parameters for models? Can users build and integrate new models? • Performance: Speed and efficiency of running models (for example, for large-scale or long-term simulations).
User Interface and User Experience	• Ease of use: Is the platform intuitive? Are there training materials or tutorials available? • Visualization capabilities: 2D/3D visualizations, time-lapse features, maps, and graphs. • Interactivity: Can users adjust parameters on the fly and see the effects in real time?
Output and Reporting	• Output formats: What formats are supported (CSV, JSON, shapefiles, reports)? • Visualization of outputs: Is the output easy to interpret? • Custom reports: Can users generate custom reports or downloadable summaries? • Data sharing: Does the platform offer ways to share outputs with stakeholders or integrate results with other tools?

Technical Architecture	• Cloud-based or On-premises: Is the computation handled in the cloud (IaaS, SaaS), or does it require dedicated local infrastructure? • Scalability: How does the platform handle larger datasets or more complex models? • Security and Privacy: How does it handle data security? Are there provisions for handling sensitive data? • Interoperability: How well does the platform work with external tools and data formats? Does it support FAIR (Findable, Accessible, Interoperable, Reusable) principles?
Cost and Licensing	• Cost structure: Is the platform free, open-source, or does it require a subscription/license? • License types: Are there different tiers of access depending on the user's role or organization?

ii. Modelling Platform review

The review of existing MPs was conducted primarily through desktop research, focusing on identifying relevant solutions within the soil and environmental modelling domain. The process involved systematic searches across multiple sources, including academic literature, project databases, and industry reports.

To ensure comprehensive coverage, keyword-based searches were performed in scientific repositories (e.g., Google Scholar, ResearchGate), EU project databases (e.g., CORDIS, Horizon Results Platform), and relevant technical publications. The objective was to identify MPs designed for soil-related simulations, environmental decision support, or broader modelling applications that could be adapted for SOILPROM. Additionally, publicly available documentation, software repositories, and industry white papers were examined to assess existing capabilities and potential gaps in current solutions.

Despite an extensive search, the investigation revealed a lack of directly comparable platforms tailored to soil-specific modelling. Many identified platforms were either proprietary solutions with restricted access, discontinued research prototypes, or general-purpose modelling tools that did not fully align with SOILPROM's objectives. This limitation necessitated a broader perspective, considering insights from related fields such as environmental monitoring, hydrological modelling, and agricultural decision support systems.

It is worth mentioning that while DSTs with modelling capabilities can, in some cases, function similarly to MPs, a distinction was made in this review to ensure a

structured and targeted analysis. However, many DSTs incorporate advanced modelling functionalities, making them valuable references for defining the functional requirements of SOILPROM's platform. By analysing both categories separately, it was possible to extract relevant insights from DSTs while maintaining a clear focus on MPs as adaptable modelling environments, ensuring a well-rounded foundation for the development of SOILPROM's system.

iii. Decision Support Tool review

The review of existing DSTs followed a desktop research approach, focusing on identifying relevant solutions developed through EU-funded projects and privately owned platforms. The investigation yielded mainly DSTs designed for optimizing fertilizer inputs, soil management, and environmental impact assessment.

Publicly available DSTs were identified through systematic searches in EU project repositories (e.g., CORDIS, Horizon Results Platform), scientific literature, and industry reports. Additionally, commercial platforms were considered to understand market trends and the integration of decision-support functionalities. Each identified DST was assessed based on predefined evaluation criteria, including usability, data integration capabilities, and relevance to SOILPROM's objectives.

The review resulted in the identification of 23 DST cases, which were systematically documented in Appendix 2, using the structure for presenting review criteria (Table II.1). The review provides a comparative overview of the selected DSTs, highlighting their functionalities, data sources, and potential applicability to SOILPROM's development.

III. FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS FOR THE MP AND DST OF SOILPROM

This section outlines the key functionalities envisioned for the final version of the SOILPROM MP and DST, scheduled for completion in M46 and subject to validation through D4.1 and D4.2. The functionalities are described in the form of functional and non-functional requirements. Functional requirements define the specific tasks, operations, or features that a system must perform, while non-functional requirements describe the overall quality, performance, and constraints of the system, such as usability, scalability, and security. These categories were used to describe the platform's functionalities to ensure a clear, structured analysis that distinguishes between essential capabilities and broader system attributes, facilitating a comprehensive assessment of existing solutions and guiding the development of SOILPROM's platform.

Given the iterative nature of the platform's development, not all functionalities or their components may be included in the initial (M18) or second (M32) releases. The selection and integration of features will follow a structured prioritization process throughout the design and development phases. This prioritization will be driven primarily by the availability of relevant outcomes, dependencies on other work packages (WPs), and the Technology Readiness Level (TRL) of the proposed functionalities, ensuring a pragmatic and efficient development trajectory.

i. FUNCTIONAL REQUIREMENTS FOR THE MODELLING PLATFORM

The primary objective of the MP is to serve as a centralized hub, enabling users to access the enhanced models developed in WP3 and validated within the project's designated use-cases. In addition to facilitating model access, the platform will guide users in acquiring the necessary data to execute these models effectively.

Beyond providing a unified and structured repository for soil models applicable across diverse scenarios and soil-related processes, the MP offers a key added value: the integration of essential functional scripts. These scripts will enable seamless coupling between models and establish connections to the required databases — an aspect currently lacking in the sector. Given the critical role of model coupling in several SOILPROM project scenarios, the availability of these scripts represents a major advancement, addressing a significant gap and enhancing the overall impact of the platform.

Detailed functional requirements for the modelling platform have been developed by taking into account the needs of potential users of MP and DST, obtained via a survey carried out in Task 5.1. The needs expressed by the potential users were

analysed in SOILPROM Deliverable 5.1 (Hoxa-Jahja et al., 2025). MP functional requirements are listed in Table III.1.

Table III.1 Functional specifications for the MP. The associated user needs (UNOs) correspond to the ones defined by Hoxa-Jahja et al. (2025).

Identifier	Name	Description	Associated User Need(s)
FR01	Model repository	The MP shall provide a structured repository for storing and accessing computational soil models developed within the project.	UN03 UN07 UN08
FR02	Model access	Users shall be able to browse, search, and filter available models based on desired metadata, such as model type, application domain, or required input data.	UN07
FR03	Model metadata	The MP shall maintain metadata for each model, including descriptions, dependencies, version history, and applicable use-cases.	
FR04	Model Integration Packages	The MP shall organize the materials in a structured directory called "Model Integration Packages", containing multiple soil models needed for the implementation of the modelling together with the necessary accompanying data.	UN08 UN09 UN10
FR05	Download Model Integration Packages	The MP shall allow users to download complete Model Integration Packages, including executables, scripts, configuration files, and supporting documentation.	UN08 UN09 UN10
FR06	Download Models	Users shall have the option to perform bulk downloads or selectively retrieve specific components.	
FR07	Functional scripts	The MP shall provide functional scripts that enable seamless coupling between models and external data sources.	
FR08	Scalability	The MP shall be designed to accommodate the integration of additional models, scripts, and functionalities as the project evolves.	

ii. Functional Requirements for the Decision Support Tool

The DST will serve as a key component of the SOILPROM project, enabling users with limited modelling expertise to access essential functionalities of the MP. The DST will provide structured guidance on selecting appropriate models for specific use-cases, identifying relevant input data, and determining the most suitable databases for data storage and retrieval. To facilitate this, the DST will execute a

curated selection of models available on the MP in real time, prioritizing comprehensive use-case coverage and diverse scenario simulations. A core feature of the DST will be its ability to deliver visual representations of model behaviour and outputs, ensuring that users can better interpret simulation results and understand the impact of various pollution processes.

Users can execute models locally, using selected models downloaded from the MP, and integrate EU-wide datasets (e.g., soil, groundwater, land cover, weather) or their own data. We aim to: enable users to select their Region of Interest (ROI) and run the specified models for their case; enable users to set up simulation scenarios, including historical soil contamination and continuous pollutant release, with limited parameter customization; and visualize results through plots and charts and export them in common graphical formats for further analysis. However, these will largely depend on data availability and technical feasibility.

Specific requirements for DST are listed in Table III.2. They are based on the literature review and the needs of potential users identified with the survey and described by Hoxa-Jahja et al. (2025).

Table III.2 Functional specifications for the DST. The associated user needs (UNOs) correspond to the ones defined by Hoxa-Jahja et al. (2025).

Identifier	Name	Description	Associated User Need(s)
FRO9	Ability to work with different models	Users shall be able to work with a selection of models from the MP via the DST.	UNO3
FR10	Guidance in choosing models and databases	Users shall receive guidance on the choice of the models based on the considered pollution processes and on the choice of available databases, based on the considered area and pollution processes.	UNO7
FR11	Executing models locally	Users shall be able to use the DST interface to run a few selected models downloaded from MP. The models should be installed locally on the users' computers.	UNO1 UNO2 UNO5 UNO6
FR12	Importing data from EU-wide databases	Users shall be able to select a specific area on the map of Europe and import a set of basic characteristics from the available databases (soil texture, depth to groundwater, land cover, series of daily weather data) to be used as input data in model simulations.	UNO5
FR13	Accepting user data	Users shall be able to use their own data to substitute data imported from the databases.	UNO1 UNO6 UNO8

FR14	Setting up scenarios	Users shall be able to easily set up their own simulation scenarios by choosing from a pre-defined set of initial and boundary conditions.	UN05 UN06 UN10
FR15	Limited customization of parameters	Users shall be able to modify a limited number of model parameters, which are considered the most important of the pollution processes.	UN08 UN09
FR16	Visualizing simulation results	Users shall be able to visualize the most important outputs from the simulation in the form of plots and charts, depending on the executed model. Users will be able to export the output in common graphical formats.	UN04

iii. NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements define how the system should perform, focusing on attributes like performance, security, usability, reliability, and scalability. Unlike functional requirements, they set standards for system behaviour rather than specific features (Eckhardt et al., 2016).

Performance Requirements
The Performance Requirements section outlines the criteria and expectations for the platform's efficiency and effectiveness in responding to user actions and requests.

Response Time
Response Time refers to the maximum acceptable time for the platform to respond to a user action or request. The platform should function as a progressive web application with swift response times for actions like page loading, transaction processing, and search queries.
Requirement: The platform should respond within a maximum of 2 seconds and normally within 1 second.
Validation: Response time can be monitored in real time on the production server.

Throughput
Throughput represents the number of concurrent user-requests that the platform can handle within a specified timeframe.
Requirement: The platform should process a minimum throughput of 1000 user requests per second.
Validation: Throughput can be tested using load testing on the production server.
Resource Utilization
Resource Utilization refers to the maximum allowed consumption of system resources like CPU, memory, disk usage, and network bandwidth.

Requirement: CPU utilization should remain below 70%, memory below 80%, and disk usage below 70% during normal operations.
Validation: Real-time system monitoring and performance testing can validate resource utilization.

Availability
Availability indicates the desired uptime percentage for the system to be operational for end users.
Requirement: The platform should have a minimum availability of 99.9% during a calendar month.
Validation: Availability can be monitored using uptime and downtime recording tools.

Security Requirements
The Security Requirements section outlines measures to protect the system, its data, and its users from unauthorized access and breaches.

Authorization and Access Control
The platform should enforce authorization and access control policies to restrict user access based on roles and privileges.
Validation: Testing and security assessments ensure the effectiveness of authorization mechanisms.

Data Confidentiality
Sensitive data should be protected using encryption mechanisms during transmission and storage.
Validation: Security assessments and audits validate data confidentiality measures.

Data Integrity
Mechanisms should be in place to detect and prevent unauthorized modifications to data.
Validation: Data integrity measures are validated through testing and audits.

Secure Coding Practices
The platform's source codes should adhere to secure coding practices to mitigate common vulnerabilities.
Validation: Code reviews, static analysis, and security testing validate secure coding practices.

Access Logs
The platform should maintain audit logs of user activities for security incident detection.

Validation: Regular reviews, incident response drills, and audits validate the effectiveness of access logs.

Security Updates

Regular security updates should be applied to address known vulnerabilities and threats.

Validation: Vulnerability scanning and security assessments validate the application of security updates.

IV. REFERENCES AND APPENDICES

Eckhardt, J., Vogelsang, A., & Fernández, D. M. (2016). Are «non-functional» requirements really non-functional?: An investigation of non-functional requirements in practice. Proceedings of the 38th International Conference on Software Engineering, 832–842. https://doi.org/10.1145/2884781.2884788.

Hoxha-Jahja, A., Rezaei, M., Kainulainen, P., & Eskelinen, T. (2025, February). Needs of Modelling Platform (MP) and Decision Support Tool (DST) users. SOILPROM project report – Deliverable 5.1.

Appendix 1. Full table of use-cases parameters.

Appendix 2. Overview of existing DSTs.

Appendix 1: Full table of use-cases parameters.

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Use-cases description framework

Use-Case 1 -WU
Use-Case 2 -WU
Use-Case 3 -WU
Use-Case 4 -WU
Use-Case 5 -FZJ
Use-Case 6 -VITO
Use-Case 7 -UPCT
Use-Case 8 -GUT
Use-Case 9 -NIBIO

*This file has been created by NIBIO and UFZ to help use-case leaders to better define use-cases' specifications (methodology and a data collection framework, MS1, M3).
*The 9 use-cases are provided in seperate sheets. The collumn data can be filled with static parameters with the corresponding unit. **NB: the list of parameters in each sub-category is not exhaustive and can be completed for each site according its specifications.**
*We hope this file will be helpful to use-case leaders for collecting available data and identify needs of additional data for the modeling purpose.
*The sheet includes a **general information** section on top and is then divided into two main sections to describe the **(A) Environmental context** and **(B) the local policy context.**

GENERAL INFORMATION
(A) ENVIRONMENTAL CONTEXT
(B) LOCAL POLICY CONTEXT

The (A) section is divided into sub-categories:	
1.	SITE CHARACTERISTICS
2.	METEOROLOGY
3.	SOIL
4.	CROP
5.	LAND MANAGEMENT
6.	WATER MANAGEMENT
7.	MONITORING - DATA AVAILABILITY
8.	ECOSYSTEM SERVICES
9.	POLLUTION IMPACT

The (B) section is divided into sub-categories:	
1.	Policy details needed for the modelling/scenarios
2.	Policy details needed for the governance analysis

For questions about **Part A Environmental Context**, please contact:
-**Manon Bajard** <manon.bajard@nibio.no>, **Jian Liu** <jian.liu@nibio.no>.
For questions about **Part B Local Policy Context**, please contact:
-**Katharine Heyl** <katharine.heyl@ufz.de> or **Jessica Stubenrauch** <jessica.stubenrauch@ufz.de>.

USE-CASE 1 – WU

GENERAL INFORMATION

Use-Case	#1a
Site name	Wageningen
Location	Central Netherlands
Land use	Agricultural area
Pollutant of concern	Microplastics
Process	Colloidal transport
Compartments	Soil and Water
Ecosystem Services assessed	Regulating and puri (ES mentionned in the Use-Cases table of the proposal)
Institution	WU
Contact person	Nicolas Beriot
Email	nicolas.beriot@wur.nl
Language of documentation (article, report...)	English

parameters	data	unit	static/tin	frequenc	period of comment	link to da
(A) ENVIRONMENTAL CONTEXT						
1. SITE CHARACTERISTICS						
Latitude	51°59'23" N	degrees	static			
Longitude	5°39'40" E	degrees	static			
Altitude	7	m	static			
Size	0,2	ha	static			
Slope	0	degree	static			
2. METEOROLOGY						
climate region	Cfb	Koeppen-Geiger cl	static			
T_average		°C	time serie	time series avaiable in		https://labdata.ps
T_min		°C	time series			
T_max		°C	time series			
precipitation	880	mm	time series			
rain intensity		mm/h	time series			
evapotranspiration		mm/year	time series			
snow length		from dd.mm to dd	time series			
wind speed	2,5	m/s	time series			
wind direction	W-SW-S	-	time series			
solar radiation		MJ/m2/day	time series			
albedo		-	time series			
humidity		%	time series			
3. SOIL						
soil type	Sand	Ref. soil group WR	static			main soil type if large
depth of soil profil		cm	static			
number of layers		#	static			
depth layer 1		cm	static			
depth layer 2		cm	static			
depth layer 3		cm	static			
clay	2	%	static			
silt	13	%	static			
sand	82	%	static			
bulk density	1375	kg/ m3	static			
soil organic matter	2,9	%	static			
pH	5,5	-	static			
CEC	39	mmol+/kg	static			
saturated hydraulic conductivity		cm/day				
soil water content		cm3/cm3	time series			
soil temperature		°C	time series			
redox potential Eh		mV	time series			
electrical conductivity		dS/m				
aggregate stability		%	method to be precise			
total metal/metalloid concentration		mg/kg				
metal/metalloid fractionation		mg/kg				
soil mineralogy	sand					
water soluble ions		mg/kg				
water retention capacity		kPa				
infiltration rate		mm/h				
...						

4. LAND USE			
crop type	crop rotation, 2024 Maize- winter whe		time series
yield level	high	t/ha	time series
sowing date	depending on crop:	dd.mm	time series
harvesting date	depending on crop:	dd.mm	time series
maximum root depth	depending on crop	cm	
catch crops	Maize		
native vegetation canopy		cm	time series
native vegetation height		cm	time series
cattle breeding and grazing	none		
5. LAND MANAGEMENT			
tillage type	plough		
tillage depth	30	cm	
tillage timing	spring and autumn		
residue management			
fertilization type	mineral/ green manaure		
fertilization rate	crop dependent	kg/ha	
fertilization timing	crop dependent		
fertilization method	crop dependent		
6. WATER MANAGEMENT			
drain depth	no drain		
drain distance/intensity	no drain		
irrigation	close to 0	mm/day	time series
depth to groundwater table			
groundwater abstraction			
flow rate		m3/s	time series
7. MONITORING - DATA AVAILABILITY			
monitoring			time series
surface runoff		mm/day	time series
subsurface runoff		mm/day	time series
suspended sediment		kg/ha	time series
nutrient			time series

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all provided

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	10
Support for primary production in ecosystem	5
Habitat for organisms and biodiversity pool	5
Genetic resource, pharmaceuticals resource	2
Decomposition of organic matter and nutrient	7
Carbon sequestration and climate regulation	5
Water purification and cycling	5
Pollution degradation and waste recycling	5
Hydrological control and flood regulation	6
Control and suppression of pests and diseases	7
Provision of raw materials	5
Support for human infrastructure	1
Soil formation, retention and erosion preventio	5
Cultural, historic, spiritual, recreational and scie	10
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that you

	Metals	Pesticides	ficroplastic	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinomycetes)		5	2	2	5
nematodes		4	1	2	4
micro-arthropods (mites, springtails etc)		4	1	2	4
larvae of beetles and flies		4	1	2	4
annelids (earthworms, enchytraeids)		4	1	2	4
ground-dwelling arthropods (spiders, beetles, centipedes, ants ...)		4	1	2	4
slugs and snails		4	1	2	4
vertebrates (rodents, moles ...)		2	1	2	3
plants		5	1	2	5
terrestrial vertebrates (mammals, amphibians, reptiles, birds ...)		5	1	1	5
human		1	1	1	

Is there any non-biotic effect (soil structure, chemistry, ...) of the pollution expected?

.....

(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please add the input

...

...

...

II. Policy details needed for the qualitative governance analysis performed by UFZ

	Name	Website/l	Notes
Local muncipality	Wageningen	https://w	
Regional muncipality	Gelderland	https://w	
Local authority for environmental/soil policy			
Regional authority for environmental/soil policy			
National authority for environmental/soil policy	Ministry of Agricul	https://w	

	Name of the regul	Website/l	Notes
Local soil/environmental legislation (if available policy on the use-c			
Regional soil/environmental legislation (if available policy on the us			
National soil/environmental legislation (if available policy on the u			

USE-CASE 2 – WU

GENERAL INFORMATION

Use-Case	#1b
Site name	Valthermond
Location	Northeast Netherlands
Land use	Agricultural area
Pollutant of concern	Microplastics
Process	Wind erosion and atmospheric transport
Compartments	Soil - Atmosphere
Ecosystem Services assessed	Wind erosion and tillage
Institution	WU
Contact person	Agatha Zamuner and Michel Riksen
Email	michel.riksen@wur.nl agatha.zamuner@wur.nl
Language of documentation (article, report…)	English

parameters	data	unit	static/ti	frequenc	period of comment	link to da
(A) ENVIRONMENTAL CONTEXT						
1. SITE CHARACTERISTICS						
Latitude	52°52'31" N	degrees	static			
Longitude	6°56'00" E	degrees	static			
Altitude	7	m	static			
Size	4,86	ha	static			
Slope	0	degree	static			
2. METEOROLOGY						
climate region	Cfb	Koeppen-Geiger cl	static			
T_average		°C	time series			
T_min		°C	time series			
T_max		°C	time series			
precipitation	880	mm	time series			
rain intensity		mm/h	time series			
evapotranspiration		mm/year	time series			
snow length		from dd.mm to dd	time series			
wind speed	2,5	m/s	time series			
wind direction	W-SW-S	-	time series			
solar radiation		MJ/m2/day	time series			
albedo		-	time series			
humidity		%	time series			
3. SOIL						
soil type	peaty sand	Ref. soil group WR	static			main soil type if large
depth of soil profil		cm	static			
number of layers		#	static			
depth layer 1		cm	static			
depth layer 2		cm	static			
depth layer 3		cm	static			
clay	1	%	static			
silt	26	%	static			
sand	72	%	static			
bulk density	2,6 (mineral materi	g/cm3	static			
soil organic matter	8	%	static			
pH		-	static			
CEC						
saturated hydraulic conductivity		cm/day				
soil water content		cm3/cm3	time series			
soil temperature		°C	time series			
redox potential Eh		mV	time series			
electrical conductivity		dS/m				
aggregate stability		%	method to be precise			
total metal/metalloid concentration		mg/kg				
metal/metalloid fractionation		mg/kg				
soil mineralogy						
water soluble ions		mg/kg				
water retention capacity		kPa				
infiltration rate		mm/h				
…						

4. LAND USE			
crop type	crop rotation		time series
yield level	high	t/ha	time series
sowing date	depending on crop:	dd.mm	time series
harvesting date	depending on crop:	dd.mm	time series
maximum root depth	depending on crop	cm	
catch crops			
native vegetation canopy		cm	time series
native vegetation height		cm	time series
cattle breeding and grazing			
5. LAND MANAGEMENT			
tillage type	plough		
tillage depth	30	cm	
tillage timing	spring and autumn		
residue management			
fertilization type	mineral		
fertilization rate	crop dependent	kg/ha	
fertilization timing	crop dependent		
fertilization method	crop dependent		
6. WATER MANAGEMENT			
drain depth			
drain distance/intensity			
irrigation		mm/day	time series
depth to groundwater table			
groundwater abstraction			
flow rate		m3/s	time series
7. MONITORING - DATA AVAILABILITY			
monitoring	wind, dust, microplastcis		time series
surface runoff		mm/day	time series
subsurface runoff		mm/day	time series
suspended sediment		kg/ha	time series
nutrient			time series

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all provided in the use-case) to 10 (this ecosystem service is the dominant one in the use-case). You can add the same number to more ecosystem services. You cannot leave the ecosystem service without a number.

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	10
Support for primary production in ecosystem	5
Habitat for organisms and biodiversity pool	5
Genetic resource, pharmaceuticals resource	2
Decomposition of organic matter and nutrient	5
Carbon sequestration and climate regulation	3
Water purification and cycling	3
Pollution degradation and waste recycling	6
Hydrological control and flood regulation	2
Control and suppression of pests and diseases	2
Provision of raw materials	5
Support for human infrastructure	1
Soil formation, retention and erosion preventi	9
Cultural, historic, spiritual, recreational and sci	9
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell me
don't know or you don't consider this impact significant. If you consider the impact as significant, fill a number 1 - 5 (low to h

	Metals	Pesticides	Microplastic	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinomycetes)			1		
nematodes			1		
micro-arthropods (mites, springtails etc)			1		
larvae of beetles and flies			2		
annelids (earthworms, enchytraeids)			3		
ground-dwelling arthropods (spiders, beetles, centipedes, ants …)			1		
slugs and snails			1		
vertebrates (rodents, moles …)			2		
plants			1		
terrestrial vertebrates (mammals, amphibians, reptiles, birds …)			2		
human			2		

Is there any non-biotic effect (soil structure, chemistry, …) of the pollution expected?
……

(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please a

no policies in place on plastics
wind erosion control policy
…

II. Policy details needed for the qualitative governance analysis performed by UFZ

wind erosion control policy

	Name	Website/li	Notes
Local muncipality			
Regional muncipality			
Local authority for environmental/soil policy			
Regional authority for environmental/soil policy			
National authority for environmental/soil policy			

	Name of the regula	Website/li	Notes
Local soil/environmental legislation (if available policy on the use-			
Regional soil/environmental legislation (if available policy on the u			
National soil/environmental legislation (if available policy on the u			

USE-CASE 3 – WU

GENERAL INFORMATION

Use-Case	#2a
Site name	Limburg
Location	South of the Netherlands
Land use	Agriculture
Pollutant of concern	Pesticide
Process	Water erosion and surface runoff
Compartments	Soil and Water
Ecosystem Services assessed	(ES mentionned in the Use-Cases table of the proposal)
Institution	WU
Contact person	Caik Oliveira
Email	caik.oliveirademiranda@wur.nl
Language of documentation (article, report...)	Dutch and/or English

parameters	data	unit	static/t	frequen	period	comme	link to d
(A) ENVIRONMENTAL CONTEXT							
1. SITE CHARACTERISTICS							
Latitude	50,9	degrees	static				not to accurate du
Longitude	5,8	degrees	static				not to accurate du
Altitude	80	m	static				
Size	38	ha	static				
Slope	3,5	degree	static				
2. METEOROLOGY							
climate region	Cfb	Koeppen-Geiger cl	static				
T_average	10,7	°C	time series				
T_min		°C	time series				
T_max		°C	time series				
precipitation	757	mm	time series				
rain intensity		mm/h	time series				
evapotranspiration		mm/year	time series				
snow length	0	from dd.mm to dd	time series				
wind speed		m/s	time series				
wind direction		-	time series				
solar radiation		MJ/m2/day	time series				
albedo		-	time series				
humidity		%	time series				
3. SOIL							
soil type	Luvisol	Ref. soil group WR	static				main soil type if la
depth of soil profil	> 2m	cm	static				
number of layers		#	static				
depth layer 1		cm	static				
depth layer 2		cm	static				
depth layer 3		cm	static				
clay	10	%	static				
silt	80	%	static				
sand	10	%	static				
bulk density	1,4	g/cm3	static				
soil organic matter	3,6	%	static				
pH	6,5	-	static				
CEC							
saturated hydraulic conductivity	10	cm/day					
soil water content		cm3/cm3	time series				
soil temperature		°C	time series				
redox potential Eh		mV	time series				
electrical conductivity		dS/m					
aggregate stability		%	method to be precise				
total metal/metalloid concentration		mg/kg					
metal/metalloid fractionation		mg/kg					
soil mineralogy							
water soluble ions		mg/kg					
water retention capacity		kPa					
infiltration rate		mm/h					
...							

4. LAND USE		
crop type		time series
yield level	t/ha	time series
sowing date	dd.mm	time series
harvesting date	dd.mm	time series
maximum root depth	cm	
catch crops		
native vegetation canopy	cm	time series
native vegetation height	cm	time series
cattle breeding and grazing		

5. LAND MANAGEMENT		
tillage type		
tillage depth	cm	
tillage timing		
residue management		
fertilization type		
fertilization rate	kg/ha	
fertilization timing		
fertilization method		

6. WATER MANAGEMENT		
drain depth		
drain distance/intensity		
irrigation	mm/day	time series
depth to groundwater table		
groundwater abstraction		
flow rate	m3/s	time series

7. MONITORING - DATA AVAILABILITY		
monitoring		time series
surface runoff	mm/day	time series
subsurface runoff	mm/day	time series
suspended sediment	kg/ha	time series
nutrient		time series

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all provided in the use-case) to 10 (this ecosystem service is the dominant one in the use-case). You can add the same number to

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	
Support for primary production in ecosystem	
Habitat for organisms and biodiversity pool	
Genetic resource, pharmaceuticals resource	
Decomposition of organic matter and nutrient cycling	
Carbon sequestration and climate regulation	
Water purification and cycling	
Pollution degradation and waste recycling	
Hydrological control and flood regulation	
Control and suppression of pests and diseases	
Provision of raw materials	
Support for human infrastructure	
Soil formation, retention and erosion prevention	
Cultural, historic, spiritual, recreational and scientific values	
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that you don't know or you don't consider this impact significant. If you consider the impact as significant, fill a number 1 - 5 (low

	Metals	Pesticides	icroplasti	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinomycetes)					
nematodes					
micro-arthropods (mites, springtails etc)					
larvae of beetles and flies					
annelids (earthworms, enchytraeids)					
ground-dwelling arthropods (spiders, beetles, centipedes, ants ...)					
slugs and snails					
vertebrates (rodents, moles ...)					
plants					
terrestrial vertebrates (mammals, amphibians, reptiles, birds ...)					
human					

Is there any non-biotic effect (soil structure, chemistry, ...) of the pollution expected?

.....

(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please add th

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...

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II. Policy details needed for the qualitative governance analysis performed by UFZ

	Name	Website	Notes
Local muncipality			
Regional muncipality			
Local authority for environmental/soil policy			
Regional authority for environmental/soil policy			
National authority for environmental/soil policy			

	Name of the regul	Website	Notes
Local soil/environmental legislation (if available policy on the use-			
Regional soil/environmental legislation (if available policy on the us			
National soil/environmental legislation (if available policy on the u			

USE-CASE 4 – WU

GENERAL INFORMATION

Use-Case	#2b
Site name	Valthermond
Location	Northeast Netherlands
Land use	Agricultural area
Pollutant of concern	Pesticides
Process	Wind erosion and atmopsheric transport
Compartments	Soil and atmosphere
Ecosystem Services assessed	Wind erosion an (ES mentionned in the Use-Cases table of the proposal)
Institution	WU
Contact person	Michel Riksen, Dirk Goossens
Email	michel.riksen@wur.nl, dirk.Goossens@wur.nl
Language of documentation (article, report...)	Dutch, English

parameters	data	unit	static/ti	frequenc	period of comment	link to da
(A) ENVIRONMENTAL CONTEXT						
1. SITE CHARACTERISTICS						
Latitude	52°52'31" N	degrees	static			
Longitude	6°56'00" E	degrees	static			
Altitude	7	m	static			
Size	4,86	ha	static			
Slope	0	degree	static			
2. METEOROLOGY						
climate region		Koeppen-Geiger cl	static			
T_average		°C	time series			
T_min		°C	time series			
T_max		°C	time series			
precipitation	880	mm	time series			
rain intensity		mm/h	time series			
evapotranspiration		mm/year	time series			
snow length		from dd.mm to dd	time series			
wind speed	2,85	m/s	time series			
wind direction	W-SW-S	-	time series			
solar radiation		MJ/m2/day	time series			
albedo		-	time series			
humidity		%	time series			
3. SOIL						
soil type	peaty sand	Ref. soil group WR	static			main soil type if large
depth of soil profil		cm	static			
number of layers		#	static			
depth layer 1		cm	static			
depth layer 2		cm	static			
depth layer 3		cm	static			
clay	1	%	static			
silt	26	%	static			
sand	72	%	static			
bulk density	2,6 (mineral mate	g/cm3	static			
soil organic matter	8	%	static			
pH		-	static			
CEC						
saturated hydraulic conductivity		cm/day				
soil water content		cm3/cm3	time series			
soil temperature		°C	time series			
redox potential Eh		mV	time series			
electrical conductivity		dS/m				
aggregate stability		%	method to be precise			
total metal/metalloid concentration		mg/kg				
metal/metalloid fractionation		mg/kg				
soil mineralogy						
water soluble ions		mg/kg				
water retention capacity		kPa				
infiltration rate		mm/h				
...						

4. LAND USE

crop type	crop rotation		time series
yield level	high	t/ha	time series
sowing date	depending on crc	dd.mm	time series
harvesting date	depending on crc	dd.mm	time series
maximum root depth	depending on crc	cm	
catch crops			
native vegetation canopy		cm	time series
native vegetation height		cm	time series
cattle breeding and grazing			

5. LAND MANAGEMENT

tillage type	plough		
tillage depth	30	cm	
tillage timing	spring and autumn		
residue management			
fertilization type	mineral		
fertilization rate	crop dependent	kg/ha	
fertilization timing	crop dependent		
fertilization method	crop dependent		

6. WATER MANAGEMENT

drain depth			
drain distance/intensity			
irrigation		mm/day	time series
depth to groundwater table			
groundwater abstraction			
flow rate		m3/s	time series

7. MONITORING - DATA AVAILABILITY

monitoring	wind, dust, pestic	?	time series
surface runoff		mm/day	time series
subsurface runoff		mm/day	time series
suspended sediment		kg/ha	time series
nutrient			time series

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	
Support for primary production in ecosystem	
Habitat for organisms and biodiversity pool	
Genetic resource, pharmaceuticals resource	
Decomposition of organic matter and nutrient	
Carbon sequestration and climate regulation	
Water purification and cycling	
Pollution degradation and waste recycling	
Hydrological control and flood regulation	
Control and suppression of pests and diseases	
Provision of raw materials	
Support for human infrastructure	
Soil formation, retention and erosion preventio	
Cultural, historic, spiritual, recreational and sci	
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that

	Metals	Pesticides	Microplas	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinor					
nematodes					
micro-arthropods (mites, springtails etc)					
larvae of beetles and flies					
annelids (earthworms, enchytraeids)					
ground-dwelling arthropods (spiders, beetles,					
slugs and snails					
vertebrates (rodents, moles ...)					
plants					
terrestrial vertebrates (mammals, amphibians					
human					

Is there any non-biotic effect (soil structure, chemistry, ...) of the pollution expected?

.....

(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on

...
...
...

II. Policy details needed for the qualitative governance ana

	Name	Website/li	Notes
Local muncipality			
Regional muncipality			
Local authority for environmental/soil policy			
Regional authority for environmental/soil polic			
National authority for environmental/soil polic			

	Name of the regula	Website/li	Notes
Local soil/environmental legislation (if availabl			
Regional soil/environmental legislation (if avail			
National soil/environmental legislation (if avai			

USE-CASE 5 – FZJ

GENERAL INFORMATION

Use-Case	#3
Site name	Jülich Zwischenscholle
Location	Rur catchment
Land use	mainly agriculture but also forest patches
Pollutant of concern	pesticides and PFAS (single hotspots)
Process	deep leaching of pesticides and PFAS
Compartments	soil and groundwater
Ecosystem Services assessed	Regulating and pu (ES mentionned in the Use-Cases table of the proposal)
Institution	FZJ
Contact person	Lutz Weihermüller, Jan Vanderborght, Ali Sadrzadeh
Email	l.weihermueller@fz-juelich.de; j.vanderborght@fz-juelich.de; a.sadrzadeh@fz-juelich.de
Language of documentation (article, report...)	German / English

parameters	data	unit	static/ti	frequenc	period of commen	link to da
(A) ENVIRONMENTAL CONTEXT						
1. SITE CHARACTERISTICS						
Latitude	50,8726	degrees	static			
Longitude	6,4486	degrees	static			
Altitude	~100	m	static			
Size	2016	ha	static			
Slope	quite flat	degree	static			
2. METEOROLOGY						
climate region		Koeppen-Geiger cl	static			
T_average	Yes (mean = 10.2°	°C	time serie	15 minute	1983 -recent	http://tec
T_min	Yes	°C	time serie	15 minute	1983 -recent	http://tec
T_max	Yes	°C	time serie	15 minute	1983 -recent	http://tec
precipitation	Yes (mean = 715 m	mm	time serie	15 minute	1983 -recent	http://tec
rain intensity		mm/h	time series			
evapotranspiration		mm/year	time series			
snow length		from dd.mm to dd	time series			
wind speed	Yes	m/s	time serie	15 minute	1983 -recent	http://tec
wind direction		-	time series			
solar radiation	Yes	MJ/m2/day	time serie	15 minute	1983 -recent	http://tec
albedo		-	time series			
humidity	Yes	%	time serie	15 minute	1983 -recent	http://tec
3. SOIL						
soil type	silt loam	Ref. soil group WR	static		main soil type if larg	
depth of soil profil	100 3000	cm	static		as this is part of a ct	
number of layers	site dependent	#	static		as this is part of a ct	
depth layer 1		cm	static			
depth layer 2		cm	static			
depth layer 3		cm	static			
clay	~20	%	static		as this is part of a ct	
silt	~70	%	static		as this is part of a ct	
sand	~10	%	static		as this is part of a ct	
bulk density	1,5	g/cm3	static		as this is part of a ct	
soil organic matter	1	%	static		as this is part of a ct	
pH		-	static		as this is part of a ct	
CEC						
saturated hydraulic conductivity		cm/day				
soil water content		cm3/cm3	time series			
soil temperature		°C	time series			
redox potential Eh		mV	time series			
electrical conductivity		dS/m				
aggregate stability		%	method to be precise			
total metal/metalloid concentration		mg/kg				
metal/metalloid fractionation		mg/kg				
soil mineralogy						
water soluble ions		mg/kg				
water retention capacity		kPa				
infiltration rate		mm/h				
...						

4. LAND USE				
crop type	crop rotation		time series	
yield level	high	t/ha	time series	
sowing date	depending on crop	dd.mm	time series	
harvesting date	depending on crop	dd.mm	time series	
maximum root depth	depending on crop	cm		
catch crops				
native vegetation canopy		cm	time series	
native vegetation height		cm	time series	
cattle breeding and grazing				
5. LAND MANAGEMENT				
tillage type	plough			
tillage depth	30	cm		
tillage timing				
residue management				
fertilization type	mineral and organic			
fertilization rate	crop dependent	kg/ha		
fertilization timing	crop dependent			
fertilization method	crop dependent			
6. WATER MANAGEMENT				
drain depth	no drains			
drain distance/intensity				
irrigation	only minor areas	mm/day	time series	
depth to groundwater table				
groundwater abstraction				
flow rate		m3/s	time series	
7. MONITORING - DATA AVAILABILITY				
monitoring	groundwater levels and pesticides		time series	https://w
surface runoff	no	mm/day	time series	
subsurface runoff	no	mm/day	time series	
suspended sediment	no	kg/ha	time series	
nutrient	no		time series	

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	9
Support for primary production in ecosystem	??
Habitat for organisms and biodiversity pool	8
Genetic resource, pharmaceuticals resource	0
Decomposition of organic matter and nutrient	9
Carbon sequestration and climate regulation	9
Water purification and cycling	9
Pollution degradation and waste recycling	2
Hydrological control and flood regulation	2
Control and suppression of pests and diseases	10
Provision of raw materials	6
Support for human infrastructure	4
Soil formation, retention and erosion preventi	2
Cultural, historic, spiritual, recreational and sci	2
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that

	Metals	Pesticides	Microplas	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinor					
nematodes					
micro-arthropods (mites, springtails etc)					
larvae of beetles and flies					
annelids (earthworms, enchytraeids)					
ground-dwelling arthropods (spiders, beetles,					
slugs and snails					
vertebrates (rodents, moles ...)					
plants					
terrestrial vertebrates (mammals, amphibians					
human					

Is there any non-biotic effect (soil structure, chemistry, ...) of the pollution expected?

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(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please add the inp

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II. Policy details needed for the qualitative governance analysis performed by UFZ

	Name	Website/l	Notes
Local muncipality	City of Jülich, City	www.juel	
Regional muncipality	Düren	https://w	
Local authority for environmental/soil policy	Düren	https://w	not sure about
Regional authority for environmental/soil policy	Landesamt für Nat	https://w	
National authority for environmental/soil policy	Bundesumweltam	https://w	not sure about

	Name of the regul	Website/l	Notes
Local soil/environmental legislation (if available policy on the use	Erftverband	https://w	maybe not responsible for the legislatio
Regional soil/environmental legislation (if available policy on the			not sure about
National soil/environmental legislation (if available policy on the			not sure about

USE-CASE 6 – VITO

GENERAL INFORMATION

Use-Case	#5
Site name	Former paper factory Willebroek
Location	Willebroek, Belgium
Land use	Residential, agriculture, nature
Pollutant of concern	PFAS
Process	Atmospheric deposition + leaching + plant uptake
Compartments	Atmosphere, Soil, Groundwater, vegetation
Ecosystem Services assessed	Purification of w (ES mentionned in the Use-Cases table of the proposal)
Institution	VITO
Contact person	Michiel Maertens
Email	michiel.maertens@vito.be
Language of documentation (article, report…)	Dutch, English

parameters	data	unit	static/ti	frequenc	period of comment	link to da
(A) ENVIRONMENTAL CONTEXT						
1. SITE CHARACTERISTICS						
Latitude	51,06146113	degrees	static			
Longitude	4,364596054	degrees	static			
Altitude	5	m	static			
Size	110	ha	static			
Slope	na	degree	static			
2. METEOROLOGY						
climate region	Cfb	Koeppen-Geiger cl	static			
T_average	12,2°C	°C	time series			
T_min	7,3	°C	time serie			https://www.meteo.be/nl/klimaat/klimaa
T_max	14,7	°C	time serie			https://www.meteo.be/nl/klimaat/klimaa
precipitation	837	mm	time series			
rain intensity		mm/h	time series			
evapotranspiration	616	mm/year	time serie			PET: https://vmm.vlaanderen.be/feiten-cl
snow length	0	from dd.mm to dd	time series			
wind speed	3,5	m/s	time serie			https://www.meteo.be/nl/klimaat/klimaa
wind direction	South-West as m	-	time series			
solar radiation		MJ/m2/day	time series			
albedo		-	time series			
humidity		%	time series			
3. SOIL						
soil type	Retisol/loamy san	Ref. soil group WRI	static			main soil type if large
depth of soil profil	200	cm	static			
number of layers	1	#	static			
depth layer 1	200	cm	static			
depth layer 2		cm	static			
depth layer 3		cm	static			
clay	12	%	static			https://www.dov.vlaanderen.be/portaal/
silt	33	%	static			
sand	55	%	static			
bulk density	1,5	g/cm3	static			
soil organic matter		%	static			
pH	6,2	-	static			
CEC						
saturated hydraulic conductivity		cm/day				
soil water content		cm3/cm3	time series			
soil temperature		°C	time series			
redox potential Eh		mV	time series			
electrical conductivity		dS/m				
aggregate stability		%	method to be precise			
total metal/metalloid concentration		mg/kg				
metal/metalloid fractionation		mg/kg				
soil mineralogy						
water soluble ions		mg/kg				
water retention capacity		kPa				
infiltration rate		mm/h				
…						

4. LAND USE			
crop type	maize/grassland/nature/urban		time series
yield level		t/ha	time series
sowing date		dd.mm	time series
harvesting date		dd.mm	time series
maximum root depth		cm	
catch crops			
native vegetation canopy		cm	time series
native vegetation height		cm	time series
cattle breeding and grazing	na		
5. LAND MANAGEMENT			
tillage type			
tillage depth		cm	
tillage timing			
residue management			
fertilization type			
fertilization rate		kg/ha	
fertilization timing			
fertilization method			
6. WATER MANAGEMENT			
drain depth	unknown		
drain distance/intensity	unknown		
irrigation	unknown	mm/day	time series
depth to groundwater table	200	cm	
groundwater abstraction	none		
flow rate	na	m3/s	time series
7. MONITORING - DATA AVAILABILITY			
monitoring	groundwater levels and PFAS concen		time series
surface runoff	na	mm/day	time series
subsurface runoff	na	mm/day	time series
suspended sediment	na	kg/ha	time series
nutrient	not relevant		time series

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	10
Support for primary production in ecosystem	3
Habitat for organisms and biodiversity pool	4
Genetic resource, pharmaceuticals resource	0
Decomposition of organic matter and nutrient	5
Carbon sequestration and climate regulation	0
Water purification and cycling	10
Pollution degradation and waste recycling	10
Hydrological control and flood regulation	0
Control and suppression of pests and diseases	0
Provision of raw materials	0
Support for human infrastructure	8
Soil formation, retention and erosion preventi	5
Cultural, historic, spiritual, recreational and sc	3
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that

	Metals	Pesticides	Microplast	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actino					
nematodes					
micro-arthropods (mites, springtails etc)					
larvae of beetles and flies					
annelids (earthworms, enchytraeids)					
ground-dwelling arthropods (spiders, beetles,					
slugs and snails					
vertebrates (rodents, moles …)					
plants					
terrestrial vertebrates (mammals, amphibians					
human					

Is there any non-biotic effect (soil structure, chemistry, …) of the pollution expected?

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(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please add the inpu

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II. Policy details needed for the qualitative governance analysis performed by UFZ

	Name	Website/li	Notes
Local muncipality	Willebroek		
Regional muncipality	Province of Antwe		
Local authority for environmental/soil policy	municipality of Wil		
Regional authority for environmental/soil policy	OVAM/VMM		
National authority for environmental/soil policy	na		

	Name of the regula	Website/li	Notes
Local soil/environmental legislation (if available policy on the us	na		
Regional soil/environmental legislation (if available policy on the	Soil Decree/Vlarebo	https://navigator.emis.vito.be/	
National soil/environmental legislation (if available policy on th	na - environmenta		

USE-CASE 7 – UPCT

GENERAL INFORMATION

Use-Case	#4
Site name	Cartagena-La Unión Mining District
Location	Region of Murcia (SE Spain)
Land use	No current use/abandoned agricultural areas/forest areas/peri-urban areas
Pollutant of concern	Metals and metalloids
Process	Biogeochemistry, Wind Erosion, Water Erosion
Compartments	Soil, Air, Water
Ecosystem Services assessed	Air quality, Regul (ES mentionned in the Use-Cases table of the proposal)
Institution	UPCT
Contact person	Mª Nazaret González Alcaraz
Email	nazaret.gonzalez@upct.es
Language of documentation (article, report…)	English, Spanish

parameters	data	unit	static/ti	frequenc	period of comment	link to da
(A) ENVIRONMENTAL CONTEXT						
1. SITE CHARACTERISTICS						
Latitude	37°37'20" N-37°4	degrees	static		latitude da	http://sian
Longitude	0°50'55" W–0°48'	degrees	static		longitude	http://sian
Altitude	0-110 a.s.l.	m	static		altitude da	http://sian
Size	aprox. 10 km2	ha	static		It corresponds to the	
Slope	See comment	degree	static		It depends on the spe	
2. METEOROLOGY						
climate region	BSk and BSh	Koeppen-Geiger cl	static		The case s	https://ed
T_average	18.54°C-19.39°C	°C	time serie	daily, mon	from 18/1 data corre	http://sian
T_min	3.64°C-10.36°C	°C	time serie	daily, mon	from 18/1 data corre	http://sian
T_max	28.24°C-32.04°C	°C	time serie	daily, mon	from 18/1 data corre	http://sian
precipitation	215.50mm-461.9	mm	time serie	daily, mon	from 18/1 data corre	http://sian
rain intensity			time series		Not available	
evapotranspiration	980.88mm-1138.	mm/year	time serie	daily, mon	from 18/1 data corre	http://sian
snow length		from dd.mm to dd	time series		Not available	
wind speed	1.36m/s-1.55 m/	m/s	time serie	daily, mon	from 18/1 data corre	http://sian
wind direction		-	time series		Not available	
solar radiation	5295.50 MJ/m2-6	MJ/m2	time serie	daily, mon	from 18/1 data corre	http://sian
albedo		-				
humidity	69.78%-73.07%	%	time serie	daily, mon	from 18/1 data corre	http://sian
3. SOIL						
soil type	Calcisols (in area	Ref. soil group WR	static			
depth of soil profil	See comment	cm	static		In water courses dep	
number of layers	See comment	#	static		In water courses dep	
depth layer 1	See comment	cm	static		In water courses it m	
depth layer 2		cm	static		Not applicable	
depth layer 3		cm	static		Not applicable	
clay	~20% (natural so	%	static		Mining se	Bibliograp
silt	~20% (natural so	%	static		Mining se	Bibliograp
sand	~60% (natural so	%	static		Mining se	Bibliograp
bulk density	~0.5 g/cm3 (natu	g/cm3	static		Mining se	Bibliograp
soil organic matter	>2% (natural soil	%	static		Mining se	Bibliograp
pH	>7.0 (natural soil	-	static		Mining se	Bibliograp
CEC	>20 cmol/kg (natural soils) and <15		static		Data of 1:	Bibliograp
saturated hydraulic conductivity	see comment	cm/day	static		Mining se	Data to be
soil water content	see comment	cm3/cm3	static		Mining se	Data to be
soil temperature	see comment	°C	static		Mining se	Data to be
electrical conductivity	<1 dS/m (natural	dS/m	static		Data of 1:	Bibliograp
aggregate stability	see comment	%	static		Mining se	Data to be
total metal/metalloid concentration	e.g. <1000 mg/kg	mg/kg	static		Mining se	Bibliograpl
metal/metalloid fractionation	e.g. <50 µg/kg wa	mg/kg	static		Mining se	Bibliograp
soil mineralogy	e.g. Quartz, Magnesium calcite, Dolc		static	(natural soils) and Quartz, Magnetite, Goethite,		Beudantite, Sphalerite, Faujasite (mining wastes)
water soluble ions	e.g. <50 mg/L SO	mg/kg or µg/kg	static		Mining se	Bibliograp
water retention capacity	see comment	kPa	static		Mining se	Data to be
infiltration rate	see comment	mm/h	static		Mining se	Data to be
redox potential Eh	see comment	mV	static		Mining se	Data to be

4. LAND USE

crop type		time series	**Not applicable**
yield level	t/ha	time series	**Not applicable**
sowing date	dd.mm	time series	**Not applicable**
harvesting date	dd.mm	time series	**Not applicable**
maximum root depth	cm		**Not applicable**
catch crops			**Not applicable**
native vegetation canopy	cm	static	Mining se Data to be
native vegetation height	cm	static	Mining se Data to be
cattle breeding and grazing			

5. LAND MANAGEMENT

tillage type		**Not applicable**
tillage depth	cm	**Not applicable**
tillage timing		**Not applicable**
residue management		**Not applicable**
fertilization type		**Not applicable**
fertilization rate	kg/ha	**Not applicable**
fertilization timing		**Not applicable**
fertilization method		**Not applicable**

6. WATER MANAGEMENT

drain depth		**Not applicable**
drain distance/intensity		**Not applicable**
irrigation	mm/day	**Not applicable**
flow rate	m3/s	**Not applicable**
depth to groundwater table		**Not applicable**
groundwater abstraction		**Not applicable**

7. MONITORING - DATA AVAILABILITY

monitoring		time series	**Not applicable**
surface runoff	mm/day	time series	**Not applicable**
subsurface runoff	mm/day	time series	**Not applicable**
suspended sediment	kg/ha	time series	**Not applicable**
nutrient		time series	**Not applicable**

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	0
Support for primary production in ecosystem	5
Habitat for organisms and biodiversity pool	7
Genetic resource, pharmaceuticals resource	0
Decomposition of organic matter and nutrient	5
Carbon sequestration and climate regulation	7
Water purification and cycling	7
Pollution degradation and waste recycling	7
Hydrological control and flood regulation	8
Control and suppression of pests and diseases	0
Provision of raw materials	0
Support for human infrastructure	0
Soil formation, retention and erosion preventi	8
Cultural, historic, spiritual, recreational and sci	6
Other (describe .....)	-

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that

	Metals	Pesticides	Microplas	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinor	X				
nematodes	X				
micro-arthropods (mites, springtails etc)	X				
larvae of beetles and flies	X				
annelids (earthworms, enchytraeids)	X				
ground-dwelling arthropods (spiders, beetles,	X				
slugs and snails	X				
vertebrates (rodents, moles ...)	X				
plants	X				
terrestrial vertebrates (mammals, amphibians	X				
human	X				

Is there any non-biotic effect (soil structure, chemistry, ...) of the pollution expected?

In areas with accumulation of mining sediment --> impaired soil structure, alteration of chemical soil properties (pH, EC, high metal conc

(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please add the inp

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II. Policy details needed for the qualitative governance analysis performed by UFZ

	Name	Website/li	Notes
Local muncipality	City of Cartagena,	https://w	
Regional muncipality	Comunidad Autón	https://w	
Local authority for environmental/soil policy	Concejalía de Presi	https://ur	
Regional authority for environmental/soil policy	Consejería de Med	https://w	
National authority for environmental/soil policy	Ministerio para la	https://w	

	Name of the regula	Website/li	Notes
Local soil/environmental legislation (if available policy on the us	Not available		
Regional soil/environmental legislation (if available policy on the	Not available		
National soil/environmental legislation (if available policy on th	Ley 7/2022, de 8 d	https://www.boe.es/buscar/act.php?id=BOE-A-202	
National soil/environmental legislation (if available policy on th	Real Decreto 9/20(	https://www.boe.es/buscar/act.php?id=BOE-A-200	

USE-CASE 8 – GUT

GENERAL INFORMATION

Use-Case	#7
Site name	Puck Bay
Location	Poland (southern Baltic Sea)
Land use	agricultural (65%), forest (23%), urban (10%), wetland (2%)
Pollutant of concern	Nutrients (mainly nitrate and phosphorous)
Process	mineralization, nitrification, denitrification, sorption, transport of pollutants from soil to t
Compartments	soil, groundwater
Ecosystem Services assessed	regulating and pı (ES mentionned in the Use-Cases table of the proposal)
Institution	GUT
Contact person	Beata Jaworska-Szulc, Dawid Potrykus
Email	beata.jaworska-szulc@pg.edu.pl, dawid.potrykus@pg.edu.pl
Language of documentation (article, report…)	English, Polish

parameters	data	unit	static/ti	frequenc	period of comment	link to da
(A) ENVIRONMENTAL CONTEXT						
1. SITE CHARACTERISTICS						
Latitude	54,6910	degrees	static			
Longitude	18,3897	degrees	static			
Altitude	from -0.5 to 110.	m	static			up to 10 m for ice-ma
Size	20230	ha	static			
Slope	The terrain is a fl	degree	static			The areas with the hi
2. METEOROLOGY						
climate region		Koeppen-Geiger cl	static			
T_average		°C	time series			
T_min		°C	time series			
T_max		°C	time series			
precipitation		mm	time series			
rain intensity		mm/h	time series			
evapotranspiration		mm/year	time series			
snow length		from dd.mm to dd	time series			
wind speed		m/s	time series			
wind direction		-	time series			
solar radiation		MJ/m2/day	time series			
albedo		-	time series			
humidity		%	time series			
3. SOIL						
soil type	sandy loam	Ref. soil group WR	static			main soil type if large
depth of soil profil	1500	cm	static			
number of layers	1	#	static			
depth layer 1	1500	cm	static			
depth layer 2	-	cm	static			
depth layer 3	-	cm	static			
clay	15	%	static			
silt	28	%	static			
sand	58	%	static			
bulk density	1,5	g/cm3	static			
soil organic matter	4	%	static			
pH		-	static			
CEC						
saturated hydraulic conductivity	0,12	cm/day				
soil water content	0,185	cm3/cm3	time series			
soil temperature		°C	time series			
redox potential Eh		mV	time series			
electrical conductivity		dS/m				
aggregate stability		%	method to be precise			
total metal/metalloid concentration		mg/kg				
metal/metalloid fractionation		mg/kg				
soil mineralogy						
water soluble ions		mg/kg				
water retention capacity		kPa				
infiltration rate		mm/h				
…						

4. LAND USE

crop type	crop rotation (main crops: winter w		time series	https://pe	based on the results
yield level	depending on cro	t/ha	time series	https://pe	based on the results
sowing date	depending on cr	dd.mm	time series	https://pe	based on the results
harvesting date	depending on cr	dd.mm	time series	https://pe	based on the results
maximum root depth		cm			
catch crops					
native vegetation canopy		cm	time series		
native vegetation height		cm	time series		
cattle breeding and grazing					

5. LAND MANAGEMENT

tillage type	Harrowing and			https://pe	based on the results
tillage depth	2.5 - 15.0	cm		https://pe	based on the results
tillage timing	depending on crops			https://pe	based on the results
residue management					
fertilization type	mineral, natural (e.g. manure)			https://pe	based on the results
fertilization rate	The average con	kg/ha		https://pe	based on the results
fertilization timing	depending on crops			https://pe	based on the results
fertilization method	Side-Dressing; Banding; Foliar Feeding			https://pe	based on the results

6. WATER MANAGEMENT

drain depth	up to 1 m				
drain distance/intensity					
irrigation	NoData	mm/day	time series		
depth to groundwater table					
groundwater abstraction					
flow rate		m3/s	time series		

7. MONITORING - DATA AVAILABILITY

monitoring	groundwater level monitoring		time serie	daily	groundwater level m
surface runoff	no	mm/day	time series		
subsurface runoff	no	mm/day	time series		
suspended sediment	no	kg/ha	time series		
nutrient	yes		time serie	yearly	municipal groundwat

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	7
Support for primary production in ecosystem	7
Habitat for organisms and biodiversity pool	5
Genetic resource, pharmaceuticals resource	0
Decomposition of organic matter and nutrient	7
Carbon sequestration and climate regulation	3
Water purification and cycling	10
Pollution degradation and waste recycling	5
Hydrological control and flood regulation	7
Control and suppression of pests and diseases	0
Provision of raw materials	5
Support for human infrastructure	5
Soil formation, retention and erosion preventi	5
Cultural, historic, spiritual, recreational and sci	7
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that

	Metals	Pesticides	Microplas	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinor					
nematodes					
micro-arthropods (mites, springtails etc)					
larvae of beetles and flies					
annelids (earthworms, enchytraeids)					
ground-dwelling arthropods (spiders, beetles,					
slugs and snails					
vertebrates (rodents, moles …)					
plants					
terrestrial vertebrates (mammals, amphibians					
human					

Is there any non-biotic effect (soil structure, chemistry, …) of the pollution expected?

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(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please add the inpu

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II. Policy details needed for the qualitative governance analysis performed by UFZ

	Name	Website/li	Notes
Local muncipality			
Regional muncipality	Municipality of Puc	https://gr	
Local authority for environmental/soil policy			
Regional authority for environmental/soil policy	General Directorat	https://ws	
National authority for environmental/soil policy	Ministry of Climate	https://ws	
National authority for environmental/soil policy	The Institute of Soi	https://en.iung.pl/	

	Name of the regula	Website/li	Notes
Local soil/environmental legislation (if available policy on the us			
Regional soil/environmental legislation (if available policy on the			
National soil/environmental legislation (if available policy on th	Rozporządzenie Ra	https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=	

USE-CASE 9 – NIBIO

GENERAL INFORMATION

Use-Case	#6
Site name	NES, Vandsemb
Location	SE Norway
Land use	Agricultural field
Pollutant of concern	Nutrient (particularly phosphorus) losses from fertilization and erosion
Process	Sorption and desorption of phosphorus in the soil, transport of phosphorus from soil
Compartments	Soil, water
Ecosystem Services assessed	Regulating and purif (ES mentionned in the Use-Cases table of the proposal)
Institution	NIBIO
Contact person	Jian Liu
Email	Jian.liu@nibio.no
Language of documentation (article, report…)	Norwegian, English

parameters	data	unit	static/t	frequen	period	ccomme	link to d
(A) ENVIRONMENTAL CONTEXT							
1. SITE CHARACTERISTICS							
Latitude	60° 07′ 39.6″ N	degrees	static				
Longitude	11° 23′ 45.1″ E	degrees	static				
Altitude	165	m	static				
Size	6,5	ha	static			6.5 ha for drainag	
Slope	0-6%	degree	static				
2. METEOROLOGY							
climate region	Dfc - Snow-Fully hun	Koeppen-Geiger cla	static				
T_average	Yes (Mean=4.9)	°C	time seri	hourly	1992-pre	Full artic	NIBIO's J
T_min	Yes	°C	time seri	hourly	1992-present		NIBIO's J
T_max	Yes	°C	time seri	hourly	1992-present		NIBIO's J
precipitation	Yes (mean=722, min	mm/year	time seri	hourly	1992-present		NIBIO's J
rain intensity		mm/h	time series				
evapotranspiration		mm/year	time series				
snow length		from dd.mm to dd	time series				
wind speed	Yes	m/s	time seri	hourly	1992-present		NIBIO's J
wind direction		-	time series				
solar radiation	Yes	MJ/m2/day	time seri	hourly	1992-present		NIBIO's J
albedo		-	time series				
humidity	Yes	%	time seri	hourly	1992-present		NIBIO's J
3. SOIL							
soil type	Planosol	Ref. soil group WR	static			main soi	kilden.nc
depth of soil profil	80	cm	static			this is a l	NIBIO's J
number of layers	5	#	static			used for	Deelstra
depth layer 1	5	cm	static				
depth layer 2	15	cm	static				
depth layer 3	20	cm	static				
depth layer 4	20	cm	static				
depth layer 5	20	cm	static				
clay (<0.002 mm)	29	%	static			Average	Deelstra
silt (0.002-0.06 mm)	58	%	static			Average	Deelstra
sand (0.06-2 mm)	13	%	static			Average	Deelstra
bulk density	1,28	g/cm3	static			0-20 cm	Deelstra
soil organic matter	1.5-2.9	%	static			0-25 cm,	NIBIO's J
pH	6.1-6.4	-	static			0-25 cm,	NIBIO's J
CEC	7.0-10.0		static			0-25 cm,	Deelstra
saturated hydraulic conductivity	145	cm/day	static		1992	0-20 cm	Deelstra
soil water content		cm3/cm3	time series				
soil temperature		°C	time series				
redox potential Eh		mV	time series				
electrical conductivity		dS/m					
aggregate stability		%	method to be precise				
total metal/metalloid concentration		mg/kg					
metal/metalloid fractionation		mg/kg					
soil mineralogy							
water soluble ions		mg/kg					
water retention capacity		kPa					
infiltration rate	available	mm/h					Deelstra
soil available P	153	mg/kg	specific		1999	P-AL	NIBIO's J
Fe extractable			specific			old data	Deelstra
Al extractable			specific			old data	Deelstra
…							

4. LAND USE

crop type	cereals		time seri	annual	1992-present	NIBIO's J
yield level	vary by years	t/ha	time seri	annual	1992-present	NIBIO's J
sowing date	vary by years	dd.mm	time seri	annual	1992-present	NIBIO's J
harvesting date	vary by years	dd.mm	time seri	annual	1992-present	NIBIO's J
maximum root depth		cm				
catch crops	vary by years			annual	1992-present	NIBIO's J
native vegetation canopy		cm	time series			
native vegetation height		cm	time series			
cattle breeding and grazing						

5. LAND MANAGEMENT

tillage type	vary by years		time seri	annual	1992-present	NIBIO's J
tillage depth	vary by years	cm	time seri	annual	1992-present	NIBIO's J
tillage timing	vary by years		time seri	annual	1992-present	NIBIO's J
residue management	vary by years		time seri	annual	1992-present	NIBIO's J
fertilization type	vary by years	Mineral fertilizers a	time seri	annual	1992-present	NIBIO's J
fertilization rate	vary by years	kg/ha	time seri	annual	1992-present	NIBIO's J
fertilization timing	vary by years		time seri	annual	1992-present	NIBIO's J
fertilization method	vary by years		time seri	annual	1992-present	NIBIO's J

6. WATER MANAGEMENT

drain depth	80	cm	static			Deelstra
drain spacing	8	m	static			Deelstra
irrigation		mm/day	time series			
depth to groundwater table						
groundwater abstraction						
flow rate		m3/s	time series			

7. MONITORING - DATA AVAILABILITY

surface runoff	vary by time	mm/day	time seri	10 min o	1992-2005	NIBIO's J
subsurface runoff	vary by time	mm/day	time seri	10 min o	1992-2005	NIBIO's J
suspended sediment	vary by time	mg/L	time seri	flow-pro	1992-2005	NIBIO's J
nutrient	vary by time	mg/L	time seri	flow-pro	1992-2005	NIBIO's J

8. ECOSYSTEM SERVICES

Rank the ecosystem services according to their importance in the use-case. Ranking is from 0 (this ecosystem service is not at all

Ecosystem service	Ranking (0-10)
Provision of food, wood, fibre and fuel	10
Support for primary production in ecosystem	10
Habitat for organisms and biodiversity pool	6
Genetic resource, pharmaceuticals resource	5
Decomposition of organic matter and nutrient	8
Carbon sequestration and climate regulation	5
Water purification and cycling	10
Pollution degradation and waste recycling	8
Hydrological control and flood regulation	6
Control and suppression of pests and diseases	3
Provision of raw materials	3
Support for human infrastructure	3
Soil formation, retention and erosion preventio	10
Cultural, historic, spiritual, recreational and scie	0
Other (describe .....)	

9. POLLUTION IMPACT

Select pollutants and biota combinations which will most probably show pollution impacts in the use-case. An empty cell means that

	Metals	Pesticides	Micropla	PFAS	Nutrients
microorganisms (bacteria, fungi, algae, actinon					
nematodes					
micro-arthropods (mites, springtails etc)					
larvae of beetles and flies					
annelids (earthworms, enchytraeids)					
ground-dwelling arthropods (spiders, beetles,					
slugs and snails					
vertebrates (rodents, moles ...)					
plants					
terrestrial vertebrates (mammals, amphibians					
human					

Is there any non-biotic effect (soil structure, chemistry, ...) of the pollution expected?

No, phosphorus is a nutrient for soil (but a pollutant for water).

(B) LOCAL POLICY CONTEXT

I. Policy details needed for modelling/scenario development [researchers working on models/scenarios, please add the i

- Maximum P application rate as the sum of manure and mineral fertilizer: 35 kg/ha for years of 2025-2026, 28 kg/ha for years of 202
- No application of manure during September 16th and February 28th/29th. (New regulations started from February 1st 2025)
- No manure application on frozen or snow-covered soil.

II. Policy details needed for the qualitative governance analysis performed by UFZ

	Name	Website	Notes
Local muncipality	Nes Municipality	https://	Website in Norwegian
Regional administration	Akershus County	https://	Website in Norwegian
Local authority for environmental/soil policy	Landbrukskontoret	https://	Website in Norwegian
Regional authority for environmental/soil policy	Statsforvalteren i Ø	https://	Website in Norwegian
National authority for environmental/soil policy	Landbruksdirektor	https://	Website in Norwegian

	Name of the regula	Website	Notes
Local soil/environmental legislation (if available policy on the use-case's assessed pollu			Nutrient management related regula
Regional soil/environmental legislation (if available policy on the use			Nutrient management related regula
National soil/environmental legislation (if available policy on the us	New Fertilizer Regu	https://w	Started from 01.02.2025

Appendix 2: Overview of existing DSTs.

Nr.	General information					Modeling capabilities				Input			User interface			Unsaturated zone		Technical				Cost and licensing	Comments
	Name	Website	Reference(s)	Developers	Primary purpose and audience	Pollutants concerned	Environmental compartments (soil/groundwater/surface water)	Modeling software used	Geographical region of application	Main input data	Connection to databases	Customization (user data and models)	Ease of use, training materials	Visualization capabilities	Interactivity (adjusting parameters on the fly)	Output types	Output shared with other tools?	Mode of operation (web-based, standalone ...)	Scalability	Security and privacy	Interoperability		
1	WaterPUCK	waterpuck.pl	Dzierzbicka-Głowacka 2021,Agricultural Water Management 263 (2022) 107438; https://doi.org/10.1016/j.agwat.2021.107438	WaterPUCK consortium (Institute of Oceanology (Polish Academy of Sciences), Gdańsk University of Technology, other institutions)	Local goverment, agricultural advisors	Hydrological variables, nutrients (N and P)	Soil, groundwater, surface water (inland and marine)	SWAT, MODFLOW 2005, MT3DMS	Puck Bay area (North Poland, Baltic Sea coast)	Daily weather data, soil (hydrological and chemical), land management practices, plant parameters, hydrogeology	Weather data (forecast) acquired from external server on daily basis	Limited customization (crop type, fertilizer doses)	No dedicated training materials, explanations integrated in the user interface	Maps, time series	Limited	Nutrient concentrations in soil and surface water, nitrate in groundwater	No	Web-based application, models run on TASK supercomputer, model results updated once per day	No	No sensitive data included	Not considered	Free	Existing platform will be improved in SOILPROM
2	Landsupport	landsupport.eu	Bancheri, M., Fusco, F., Dalla Torre, D., Terribile, F., Manna, P., Langella, G., ... & Basile, A. (2022). The pesticide fate tool for groundwater vulnerability assessment within the geospatial decision support system LandSupport. Science of the Total Environme	Landsupport consortium	Local goverment, agricultural advisors	Nitrate, Pesticides	Soil	ARMOSA crop simulation model for the root zone; Analytical transfer functions for deep vadose zone	Valle Telesina in Italy, Marchfeld region in Austria, Zala Contry in Hungary	soil physical and hydrological properties, climate, groundwater table depth, crops and pesticides	Weather data taken from Copernicus, but no real-time connection	Limited customization (crop type, agicultural practices)	Short manual available	Maps	Yes	Groundwater vulnerability, pollutant travel time through unsaturated zone	Not sure	Web-based	Unknown	Requires user account	Unknown	Free	Landsupport H2020 project

3	WaterProtect collaborative tool	https://geologia.pgi.gov.pl/waterprotect/	Kuczyńska, A., Jarnuszewski, G., Nowakowska, M., Wexler, S. K., Wiśniowski, Z., Burczyk, P., ... & Woźnicka, M. (2021). Identifying causes of poor water quality in a Polish agricultural catchment for designing effective and targeted mitigation measures. Science of the Total	Polish geological Institute (as part of WaterProtect consortium)	Local goverment, citizens	Nitrate, ammonia, sulphate, chloride	Groundwater	MODFLOW	Gowienica River catchment (NW Poland)	Hydrogeological properties	No (static data)	No	Online help	Maps, text data	No	Monitoring results, travel times in soil and groundwater	Not sure	Web-based	Unknown	Not sure	Unknown	Free	WaterProtect H2020 project

4	Unknown	Unknown	Vero, S. E., Healy, M. G., Henry, T., Creamer, R. E., Ibrahim, T. G., Richards, K. G., ... & Fenton, O. (2017). A framework for determining unsaturated zone water quality time lags at catchment scale. Agriculture, Ecosystems & Environment, 236, 234-242.	Unknown	Policy makers, local government	Nitrate	Soil	HYDRUS-1D	Two catchments in Ireland (grassland and arable)	Soi properties, weather data	No (static data)	Yes	Unknown	Unknown	No	Unsaturated zone travel time	Not sure	Not sure	Unknown	Unknown	Unknown	Unknown	

5	SoilNavigator DSS	http://www.soilnavigator.eu/	Van Leeuwen, J. P., Creamer, R. E., Cluzeau, D., Debeljak, M., Gatti, F., Henriksen, C. B., ... & Rutgers, M. (2019). Modeling of soil functions for assessing soil quality: Soil biodiversity and habitat provisioning. Frontiers in Environmental	Landmark2020 project consortium https://landmarkproject.eu/	Farmers, policy makers	Soil functions, including soil nutrient status	Soil	Decision Expert Model	Austria, Germany, Denmark, France, Ireland	Soil properties, agricultural practices	No	Yes	Online help	Reports	Yes	Qualitative evaluation of selected soil functions	No	Web-based	Unknown	Unknown	Unknown	Free	
6	CRIS	http://cris.ietu.katowice.pl/Home.aspx	Unknown	CRIS project consortium	Environmental agencies, government	Hydrological variables, nitrate	Atmosphere, soil, surface water, groundwater	SWAT, MODFLOW 2005, MT3DMS, GEMSS, CALPUFF	Mała Wisła river basin and Goczałkowice reservoir, S. Poland	Soil properties, hydrological, geological and weather data	Yes (weather)	No	Unknown	Maps	No	Maps of hydrological variables and nitrate concentration	No	Web-based	Unknown	Unknown	Unknown	Free	Interface seems not working
7	CANWET	https://www.grnland.com/Decision-Support-Systems/CANWET.html	Unknown	GREENLAND(R) Group of Companies	Environmental agencies, government, scientists	Hydrological variables, nutrients (N and P)	Soil, surface water, groundwater	SWAT, MODFLOW	various areas in Canada	Soil properties, hydrological, geological and weather data	Not sure	Yes	Unknown	Maps	Unknown	Maps of hydrological variables, N and P concentrations	Unknown	Not sure	Yes	Unknown	Unknown	Commercial	

8	WEB (Watershed Evaluation of BMPs (best management practices))	Unknown	Shao, H., Yang, W., Lindsay, J., Liu, Y., Yu, Z., & Oginskyy, A. (2017). An open source GIS-Based decision support system for watershed evaluation of best management practices. JAWRA Journal of the American Water Resources Association, 53(3), 521-531.	Unknown	Unknown	nitrogen, phosphorus	soil	SWAT, GAT	Gully Creek watershed, Ontario, Canada	geospatial data, climat data, flow data, economic data, water quality data, management data	Yes (GIS)	Unknown	Help module in software environment	Maps, Time series	Unknown	Time series of nutrient reductions in selected fields	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	

9	CLUES	Unknown	Alexander H. Elliott, Annette F. Semadeni-Davies, Ude Shankar, John R. Zeldis,David M. Wheeler, David R. Plew, Gerald J. Rys, Simon R. Harris (2016). A national-scale GIS-based system for modelling impacts of land use on water quality. Environmental Modelling & Software	NIWA (National Institute for Water and Atmospheric Research) with support from Landcare Research, AgResearch and Plant and Food Research, and Harris Consulting for the Ministry for Primary Industries	Not sure	total nitrogen, total phosphorus, sediments and E. coli	soil, surface water, groundwater	software written primarily in VB.Net, with some FORTRAN code, basing on Overseer, Spasmo and Sparrow models	New Zealand	land use, farm survey data, mean annual temperature, rainfall and flow rates, point sources of nutrients and E. coli, physiographic data, ocean salt and nitrate concentrations, soil drainage information, scenario tables containing default and user defined land use and land	Yes (GIS)	Unknown	User manual can be found in: Semadeni-Davies, A., Elliott, S., Shankar, U., 2014. How CLUES can help in managing catchment nutrient limits. In: Currie, L.D., Christensen, C.L. (Eds.), Nutrient Management for the Farm, Catchment and Community. Fertilizer and Lime Research	Maps	Unknown	nutrient concentration maps	Unknown	link to the code: ftp://ftp.niwa.co.nz/clues/; plugin to ArcGIS; ; ArcGIS GIS v. 10.3.1 package (ESRI) and a Microsoft Windows operating system is required	Unknown	Unknown	Unknown	Free	the link to the code does not work

10	Unknown	http://www.lec.lancs.ac.uk/cswm/seal/	Caspar J.M. Hewett, Paul F. Quinn, A. Louise Heathwaite, Aidan Doyle, Sean Burke,Paul G. Whitehead, David N. Lerner (2009). A multi-scale framework for strategic management of diffuse pollution. Environmental Modelling & Software 24 74–85	Lancaster University, Newcastle University, University of Sheffield,University of Reading	regional and national decision makers	phosphorus, nitrogen, pesticides	soil, groundwater	TopManage and TOPCAT, DSM (Decision Support Matrix)	ited Kingdo	soil type, crop type, rainfall data	Yes (GIS)	Unknown	Unknown	Maps, time series	Unknown	Time series of nutrient concentration	Unknown	available at www.ncl.ac.uk/iq	Unknown	Unknown	Unknown	Free	the link www.ncl.ac.uk/iq is void; some links at the project website are also void; seems that the DSS has only historical meaning

11	MOSDEW	https://web.archive.org/web/20131028033021/http://www.rivertwin.de/	T. Gaiser, A. Printz, H.G. Schwarz von Raumer, J. Go¨tzinger, V.A. Dukhovny, R. Barthel, A. Sorokin, A. Tuchin, C. Kiourtsidis, I. Ganoulis, K. Stahr (2008). Development of a regional model for integrated management of water resources at the basin scale. Physics and	Unknown	planning authorities and decision makers	nitrogen, phosphorus	river basins, soil	ACRE, MODFLOW, MONERIS, QUAL 2K, CASIMIR, LARSIM, SLISYS, WEAP	Neckar basin (Germany), also West Africa and Central Asia	climat data, crop type, land use, estimates on emmisions from point sources	Unknown	Unknown	Unknown	Time series	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	many links at the website of the project are void
12	VegSyst-DSS	https://w3.ual.es/GruposInv/nitrogeno/VegSyst-DSS.shtml	Tei F., Nicola S., Benincasa P., Advances in Research on fertilization management of vegetapble crops, section 8.2, Springer, Switzerland, 2018.	Universidad de Almería	farmers	nitrogen	soil	Unknown	pain (Almeri	climat data, soil characteristics, irrigation layout, manure application	Unknown	Unknown	video user manual available at https://w3.ual.es/GruposInv/nitrogeno/VegSyst-DSS.shtml	Time series	Unknown	Daily values of crop biomass production, crop N uptake and crop evapotranspiration	Unknown	Stand alone; download from https://w3.ual.es/GruposInv/nitrogeno/VegSyst-DSS.shtml	Unknown	Unknown	Unknown	Free	

13	PLANET	https://www.planet4farmers.co.uk/Content.aspx?name=PLANET	Tei F., Nicola S., Benincasa P., Advances in Research on fertilization management of vegetapble crops, section 8.2, Springer, Switzerland, 2018.	ADAS and SRUC with funding and support from Defra and the Scottish Government	farmers and advisers in England/Wales and Scotland	nitrogen, phosphorus, pothas	soil	Unknown	Scotland	farm details, cropping, soil analysis results, organic manure and nutrient/lime use for each crop in each field	Unknown	Unknown	Tutorials and Help at https://www.planet4farmers.co.uk/Content.aspx?name=Tutorials			manure N capacity and loading, capacity of existing slurry, balance of nitrogen, phosphorus and potash	Unknown	https://www.planet4farmers.co.uk/Content.aspx?name=PLANET, tutorials are also available	Unknown	Unknown	Unknown	Free after registration	The PLANET England helpline has been discontinued https://www.planet4farmers.co.uk/Content.aspx?name=Contact
14	NE-Nutrient Expert	www.nutrientexpert.cn	ZHANG Jia-jia, DING Wen-cheng, CUI Rong-zong, LI Ming-yue, Sami ULLAH1, HE Ping, (2022), The Nutrient Expert decision support system improves nutrient use efficiency and environmental performance of radish in North China, Journal of Integrative	Unknown	farmers	pottasium, phosphorus, nitrogen	soil	This system is based on an extensive database of yield responses and agronomic efficiency estimates from a large number of field experiments conducted in the main radish-producing areas in China	North China	field management and fertilizer application in farmers' practice for the previous season, soil information, water availability	Unknown	Unknown	Unknown	Unknown	Unknown	system provides optimal nutrient management practices, including the method, amount, and timing of fertilization	Unknown	mobile phone-based decision support system	Unknown	Unknown	Unknown	Unknown	www.nutrientexpert.cn is only in Chinese version

15	Unknown	Unknown	Srinivas R., Drewitz M., Magner J. (2020).Evaluating watershed-based optimized decision support framework for conservation practice placement in Plum Creek Minnesota. Journal of Hydrology 124573	Unknown	Unknown	nitrogen, phosphorus	soil, groundwater	Using python coding, the system integrates three robust models namely Prioritize, Target and Measure Application (**PTMApp**), Agricultural Conservation Planning Framework (**ACPF**) and Hydrological Simulation Program FORTRAN-Scenario Application Manager	Plum Creek watershed in Minnesota	high-resolution Light Detection and Ranging (LiDAR)-hydro-conditioned DEM and crop data, soil data, land data, nutrient loadings, pesticiede concentrations, metorological data	Yes (Lidar)	Unknown	Unknown	Maps	Unknown	runoff risk assess-ment maps, tile drained fields maps, sediment and nutrient areas maps	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
16	CAL-FERT	http://www.cespevi.it/softunipi/calfert.html	Tei F., Nicola S., Benincasa P., Advances in Research on fertilization management of vegetapble crops, section 8.2, Springer, Switzerland, 2018.	University of Pisa	farmers	nitrogen, phosphorus, potassium	soil	Excel™ spreadsheet; calculates fertilisation by considering soil analysis, crop nutrient uptake and the mineralisation of nutrients from soil organic matter and decomposition of biomass of previous crops.	Tuscany, Ital	expected yield, cropping dates and climate conditions	Yes (data from meteorological station)	Unknown	Manual at http://www.cespevi.it/softunipi/calfert.html (Italian)	Graphs	Unknown	nutrient contributions and losses, quantity of the nutritional element in the root zone	Unknown	standalone avaialble at http://www.cespevi.it/softunipi/calfert.html	Unknown	Unknown	Unknown	Free	

17	GREEN-FERT	http://www.cespevi.it/softunipi/greenfert.html	Tei F., Nicola S., Benincasa P., Advances in Research on fertilization management of vegetapble crops, section 8.2, Springer, Switzerland, 2018.	University of Pisa	farmers	fertilizers	soil	Excel™ spreadsheet with database for interpretation of the aqueous extracts; users can modify the database according to their personal experience	Italy	Unknown	Unknown	Unknown	Manual at http://www.cespevi.it/softunipi/calfert.html (Italian)	Unknown	Unknown	Unknown	Unknown	standalone	Unknown	Unknown	Unknown	Free	The spreadsheet is not available avaialble at http://www.cespevi.it/softunipi/greenfert.html
18	NDICEA nitrogen & carbon planner	https://louisbolk.nl/en/ndicea	Tei F., Nicola S., Benincasa P., Advances in Research on fertilization management of vegetapble crops, section 8.2, Springer, Switzerland, 2018.	Louis Bolk Instituut in The Netherlands	Farmers and advisors	nitrogen	soil	Unknown	The Netherlands, Flanders (Belgium), England, Denmark and Spain	current cultivation plan, results from soil and fertiliser analyses; information on crops, yields and fertilisation used over at least the previous two years	Unknown	Unknown	Unknown	Unknown	Unknown	Graph crop nitrogen uptake versus nitrogen availability Graph course soil inorganic nitrogen level (topsoil, subsoil) Graph cumulative nitrogen leaching for each crop / catchcrop Graph cumulative nitrogen denitrification from topsoil Graph course of topsoil pH Graph	Unknown	standalone	Unknown	Unknown	Unknown	Commercial software	more details can be found at also https://www.google.com/url?sa=i&url=https%3A%2F%2Ffairway-is.eu%2Findex.php%2Fdocuments%2Fcategory%2F7-decision-support-tool-information-sheets%3Fdownload%3D19%3Anitrogen-dynamics-in-crop-rotations-in-ecological-agriculture

19	N-Expert	https://n-expert.igzev.de/?lang=en	Marisa Gallardo, Antonio Eliac, Rodney B. Thompson a. (2020). Decision support systems and models for aiding irrigation and nutrient management of vegetable crops, Agricultural Water Management 240 106209. also Tei F., Nicola S., Benincasa P., Advances in	Leibniz Institute of Vegetable and Ornamental Crops	farmers	nutrients: N, P, K and Mg	soil	Unknown	Germany	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	calculate the N (and also P, K and Mg) fertiliser requirement of vegetable crops and also to prepare nutrient balances for N, P, K and Mg as required by German Law	Unknown	standalone version available at https://n-expert.igzev.de/downloads-2/?lang=en	Unknown	Unknown	Unknown	Free	

20	AzoFert	Unknown	Jean-Marie Machet, Pascal Dubrulle, Nathalie Damay, Rémy Duval, Jean-Luc Julien, Sylvie Recou (2017). A Dynamic Decision-Making Tool for Calculating the Optimal Rates of N Application for 40 AnnualCrops While Minimising the Residual Level of Mineral N at Harvest.	Pascal Dubrulle, pascal.dubrulle@inra.fr. Address: 2, Chaussée Brunehaut-Estrées-Mons, CS 50136, 80203 Péronne CEDEX, France	farmers	nitrogen	soil	Unknown	France	initial mineral N content and moisture in the soil profile on the opening date of the balance sheet and technical information pertaining to the plots to be fertilised	Unknown	Unknown	Unknown	Unknown	Unknown	N uptake by plants, changes in yield and soil mineral N at harvest time as a function of the fertiliser N dose	Unknown	standalone application	Unknown	Unknown	Unknown	Unknown	available at the developer
21	RB209	https://ahdb.org.uk/nutrient-management-guide-rb209; also https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Thumbs/RB209/2023/NutManGuideRB209S1_230526_WEB.pdf	Marisa Gallardo, Antonio Eliac, Rodney B. Thompson a. (2020). Decision support systems and models for aiding irrigation and nutrient management of vegetable crops, Agricultural Water Management 240 106209.	Agriculture and Horticulture Development Board (AHDB)	farmers	nutrients: N,P,K	soil	Unknown	UK	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	N, P and K fertilizer recommendations	Unknown	smartphone application	Unknown	Unknown	Unknown	Commercial code	should be available at https://ahdb.org.uk/nutrientmanagement-guide-rb209the RB209, but is no longer available. We recommend that users delete it and view the latest RB209 data on the AHDB website.

22	SPARROW (SPAtially Referenced Regressions On Watershed Attributes)	http://water.usgs.gov/nawqa/sparrow/dss/	Nathaniel L. Booth, Eric J. Everman, I-Lin Kuo, Lori Sprague, and Lorraine Murphy, (2011). A WEB-BASED DECISION SUPPORT SYSTEM FOR ASSESSING REGIONAL WATER-QUALITY CONDITIONS AND MANAGEMENT ACTIONS. JOURNAL OF THE AMERICAN WATER RESOURCE	USGS	water-resources managers and researchers with a general familiarity of hydrologic principles	nutrients: N,P	river basins	calibrated SPARROW models	USA (Missisipi River Basin, Chesapeake Bay, and others)	land use, point sources of contaminats, land cover	Yes (GIS)	Unknown	the usage requires substantial training and expertise, https://pubs.usgs.gov/tm/2006/tm6b3/	Maps, graphs	Unknown	The model estimates contaminant concentrations, fluxes (or "mass," which is the product of concentration and streamflow), and yields in streams (mass of nutrients entering a stream per acre of land), and evaluates the contributions of selected contaminant sources and	Unknown	standalone avaialble at https://www.usgs.gov/mission-areas/water-resources/science/sparrow-modeling-estimating-nutrient-sediment-and-dissolved# software	Unknown	Unknown	Unknown	Free	Seemingly not related to soil. Standalone or delivered by web-browser
23	CropManage	https://cropmanage.ucanr.edu/	Tei F., Nicola S., Benincasa P., Advances in Research on fertilization management of vegetapble crops, section 8.2, Springer, Switzerland, 2018.	University of California	farmers	nutrients: N	soil	Unknown	alifornia, Ita	crop type, soil type, fertilizer an irrigation event, choice of weather station	Yes (weather station)	Unknown	Tutorials available at https://cropmanage.ucanr.edu/ after registration	Unknown	Unknown	level of irrigation and fertilization	Unknown	on-line software	Unknown	Unknown	Unknown	Free	