User requirement

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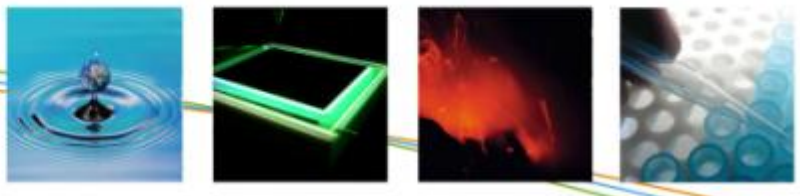

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List of abbreviations & acronyms

AB	Aigües de Barcelona
ACA	Agència Catalana de l'Aigua
AGBAR	Aigües de Barcelona
ARiMR	Agency for Restructuring and Modernisation of Agriculture
BMPs	Best Management Practices
CBDG	Central Geological Database
CPABLL	Consorci del Parc Agrari del Baix Llobregat
CSIC	Centro Superior de Investigaciones Científicas
CUADLL	Comunitat d'Usuaris d'Aigües del Dellta del Llobregat
CVBB	Coordination Center Information and Guidance for sustainable Fertilization (Coördinatiecentrum Voorlichting en Begeleiding duurzame Bemesting)
GISWUA	Geographic Information System of the Water Users Association
GUGiK	Central Office of Geodesy and Cartography
GUS	Central Statistical Office of Poland
IMGW	Institute of Meteorology and Water Management – National Research Institute
PGI-NRI	Polish Geological Institute – National Research Institute
PPP	Plant Protection Product
SPD-PSH	Data processing system of the Polish Hydrogeological Service

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1 Introduction

1.1 Purpose

The User Requirements list describes the business needs for what users require from the collaborative management tools in the different action labs. User Requirements Specifications (URS) are written early in the validation process, typically before the system is created. They are written by the system owner and end-users. User Requirements Specifications are not intended to be a technical document; readers with only a general knowledge of the system should be able to understand the requirements outlined in the URS.

1.2 Overview

Tools designed to organise and visualise data have been developed in most of the 7 case study areas to various degrees, but lack essential functionalities to be used in a collaborative decision making process. As the existing tools are already familiar to some of the actors in the project, WaterProtect further develop the existing tools and identify actor and stakeholder needs for improvements. From this, new building blocks are developed and integrated in the existing tools. The new modules will extend the capabilities of the existing tools to allow an evaluation of alternative scenarios defined by the multiple actors. The developments may include new modules for making predictions (simulate effect of mitigation on water quality including time delay effects), assess risk areas (delineation of risk areas based on farming systems, land use and connectivity to receptors), and effects of mitigations (test mitigation scenarios and BMP) as well as the cost-effectiveness of mitigations (evaluate costs related to mitigation and BMP in relation to impact on water quality) or more user-friendly accessibility (easy to use functionalities, better accessible on the WEB).

The present report collects the user requirements for the further development of tools in the seven action labs included in WaterProtect. The action labs for Belgium, Italy and Romania are reported together, while the remaining four (Ireland, Denmark, Spain and Poland) are reported individually.

The user requirements list includes different categories of requirements such as:

- **Technical specifications –** the technical requirements for the system
- **General specifications –** specifications with impact on other requirement, f.i. user management on data level
- **Data specifications** – the type of information that a system must be able to process
- **Input specifications** – how comes the data into the system
- **Program specifications** – the functions and workflow that the system must be able to perform, f.i. functionalities, visualizations, etc.
- **Output specifications** – the functions for downloading / exporting management information
- **Life Cycle specifications** – including how the system will be maintain and users trained

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Requirements are provided with a unique identifier, such as an ID#, to aid in traceability throughout the validation process. Every UR has a priority and a success criterion to be used for validation testing.

1.3 Definitions

User requirements are formulated by using the following words:

- Shall : to indicate that the definition is an absolute requirement
- Shall not: indicates that it is an absolute prohibition of the spec
- Should: is equivalent to recommend, means that there are valid reasons to ignore a particular requirement, but the implications need to be weighed
- Should not: is equivalent to not recommended, means that a particular behaviour may be acceptable or useful, but again, the implications need to be weighed.
- May: means optional

The user requirement is summaried and priotised in a matrix organised as the table below

ID	Category	UR	Performance	Priority

With:

- Id: number of the UR (f.i. URQ-001)
- Category: technical, general, input, output, functionality, visualization, data and information, … .
- UR: the user requirement
- Performance criteria: on-the-fly, over-night, …(only applicable for functionalities)
- Priority: a scoring from 1 to 3, where 1 is “need to have” and 3 is “nice to have”

The following terms are used to distinguish different user types

- Viewer: person who can access and view data but cannot modify it.
- Editor: person who can add and modify data.
- Administrator: person who can configure the database.
- Operator: an institution (company, research centre or administration) that provides data to the Editor.

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Action labs: *Bollaertbeek (BE), Val Tidone (IT) and Maramures (RO)*

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2 Bollaertbeek (BE), Val Tidone (IT) and Maramures (RO)

2.1 General description

2.1.1 Objective

The overall objectives of the WaterProtect-EU tool are:

- A ***user-friendly web-based collaborative management tool*** with collective participation of farmers and consumers.
- The tool provides ***knowledge on the functioning of the water system*** through the ***integration*** of geospatial information (landscape, soils, geology, land use, crops, urban use, rivers, water collection), water monitoring, results of hydrological and hydrogeological modelling of the interaction between farming systems and water quality, and cost-efficiency of mitigation measures.
- The tool shall use transparent and ***understandable indicators*** to ensure reliable and comparable data in order to involve farmers and citizens.
- The tool shall ***support the identification and localization of measures*** to be implemented.
- The user needs only a ***browser*** to consult the WaterProtect tool.
- The web-based tool is to facilitate the ***exchange of knowledge*** among actors and ***explore the optimal local solutions.***
- The tool should ***organise and visualise data*** of the use case
- The tool should ***cover functionalities*** to be used in a ***collaborative decision making process***.
- The tool should include a module for identifying vulnerable and risk zones for water pollution.
- The tool may include new modules for making predictions (*what is the effect of mitigation on water quality?*), assess risk areas, effects of mitigation meausures and the cost-effectiveness of measures.
- The tool is based on an open source GIS-environment
- The should should organize data in a digestible manner so it can reach various target groups in the action labs (farmers and decision makers)

The benefits of the WaterProtect tool are:

- Creating ***transparency*** in the connection between farming systems and water quality: WaterProtect will result in more transparent relationships between the application of nitrate and pesticides (and their relevant metabolites) and their occurrence in drinking water intake.
- Increasing ***local engagement*** by sharing data from participatory monitoring

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- ***Reporting tool*** for water quality in relation to land use and level of nitrate pollution of drinking and surface water in Mara catchments
- Facilitating the use and ***interpretation of collected monitoring data*** and converting technical data into easily readable/digestible information
- Providing good data for change in ***decision making*** of relevant stakeholders involved in water management, and improvement of water quality

Next assumptions need to be taking into account for the WaterProtect tool:

- The WaterProtect tool will not be realised as a stand-alone application.
- It is assumed that the tool will be tested and successful results could lead to better decision making related to water quality.
- Tool in Maramures action lab could be linked to water authority/other relevant SH application/tool.

2.1.2 Concept of use

The existing WaterProtect-BE platform will be used and developed for three EU case studies more specific the Bollaertbeek (Belgian use case), the Val Tidone catchment (Italian use case) and the Mara catchment (Romanian use case).

2.1.2.1 Use cases

Belgian use case

The Belgian use case is the Bollaertbeek catchment (23 km^2/ 167 farmers) with mixed urban/rural land-use which is part of the surface water capturing area of the drinking water production company de Watergroep. Plant protection product (PPP) concentrations are a problem for water quality in the catchment. Despite several extension and training campaigns on water contamination problems by PPPs, there still is a low uptake of mitigation measures. Nitrate concentrations in surface water in the region have improved after the establishment of water quality groups (by CVBB); this approach is a combination of monitoring, setting up discussion groups, advising farmers on fertilization and fertilization plans.

In WaterProtect a governance strategy to decrease PPP concentrations in surface water in the region will be developed building on the experience from the water quality groups (CVBB) and the lessons learnt from other successful cases of increased uptake of best management practices (BMPs) of crop protection in the Kemmelbeek catchment and the Cicindria catchment.

Italian use case

The Italian use case is the Val Tidone catchment (207km^2/ 455 farmers), placed in the north-west of Italy in Emilia Romagna region. The area covers five municipalities: Ziano Piacentino, Castel S.Giovanni, Nibbiano, Pianello, and Borgonovo for 28548 inhabitants. The Valley begins at the foot of Mount Penice (1460 m) and extends in a hilly area to the plain where the river of the same name

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flows into the Po River. The landscape is characterised by an alternation of vineyards, woods, and typical villages. The surface and ground water are used for drinking water, agricultural and zootechnical sectors. The ground water in Val Tidone Catchment presents a significant concentration of pesticides and nitrates as expressed by the local environment Authority and partner of the project ARPAE-ER. By now the impact of the grape cultivation on pesticides and nitrates groundwater contamination was never investigated.

Therefore, during the three years of the WaterProtect project, the ground water will be monitored and historical data will be collected in order to determinate the possible contribution of grape cultivation on water contamination by pesticides and nitrates. Furthermore a governance strategy to decrease PPP and nitrates concentrations in ground water in the Tidone Catchment will be developed taking into account the experience of the different actors involved in the project (research institution, environmental agencies, consumer association, category associations, plant protection consortium, drinking water supplier company, Social Cellars, winegrowers) and learning from previous successful projects on intensive dissemination and training of Best Management Practices (PMPs) and sustainable use of pesticides, as for example TOPPS Life Project (http://www.topps.unito.it), EU Browse Project - using the OpenTea Platform (http://www.opentea.eu) and SUPTraining Project (http://www.sup-training.eu).

Romanian use case

Romanian case is located in Mara catchment (20 km^2), Maramures County, and it is representative for small scale/ subsistence farming systems in the Carpathian Mountains – cattle and sheep breeding. The study area is a typical cultural landscape shaped by traditional practices. Water supply in the village with 385 households is secured by communal pipeline distribution and private wells used by more than half of the households in the village; furthermore, Mara river is a protected area of local interest due to the presence of important protected species: trout (Salmo trutta), grayling (Thymallus thymallus) whose survival depends on the water quality. Cattle and sheep breading in the catchment area affects the drinking water quality but also the surface water quality since manure is used as a large scale fertilizer and leaks from the barns of most of the households. Nitrates and nutrient levels are monitored only in surface water downstream on two sections of the Mara River. There is no centralized sewage system in this case study, which poses major problems for surface and underground water quality.

In WaterProtect a governance strategy to decrease nitrates concentrations in surface water in the region will be developed by identifying and promoting best management practices in relationship with manure management and by involving relevant stakeholders and decision makers at regional and national level. N2000 Maramures Platform will be used to fundament the collaborative tool for RO: members of Maramures NATURA2000 Platform: (e g Romanian Waters – Regional Water Management Unit, Department of Agriculture Maramures, Environmental Protection Agency Maramures (EPA MM), National Environmental Guard, Maramures County Inspectorate, Maramures County Council) share a common vision regarding protection of natural resources in Maramures County. The Maramures N2000 Platform will ensure exchange and harmonization of relevant information and data, as well as dissemination of information.

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2.1.2.2 WaterProtect-BE platform

The existing WaterProtect-BE platform will be used and developed into a WaterProtect-EU tool for three EU case studies, Belgian, Italian and Romanian, to:

1. Visualize monitoring data of several stakeholders in color coded maps and time series
2. Visualize land resources data (land use, soil characteristics, digital elevation model and hydrological network) in relation to water quality at monitoring locations
3. Delineate water pathways in the watershed and determine vulnerable zones for water pollution
4. Assess suitable measures in the vulnerable zones in the catchment aiming to improve water quality

2.1.2.3 Conceptual scheme

Scheme

Figure 1 gives a conceptual overview of the WaterProtect management tool. The scheme contains a database component to integrate different types of data, a web tool component for the visualisation of the data integrated with different maps and the users who will use the WaterProtect tool.

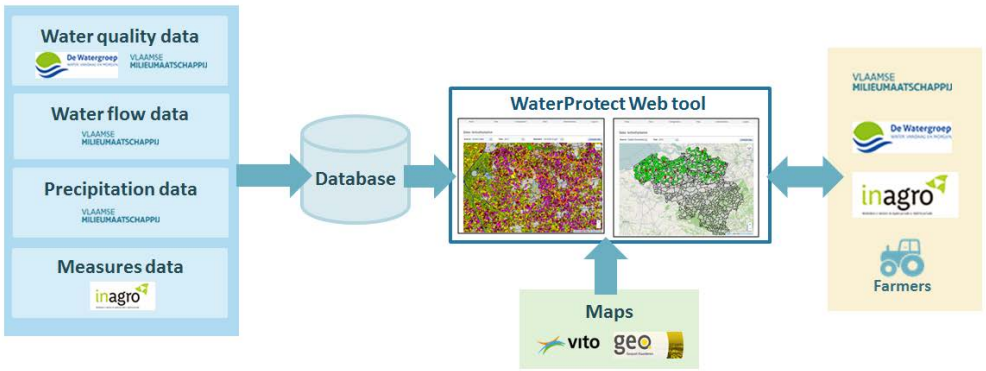

Figure 1: Conceptual scheme of WaterProtect collaborative management tool, using as example the Belgian case study and its actors

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Components

a) Database component

In the **Belgian case study**, the database component integrates water quality data, water flow data, precipitation data and information on measures into one database. The water quality data comes from De Watergroep and the Flanders Environment Agency, the water flow and precipitation data comes from the Flanders Environment Agency and the information on measures from Inagro.

For the **Italian case study**, the database component integrates groundwater level data, precipitation data, land use data and measurement data (temperature, pH, conductibility, nitrates and pesticides used in vineyards) type of pesticides used in vineyards data. The groundwater level, precipitation and soil use data comes from ARPA-ER while the measurement data comes from ARPE-ER, IRETI and UCSC.

And in the **Romanian case study**, the database component integrates water quality data, water flow data, precipitation data and information on measures into one database. The water quality data comes from Romanian Waters – Regional Water Management Unit, management plan of Tisza River Basin, monitoring in the field performed by Partner UTC; the water flow and precipitation data comes from Romanian Waters – Regional Water Management Unit / EPA MM and the information on measures from UTC.

b) Web tool component

In the **Belgian case study**, the Web tool component visualises the different types of data integrated with different maps. The maps come from VITO and Geopunt Flanders. Geopunt Flanders (www.geopunt.be) is a website that makes maps, such as drainage map, groundwater protection zones, groundwater vulnerability map, etc public available. VITO delivers maps such as risk maps or maps based on modelling.

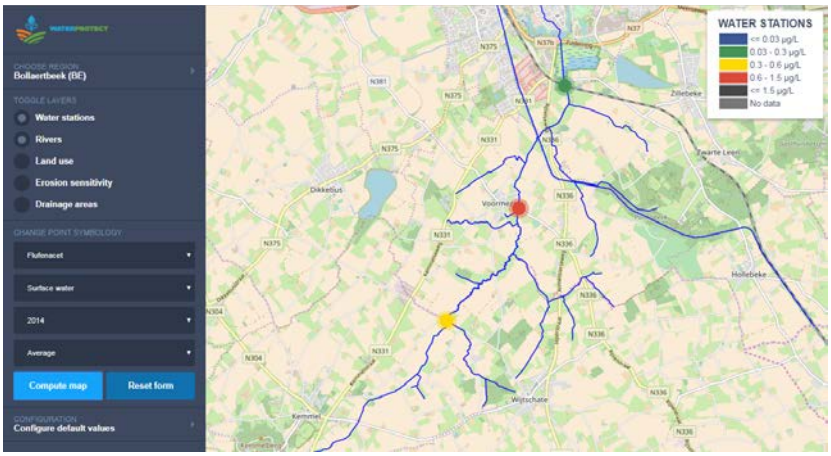

Figure 2: WaterProtect tool visualizes the average concentration of a certain substance in surface water for 2014 in different monitoring stations at the Bollaertbeek.

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For the **Italian case study**, the web tool component visualises the different types of data integrated with different maps. The maps are made available by ARPA-ER created with ArcGIS software developed by ESRI, California, United States (www.esriitalia.it) that makes map such as land use data, soil geology data, land hydrology data, conceptual model of groundwater aquifer, etc. public available by cost. Figure 3 shows the soil lithology of the Action Lab catchment.

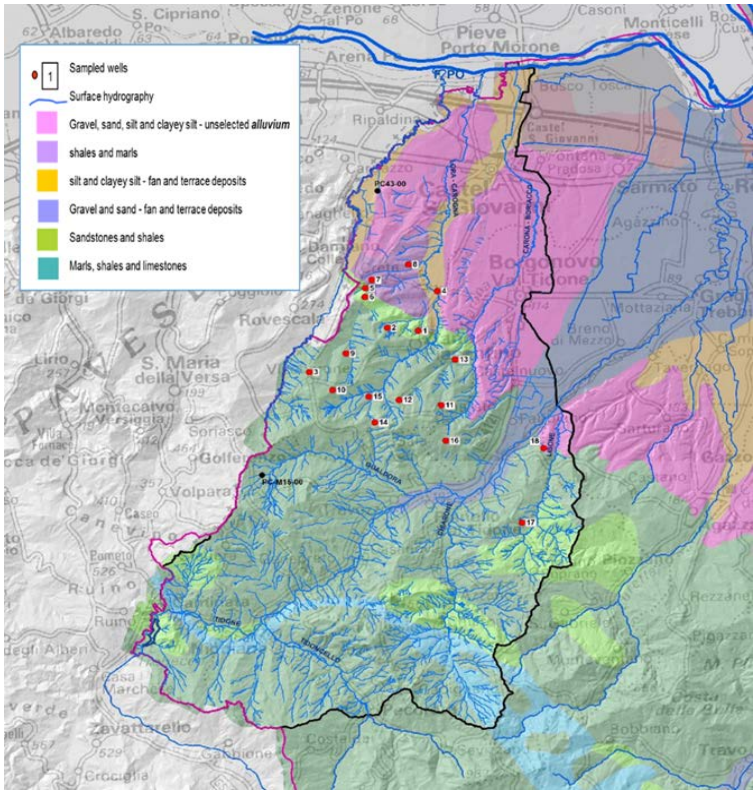

Figure 3 Soil Lithology of the Catchment in the Italian Action lab

For the **Romanian case study**, the Web tool component visualises the different types of data integrated with different maps. The maps for Maramures will be developed by a GIS consultant and it will use open source GIS.

c) Users

For the **Belgian case study**, the users of the WaterProtect tool are Flanders Environment Agency, the drinking water company De Watergroep, Inagro and the farmers.

For the **Italian case study**, the users of the WaterProtect tool are ARPAE-ER, the drinking water supplier company IRETI, Catholic University, farmers associations, Plant Protection products Consortium and the farmers.

And in the **Romanian case study**, the users of the WaterProtect RO tool are Romanian Waters – Regional Water Management Unit, Ocna Sugatag municipality – providing the drinking water for the area and the farmers.

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Section 2.3 Users and user interface describes the different users more in detail including their role, their input in the project, the impact and where the system is expected to be used.

2.1.3 Users and user interface

This section describes the different users more in detail. Two types of user are defined:

- Primary users: users who deliver data to the project and use the WaterProtect tool to support their activities and policy.
- Secondary users: users who consult occasionally the WaterProtect tool - farmers and other interested actors.

For the **Belgian case study** the users are:

Flanders Environment Agency

- Flanders Environment Agency

Identification:	Flanders Environment Agency	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development at the Bollaertbeek.		
Input in the project:	They deliver water quality, water flow and prepicitation data for the WaterProtect tool.		
Impact for the stakeholder:	The Flanders Environment Agency shall be able to follow up the water quality of the Bollaertbeek, determine the water pathways in the watershed and vulnerable zones for water pollution. All this information is important in local project development. The WaterProtect management information should create more transparency on the link between farming systems and water quality.		
Where is the system expected to use?	Flanders Environment Agency shall use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- De Watergroep

Identification:	De Watergroep	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up the water quality in correlation with the application of nitrate and pesticides.		

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Input in the project:	They deliver water quality data for the WaterProtect tool.
Impact for the stakeholder:	De Watergroep is a drinking water company and shall use the WaterProtect tool to follow up the water quality at the Bollaertbeek . The WaterProtect management information should give more clarity about the relationships between the application of nitrate and pesticides (and their relevant metabolites) and their occurrence in drinking water intake.
Where is the system expected to use?	De Watergroep shall use the WaterProtect tool via pc at the office.

- Inagro

Identification:	Inagro	*Type user:*	Primary
Role:	Delivering knowledge and data related to measures for the WaterProtect tool and use the WaterProtect management information to assess suitable measures in the vulnerable zones in the catchment of the BollaertBeek aiming to improve water quality.		
Input in the project:	They deliver information on measures for the WaterProtect tool and the knowledge which measures can be used in what circumstances.		
Impact for the stakeholder:	Inagro shall use the WaterProtect tool to follow up the water quality, to determine the water pathways in the watershed and vulnerable zones for water pollution, to assess the suitable measures at the vulnerable zones and determine the results of the applied measures at the Bollaertbeek. Inagro shall use these information in meetings with the farmers.		
Where is the system expected to use?	Inagro shall use the WaterProtect tool via pc, tablet and smartphone. Tablets and smartphones are easy to use during meetings with the farmers.		

- Farmers

Identification:	Farmers	*Type user:*	Secondary
Role:	Consulting on occasionally basis the WaterProtect tool to understand why particular measures are applied and what are the effects of these measures.		

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Input in the project:	No data input in the project.
Impact for the stakeholder:	At the moment the farmers don't have the opportunity to follow up the effects of applied measures. With the WaterProtect tool they can follow up the water quality, what are the effects of the applied measures, and so on.
Where is the system expected to use?	The famers shall use the WaterProtect tool via pc, tablet or smartphone. Smartphones will be used mostly in the field.

For the **Italian case study** the users are:

- ARPAE-ER

Identification:	ARPAE-ER	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development at the Tidone Catchment.		
Input in the project:	They deliver groundwater level data, precipitation data, land use data and measurement data for the WaterProtect tool.		
Impact for the stakeholder:	The ARPAE-ER shall be able to follow up the water quality of the Tidone Catchment, determine the water pathways in the watershed and vulnerable zones for water pollution. All this information is important in local project development. The WaterProtect management information should create more transparency on the link between farming systems and water quality. Furthermore, ARPE-ER will be able to integrate the knowledge of conceptual model of groundwater aquifer.		
Where is the system expected to use?	ARPE-ER will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- IRETI

Identification:	IRETI	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up the water quality in correlation with the application of nitrate and pesticides.		
Input in the project:	They deliver water quality data for the WaterProtect tool.		
Impact for the	IRETI is a local drinking water company and shall use the WaterProtect tool to follow up the water quality at the Tidone Catchment. The WaterProtect		

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stakeholder:	management information should give more clarity about the relationships between the application of nitrate and pesticides (and their relevant metabolites) and their occurrence in drinking water intake.
Where is the system expected to use?	IRETI shall use the WaterProtect tool via pc at the office.

- UCSC

Identification:	UCSC	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development at the Tidone Catchment.		
Input in the project:	They deliver measurement data for the WaterProtect tool.		
Impact for the stakeholder:	The UCSC shall be able to follow up the water quality of the Tidone Catchment, determine the water pathways in the watershed and vulnerable zones for water pollution. All this information is important in local project development. The WaterProtect management information should create more transparency on the link between farming systems and water quality.		
Where is the system expected to use?	UCSC will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- Plant Protection Products Consortium

Identification:	Plant Protection Products Consortium	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development at the Tidone Catchment.		
Input in the project:	They deliver pesticides use data for the WaterProtect tool.		
Impact for the stakeholder:	The Plant Protection Products Consortium shall be able to follow up the water quality of the Tidone Catchment and the real use of pesticides, in terms of type of pesticides. All this information is important in their consultancy activities.		

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Where is the system expected to use?	Plant Protection Products Consortium will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.

- Farmers Associations

Identification:	Farmers Associations	*Type user:*	Primary
Role:	Support partner for communication between technicians and farmers and use the WaterProtect management information to support the farmers.		
Input in the project:	They deliver contact information of farmers.		
Impact for the stakeholder:	The Farmers Associations shall be able to follow up the water quality of the Tidone Catchment and the real use of pesticides, in terms of type of pesticides. All this information is important in their consultancy and training activities.		
Where is the system expected to use?	Farmers Associations will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- APCS

Identification:	APCS	*Type user:*	Secondary
Role:	Consulting the WaterProtect tool to understand the status of the ground water and why particular mitigation measures are applied and what the effects of these measures are.		
Input in the project:	As partner of the project APCS keeps the contact with farmers and all the stakeholders in the Tidone Catchment.		
Impact for the stakeholder:	With the WaterProtect tool APCS can follow up the water quality, what are the effects of the applied applied mitigation measures, and offer assistence to farmers and other stakeholders.		
Where is the system expected to use?	APCS shall use the WaterProtect tool via pc, tablet or smartphone. Smartphones will be used mostly in the field.		

- Consorzio Bonifica

Identification:	**Consorzio di Bonifica**	*Type user:*	Primary

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Role:	Use the WaterProtect tool to follow up the water quality in correlation with the application of nitrate and pesticides.
Input in the project:	Support partner or the project giving important information for the management of the water use in Val Tidone Catchment.
Impact for the stakeholder:	Consorzio di Bonifica is the irrigation water manager in Tidone Catchment and with the WaterProtect Tool can follow up the water quality, what are the effects of the applied mitigation measures, in order to improve their management approach.
Where is the system expected to use?	Consorzio di Bonifica shall use the WaterProtect tool via pc, tablet or smartphone. Smartphones will be used mostly in the field.

- Farmers

Identification:	Farmers	*Type user:*	Secondary
Role:	Consulting on occasionally basis the WaterProtect tool to understand why particular measures are applied and what the effects of these measures are.		
Input in the project:	No data input in the project.		
Impact for the stakeholder:	Now the farmers do not have the opportunity to follow up the effects of applied measures. With the WaterProtect tool they can follow up the water quality, what are the effects of the applied measures, and so on.		
Where is the system expected to use?	The famers shall use the WaterProtect tool via pc, tablet or smartphone. Smartphones will be used mostly in the field.		

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For the **Romanian case study** the users are:

- Romanian Waters – Regional Water Management Unit

Identification:	Romanian Waters – Regional Water Management Unit	Type user:	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development in Maramures case.		
Input in the project:	They deliver water quality, water flow and prepicitation data for the WaterProtect tool.		
Impact for the stakeholder:	Romanian Waters – Regional Water Management Unit shall be able to follow up the water quality of Maramures case, determine the water pathways in the watershed and vulnerable zones for water pollution. All this information is important in local project development. The WaterProtect management information should create more transparency on the link between farming systems and water quality.		
Where is the system expected to use?	Romanian Waters – Regional Water Management Unit shall use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- Ocna Sugatag municipality

Identification:	Ocna Sugatag municipality	Type user:	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up the water quality in correlation with the application of nitrates.		
Input in the project:	They deliver water quality data for the WaterProtect tool (indirectly).		
Impact for the stakeholder:	Ocna Sugatag municipality shall use the WaterProtect tool to follow up the water quality at Maramures case. The WaterProtect management information should give more clarity about the relationships between the application of nitrate and pesticides (and their relevant metabolites) and their occurrence in drinking water intake.		
Where is the system expected to use?	They deliver water quality data for the WaterProtect tool (secondary source).		

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- Farmers

Identification:	Farmers	Type user:	Secondary
Role:	Consulting on occasionally basis the WaterProtect tool to understand why particular measures are applied and what are the effects of these measures.		
Input in the project:	No data input in the project.		
Impact for the stakeholder:	At the moment the farmers don't have the opportunity to follow up the effects of applied measures. With the WaterProtect tool they can follow up the water quality, what are the effects of the applied measures, and so on.		
Where is the system expected to use?	The famers shall use the WaterProtect tool via pc, tablet or smartphone. Smartphones will be used mostly in the field. Would be useful to be linked with Social media.		

- ARPAE-ER

Identification:	ARPAE-ER	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development at the Tidone Catchment.		
Input in the project:	They deliver groundwater level data, precipitation data, land use data and measurement data for the WaterProtect tool.		
Impact for the stakeholder:	The ARPAE-ER shall be able to follow up the water quality of the Tidone Catchment, determine the water pathways in the watershed and vulnerable zones for water pollution. All this information is important in local project development. The WaterProtect management information should create more transparency on the link between farming systems and water quality. Furthermore, ARPE-ER will be able to integrate the knowledge of conceptual model of groundwater aquifer.		
Where is the system expected to use?	ARPE-ER will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- IRETI

Identification:	IRETI	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up the water quality in correlation with the application of nitrate and pesticides.		

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Input in the project:	They deliver water quality data for the WaterProtect tool.
Impact for the stakeholder:	IRETI is a local drinking water company and shall use the WaterProtect tool to follow up the water quality at the Tidone Catchment. The WaterProtect management information should give more clarity about the relationships between the application of nitrate and pesticides (and their relevant metabolites) and their occurrence in drinking water intake.
Where is the system expected to use?	IRETI shall use the WaterProtect tool via pc at the office.

- UCSC

Identification:	UCSC	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development at the Tidone Catchment.		
Input in the project:	They deliver measurement data for the WaterProtect tool.		
Impact for the stakeholder:	The UCSC shall be able to follow up the water quality of the Tidone Catchment, determine the water pathways in the watershed and vulnerable zones for water pollution. All this information is important in local project development. The WaterProtect management information should create more transparency on the link between farming systems and water quality.		
Where is the system expected to use?	UCSC will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- Plant Protection Products Consortium

Identification:	Plant Protection Products Consortium	*Type user:*	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development at the Tidone Catchment.		

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Input in the project:	They deliver pesticides use data for the WaterProtect tool.
Impact for the stakeholder:	The Plant Protection Products Consortium shall be able to follow up the water quality of the Tidone Catchment and the real use of pesticides, in terms of type of pesticides. All this information is important in their consultancy activities.
Where is the system expected to use?	Plant Protection Products Consortium will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.

- Farmers Associations

Identification:	Farmers Associations	*Type user:*	Primary
Role:	Support partner for communication between technicians and farmers and use the WaterProtect management information to support the farmers.		
Input in the project:	They deliver contact information of farmers.		
Impact for the stakeholder:	The Farmers Associations shall be able to follow up the water quality of the Tidone Catchment and the real use of pesticides, in terms of type of pesticides. All this information is important in their consultancy and training activities.		
Where is the system expected to use?	Farmers Associations will use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- Farmers

Identification:	Farmers	*Type user:*	Secondary
Role:	Consulting on occasionally basis the WaterProtect tool to understand why particular measures are applied and what the effects of these measures are.		
Input in the project:	No data input in the project.		
Impact for the stakeholder:	Now the farmers do not have the opportunity to follow up the effects of applied measures. With the WaterProtect tool they can follow up the water quality, what are the effects of the applied measures, and so on.		

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Where is the system expected to use?	The famers shall use the WaterProtect tool via pc, tablet or smartphone. Smartphones will be used mostly in the field.

For the **Romanian case study** the users are:

- Romanian Waters – Regional Water Management Unit

Identification:	Romanian Waters – Regional Water Management Unit	Type user:	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up their project development in Maramures case.		
Input in the project:	They deliver water quality, water flow and prepicitation data for the WaterProtect tool.		
Impact for the stakeholder:	Romanian Waters – Regional Water Management Unit shall be able to follow up the water quality of Maramures case, determine the water pathways in the watershed and vulnerable zones for water pollution. All this information is important in local project development. The WaterProtect management information should create more transparency on the link between farming systems and water quality.		
Where is the system expected to use?	Romanian Waters – Regional Water Management Unit shall use the WaterProtect tool mostly via pc and less by tablet or smartphone. Smartphone and tablet are easy to use in the field.		

- Ocna Sugatag municipality

Identification:	Ocna Sugatag municipality	Type user:	Primary
Role:	Delivering data for the WaterProtect tool and use the WaterProtect management information to follow up the water quality in correlation with the application of nitrates.		
Input in the project:	They deliver water quality data for the WaterProtect tool (indirectly).		
Impact for the stakeholder:	Ocna Sugatag municipality shall use the WaterProtect tool to follow up the water quality at Maramures case. The WaterProtect management information should give more clarity about the relationships between the application of nitrate and pesticides (and their relevant metabolites) and their occurrence in drinking water intake.		
Where is the system expected to use?	They deliver water quality data for the WaterProtect tool (secondary source).		

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- Farmers

Identification:	Farmers	Type user:	Secondary
Role:	Consulting on occasionally basis the WaterProtect tool to understand why particular measures are applied and what are the effects of these measures.		
Input in the project:	No data input in the project.		
Impact for the stakeholder:	At the moment the farmers don't have the opportunity to follow up the effects of applied measures. With the WaterProtect tool they can follow up the water quality, what are the effects of the applied measures, and so on.		
Where is the system expected to use?	The famers shall use the WaterProtect tool via pc, tablet or smartphone. Smartphones will be used mostly in the field. Would be useful to be linked with Social media.		

2.1.4 Other

Other important requirements are:

- User management to taking into account the confidentiality of the data.
- Export of data or reports
- The visualization of the data
- Other data that is not included in the conceptual scheme

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2.2 Specific requirements

2.2.1 Approach for UR collection

2.2.1.1 Belgian use case

A demotool (https://waterprotecteu.marvin.vito.be/) has been developed that fulfils part of the objectives but needs further development. This demotool has the objective to demonstrate some functionalities to support our interactions with the stakeholders.

Figure 4 gives an overview of our approach for the user requirement (UR) collection. The first step in our consultations is sending a questionnaire[1] to the stakeholders to collect and analyse information about their expectations of the WaterProtect collaborative management tool. The results of the questionnairs are discussed during the interviews:

- Inagro in November 2017
- De Watergroep in November 2017
- Flanders Environment Agency in December 2017
- Farmers in February 2018

The first three interviews were face-to-face interactions in a small group starting from the results of the questionnaire (3 to 5 persons) while the last one was a short discussion on using the tool in an interactive session in larger groups (12-15 persons). The outcome of the interviews and questionnaire results into a user requirement list.

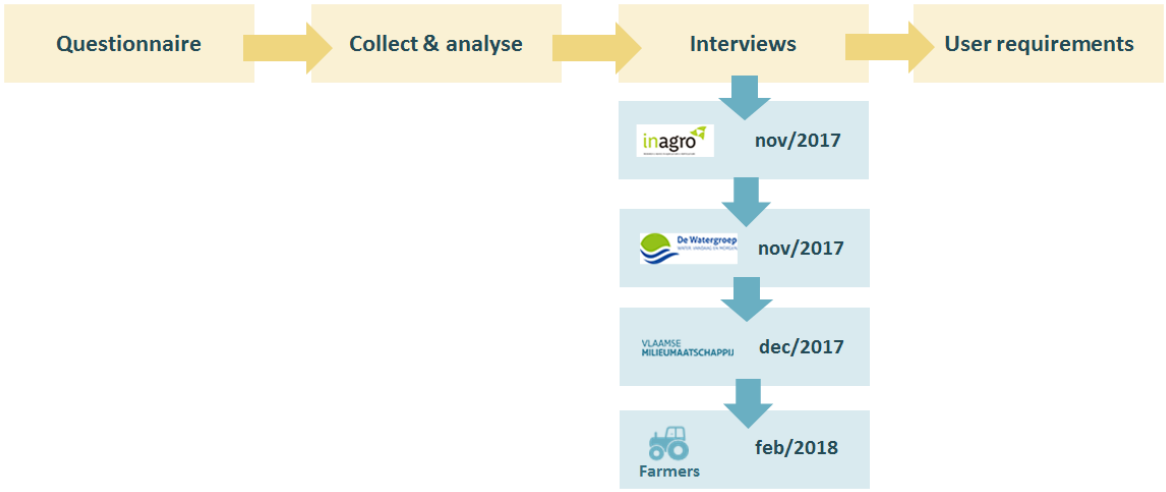

Figure 4: Approach for UR collection

[1] Questionnaire: see Appendix A

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2.2.1.2 Italian use case

The demotool developed for the Belgian use case is intended to be used also in the Italian Action Lab. The user requirements collection follow the approach described for the Belgian Action Lab. However in Italy a preliminary questionnaire was developed containing questions pertinent for different activities of the 7 working packages of the project. Three questions were related to the Geographical Information Systems, which is the base of the demotool under development. Based on the results obtained from this preliminary questionnaire, it was decide to not submit the questionnaire developed for the Belgian Action Lab, and further adapted for the Italian Action Lab, to the farmers.

2.2.1.3 Romanian use case

The demotool developed for the Belgian use case will be used for the Romanian Action Lab as well.

The process of collecting the UR for the Romanian Action Lab included several meetings and discussions with the following major stakeholders (October 2017-February 2018):

- Romanian National Water Authority, Maramures,
- Environmental Protection Agency Maramures,
- Ocna Sugatag Mayor House,
- Farmers' association in Ocna Sugatag.

The meetings focused on WaterProtect collaborative management tool targeted in the project, describing the existing Belgian demotool and presenting the opportunities of developing a tool for the Romanian case. The process of collecting stakeholder's input included open discussions (open questionnaire) targeting: water quality data to be included in the tool, relevance and ranking of data (eg maps) to be included in the tool/application, SH's expectations related to WaterProtect tool and their willingness/availability to use it.

2.2.2 Results of the questionnaire

2.2.2.1 Belgian use case

The general expections of the WaterProtect tool for the users are:

- Farmers can consult easily information to take appropriate measures.
- The output of the tool, such as visualizations and reports, needs to be clear and easy to understand for explaining a particular problem, f.i. the problem of PPP in the waterways, to the farmers.
- The tool need to be userfriendly for the farmers so that they can use the tool with limited explanation.
- The tool should be able to give a picture of the most recent measurements and exceedances, and with a simple click-through the user can retrieve the underlying data.
- The tool should be able to give a clear view of the situation in the catchment and the impact of the measures.

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For consulting the WaterProtect tool users choose mostly the PC, although tablet and smartphones are also relevant mostly in meetings with the farmers and in the fields. Therefore responsive webdesign is very important.

The WaterProtect tool shall contain water quality data of the defined substances in the catchment of the Bollaertbeek, mostly herbicides such as Bentazon, Terbutylazin, Linuron, etc.

The tool integrates data with maps. The most impartant maps are:

- Monitoring stations
- Water courses
- Agricultural Land Use
- Potential erosion for agricultural parcels
- Drainage areas linked to monitoring stations
- Drainage map (map shows flowlines in the landscape where the water flows after a rainfall, taking into account the topography and the waterways)
- Groundwater protection zones
- Groundwater vulnerability map
- Nitrate-sensitive zones
- Risk map with demarcation critical areas for runoff of substances to surface water

Next to monitoring data, discharge data and precipitation data the tool shall contain also information related to measures. Most users prefer that the tool should be able to indicate what measures are planned, where and when, and the tool should be able to suggest a number of possible measures.

How to implement these requirements needs to be discussed in detail with Inagro.

The WaterProtect tool provides visualisations on map and on graphs although the possibility to consult the underlying data is also important.

A last aspect is exporting data, relevant for reporting, further data processing in excel, data integration in other models and using management information in the meetings with the farmers.

During the planned interviews we will further clarify and discuss the collected requirements in detail.

The detailed results of the questionnaire can be found in Appendix B: Results of the Belgian questionnaire.

2.2.2.2 Italian use case

In the preliminary questionnaire developed in the Italia Action lab the farmers were questioned about:

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1. The existence of a GIS platform in Val Tidone for land cultivation and water vulnerability to pesticides and nitrates.
2. Their interest for the use of a GIS platform containing the land cultivation and water vulnerability to pesticides and nitrates, for their needs.
3. Their interest for training courses for the use of a GIS platform containing land cultivation and water vulnerability to pesticides and nitrates in Val Tidone.

The results obtained from the interview of 175 farmers show that 80 % of the famers have no idea about the existence of a GIS platform in Val Tidone for land cultivation and water vulnerability to pesticides and nitrates, whereas 17 % said that there exists a GIS platform for land cultivation and/or and water vulnerability to pesticides and nitrates. However, 3% of the famers did not give an answer. Concerning their interest on having such GIS platform for personal needs and use, 49% give a positive answer, 50% give a negative answer and 1% consider it irrelevant. However, 53% of the interviewed farmers express their interests for training courses for the use of GIS platform containing land cultivation and water vulnerability to pesticides and nitrates in Val Tidone, with a specific request for the winter period.

In the Italian Action lab, the Belgian questionnaire (Appendix A) was translated in Italian Language and adapted for the Italian reality and was used for stakeholders consulation, except farmers.

The general expections of the WaterProtect tool for the users are:

- Farmers and other stakeholders consult easily information to take appropriate measures.
- The output of the tool, such as visualizations and reports, needs to be clear and easy to understand for explaining a particular problem
- The tool need to be userfriendly for the farmers so that they can use the tool with limited explanation.
- The tool should be able to give a picture of the most recent measurements and exceedances, and with a simple click-through the user can retrieve the underlying data.
- The tool should be able to give a clear view of the situation in the catchment and the impact of the measures.

For consulting the WaterProtect tool users choose mostly the PC.

The WaterProtect tool shall contain water quality data for pesticides and nitrates. The pesticides will be decided based also on the examples given by the stakeholders.

The tool integrates data with maps. The most important maps are:

- Monitoring stations
- Water courses
- Agricultural Land Use
- Potential erosion for agricultural parcels
- Drainage areas linked to monitoring stations

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- Drainage map (map shows flowlines in the landscape where the water flows after a rainfall, taking into account the topography and the waterways)
- Groundwater protection zones
- Groundwater vulnerability map
- Nitrate-sensitive zones
- Risk map with demarcation critical areas for runoff of substances to surface water

Next to monitoring and precipitation data, the tool shall contain also information related to measures. The WaterProtect tool provides visualisations on map and on graphs although the possibility to consult the underlying data is also important.

An important aspect underlined by the stakeholders is exporting data. They highlighted the need for further data processing in excel data integration in other models and using management information for personal uses.

During the tool development, the present/additional user requirements will be further discussed with the stakeholders.

The results of the extended questionnaire are available in Appendix C.

2.2.2.3 Romanian use case

During the meetings with relevant SH in Romanian case lab, several aspects are worth mentioning:

- there is interest and willingness to use/test the tool;
- stakeholders are interested in water quality in relationship with land use and the WaterProtect tool may provide an interesting overview of such status quo for water quality in a very representative traditional semi-subsistence farming area (maps reflecting the existing quality classes for water quality in the monitoring stations from action lab, according to the Water Framework Directive – Directive 2000/60/EEC, the Normative regarding the classification of surface water quality water quality).

As general characteristics the Romanian tool will be developed in a friendly, easy to access manner, in Romanian language (English could be included as well), in open source (GIS) and shall work on pc, tablet or smartphone (farmers will most probably use the smartphone).

Main data to be displayed in the Romanian WaterProtect tool will include water quality data for nitrates. Maps will also be included, so there will be a good visualization of relevant information in the target catchment area: Most relevant maps include:

- monitoring stations,
- nitrate sensitive zones,
- water courses,
- agricultural land use,
- risk map with demarcation critical areas for runoff of substances to surface water.

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The WaterProtect tool will provide visualisations on maps and graphs, which is very important and easy to access by farmers; nevertheless, it will provide the possibility to consult the underlying data as well, but these aspects are to be mainly used by authorities.

Further possibilities to integrate the tool with other existing applications so that it may provide good data for change in decision making related to water management will be discussed with the Romanian National Water Authority, Maramures and Ocna Sugatag Mayor House.

2.2.3 Technical specifications

URQ-01 The tool shall be a web tool so that users only need a browser for consulting WaterProtect data

The data and the application shall be centralised on a server. The users only needs a browser for consulting the WaterProtect tool.

URQ-02 The web tool shall work on pc, tablet and smartphone

The users will use a tablet, or a smartphone or a pc for consulting the WaterProtect tool. This means that the tool needs to be developed in a responsive way [2]so that the front-end application can work on the three devices.

URQ-03 The web tool shall be developed with open source framework and libraries

The WaterProtect application consists of two parts: a front-end part for the visualization of the data in the browser and a back-end part for storing the maps, the data and performing calculations. The development of all these components will based on open source framework and libraries.

URQ-04 The web tool shall use REST API for loading discharge and precipitation data.

The discharge data, precipitation data and partly of the monitoring data of the Belgian use case are stored in the database of VMM. VMM provides REST API services for consulting the data. The WaterProtect tool will use these services for the visualization of the data.

2.2.4 Functional specifications

2.2.4.1 General specifications

URQ-05 The web tool shall be userfriendly and easily understandable for farmers and other users

The WaterProtect tool will be interactively so that it is easy understandable and userfriendly in use for users with little knowledge.

[2] Responsive design is an approach to web page creation that makes use of flexible layouts, images, and cascading style sheet media queries. The goal of responsive design is to build web pages that detect the visitor's screen size and orientation and change the layout accordingly.

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URQ-06 The web tool shall be multilingual

The tool shall be used by the Belgian, the Italian and the Romanian action lab. The data and the tool shall be available in the local language of the action lab so that farmers can use easily the tool.

URQ-07 The web tool shall contain user management

The tool shall contain user management for advanced usage. Farmers and other users who only view the WaterProtect data won't need an login. A login can be a step too far for them for using the tool. Advanced users with a login can f.i. export data, load new data, register measures applied on a certain location, and so on.

URQ-08 The web tool shall contain a search functionality on address

The user can find a certain location on a map by entering an address.

URQ-09 The web tool may provide the possibility to see info of other action labs

Certain users, f.i. authorities, are interested to see information of other action labs. This requirement is optional.

URQ-10 Farmers should receive e-mail notifications with a link to the WaterProtect App

In general, farmers don't have the intention to go on a regular basis to the WaterProtect App for following up the water quality status. They are mainly interested in consulting the app when the status is bad. In another project in the Belgian use case (CVBB) they receive mails with the results of nitrate monitoring. They prefer this kind of direct communication. To encourage the farmers to use the WaterProtect App, the tool will send mails to the farmers with a link to the app. The decision to send a mail can be based on:

- exceedance of a particular standard at a certain monitoring location
- based on particular parameters (for example meteo) - more as warning system to prevent exceedances

2.2.4.2 Input specifications

URQ-11 The tool should contain a load procedure for uploading monitoring data of a particular region

The advanced users of different action labs need the possibility to load new sets of monitoring data. The monitoring data of the Romanian use case are available in excel format.

URQ-12 The tool shall use an automatic load procedure for loading discharge and precipitation data.

This user requirement is related to the URQ-04. The advanced users of the Belgian action lab don't need to upload new datasets of discharge and precipitation data. The tool will use the REST API services for this.

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2.2.4.3 Data specifications

Maps

The following user requirements describes the different maps needed for the WaterProtect tool per action lab.

URQ-13 The tool shall contain an basis set of maps for the Belgian and the Italian use case

The basic set of maps are:

- Monitoring stations
- Water courses
- Agricultural land use
- Potential erosion for agricultural parcel
- Drainage areas linked to the monitoring stations

URQ-14 The tool shall contain an basis set of maps for the Romanian use case

The basic set of maps are:

- Monitoring stations
- Nitrate sensitive zones
- Water courses
- Agricultural land use
- Risk map with demarcation critical areas for runoff of substances to surface water

URQ-15 The tool should contain following maps for the Belgian and Italian use case:

The following maps have a priorioty of 2 and won't be included in the first version of the WaterProtect tool:

- Groundwater protection zone
- Groundwater catchment map
- Sewerage map
- Soil type map
- Topographic map

URQ-16 The tool should contain following maps for the Romanian use case:

The following maps have a priorioty of 2 and won't be included in the first version of the WaterProtect tool:

- Groundwater catchment map
- Soil type map
- Topographic map
- Administrative areas

URQ-17 The tool may contain following maps for the Belgian and the Italian use case:

The following maps have a priority of 3:

- Map of applied measures with an indication which measures had a positive effect
- Map with disharge monitoring stations
- Map with protected areas

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- Map focus areas
- Map with water storage capacity of the soil

The map with discharge monitoring stations is not relevant for the Italian use case.

URQ-18 The tool may contain following maps for the Belgian use case:

The following maps have a priorioty of 3:

- Map of applied measures with an indication which measures had a positive effect
- Map with protected areas

Monitoring data

The monitoring data is dependent on the action lab.

URQ-19 The tool shall contain the whole set of measured pesticides and visualize only the problem substances

The tool will contain in the background the whole set of substances but only the problem substances shall be visuable in the tool. Problem substances are substances with exceeding a particular threshold.

URQ-20 The tool may contain also the commercial product names, next to the active substances in PPPs

Farmers have knowledge of commercial product names of pesticides but not of the individual active substances. The priority of this requirement is set to 3 because the market of the commercial pesticide products is changeable and at the moment it is unclear how to standardize updates the information.

URQ-21 The tool shall contain nitrates

This user requirement is most relevant for the Romanian and the Italian use case. The tool will contain in the background all the information, but only the substances with a threshold exceedance are visualized in the tool.

URQ-22 The tool may contain phosphates and suspended matter

This requirement is less relevant for the three action labs, therefore the priority is set to 3.

URQ-23 The tool shall contain discharge data

Discharge data will be loaded and visualized in the tool. This requirement is not relevant for the Romanian and the Italian use case.

URQ-24 The tool shall contain precipitation data

Precipiptation data will be loaded and visualized in the tool. This requirement is not relevant for the Romanian use case.

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Measures data

URQ-25 The web tool shall contain a set of measures with a detailed description for each measure in pdf

One of the deliverables of work package 4 are detailed descriptions of the measures.We can create pdf data sheets of the detailed descriptions to use in the tool.

2.2.4.4 Program specifications

Standards

URQ-26 The tool shall contain environmental standards PNEC, MAC-EQS and drinking water standard for PPPs

The tool shall contain the following environmental standards:

- Evalution of the average concentration using the annual average of the selected dataset against the PNEC
- Evaluation of the max.concentration using the yearly maximum of the selected dataset against the MAC-EQS
- Evaluation of the average concentration using the annual average of the selected dataset against the drinking water standard of 0,1 µ/l for PPPs

This requirement is relevant for the Belgian and Italian use case.

URQ-27 The tool shall contain as environmental standards classifications corresponding the Water Frame Work Directive

The tool shall contain the following environmental standards:

- Evaluation of physical-chemical indicators (nitrates, nitrites, Dissolved Oxygen, Ph, CBO5) according to the Water Framework Directive – Directive 2000/60/EEC, the Normative regarding the classification of surface water quality
- The classification of the Water Framework Directive – Directive 2000/60/EEC (DCA) provides a system for classifying the surface water quality into five categories of quality:
    - Quality class 1: quality category - very good quality, level of impurities - absent, representation colour is blue.
    - Quality class 2: quality category - good quality, level of impurities - low, representation colour is green.
    - Quality class 3: quality category - moderate, level of impurities - moderate, representation colour is yellow.
    - Quality class 4: quality category - satisfactory, level of impurities - critical, representation colour is orange.
    - Quality class 5: quality category - degraded, level of impurities - heavy, representation colour is red.

This requirement is only relevant for the Romanian use case.

URQ-28 The web tool shall not provide the possibility to use user defined standards

The tool will not allow to use user defined standards.

Measures

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URQ-29 The user shall be able to click on a particular measure to view detailed measure info

This requirement is related to requirement UR-23. The user selects a particular measure and clicks on an info button. The tool will visualize the related pdf data sheet.

URQ-30 The user should be able to register certain measures planned at a particular location on a map

The tool provides the possibility to select measures which are planned and link them to a certain location on a map. This requirement shall be implemented in the second version of the tool.

URQ-31 The web tool should be able to determine the applicability of a measure on a certain location, visualised in spider diagram or barchart

The tool should be able to calculate if a measure is applicable on a certain location. The results are visualized in a graph, f.i. a spider diagram or a barchart. This requirement can only be fulfilled if there are calculation rules available for each measure. Therefore the priority is set to 2.

URQ-32 The web tool may give an indication of the possible effect of the measure on a certain location (field)

To give an indication of the possible effect of a measure on a certain location is difficult to calculate and requires a lot of literature study. Therefore the priority is set to 3.

Visualisation

URQ-33 The web tool shall contain a basis set of visualizations for the Romanian use case

The web tool shall be able to generate a graph which visualises:

- Time series of monitoring data for a substance at a particular location
- Indication of the environmental standard (line)

URQ-34 The web tool should contain the following set of visualizations for the Romanian use case

The web tool should be able to generate the following visualisations:

- Graph with average and max. measurement per month, including annual average for a substance at a particular location
- Pie chart of land use for the catchment associated with a particular location

URQ-35 The web tool shall contain a basis set of visualizations for the Belgian and Italian use case

The web tool shall be able to generate a graph which visualises:

- Time series of monitoring data for a substance at a particular location
- The precipitation data
- The river discharge data
- Indication of the environmental standard (line)

The user shall be able to deselect the precipitation data and the river discharge data. River discharge data is not relevant for the Italian use case.

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URQ-36 The web tool should contain the following set of visualizations for the Belgian and Italian use case

The web tool should be able to generate the following visualisations:

- Graph with average and max. measurement per month, including annual average for a substance at a particular location
- Graph with average and max. precipitation data per month, including annual average for a substance at a particular location
- Graph with average and max. discharge data per month, including annual average for a substance at a particular location
- Pie chart of land use for the catchment associated with a particular location
- Pie chart of erosion sensitivity for the catchment associated with certain location

Visualizations of discharge data are not relevant for the Italian use case.

2.2.4.5 Output specifications

URQ-37 The user shall be able to download data

The user shall be able to download:

- Monitoring data of a substance at a certain location for a particular period
- Precipitation data at a certain location for a particular period
- Discharge data at a certain location for a particular period

The download functionality will be only available for users with a login. Download of discharge data is not relevant for the Italian and the Romanian use case.

URQ-38 The web tool shall provide data downloads in csv format

This requirement is related to URQ-35. Monitoring data, precipitation data and discharge data can be downloaded in csv format. This gives the user the opportunity to create their own graphs in excel or perform further calculations.

URQ-39 The web tool may be able to create a pdf report with relevant info & graphs of a certain location

The main focus of the web tool is to use the application as a collaborative management tool in a interactive way between different stakeholders. The stakeholders will use a pc or tablet during the interactions. In Romania, there are regions with less internet possibilities. if this causes problems to use the application we need to review the priority of this requirement. At the moment this requirement is optional to promote the usage of the tool.

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2.2.5 UR matrix

The user requirement matrix contains the following information:

- Id: number of the UR (f.i. URQ-001)
- Category: technical, general, input, output, program, …
- UR: the user requirement
- Performance criteria: on-the-fly, over-night, …(only applicable for functionalities)
- Priority: a scoring from 1 to 3, where 1 is "need to have" and 3 is "nice to have"

ID	Category	User requirement	Performance	Priority	Belgian use case	Italian use case	Romanian use case
URQ-1	Technical	The tool shall be a web tool so that users only need a browser for consulting WaterProtect data		1	x	x	x
URQ-2	Technical	The web tool shall work on pc, tablet and smartphone		1	x	x	x
URQ-3	Technical	The web tool shall be developed with open source framework and libraries		1	x	x	x
URQ-4	Technical	The web tool shall use REST API for loading discharge and precipitation data.		1	x		
URQ-5	General	The web tool shall be userfriendly and easily understandable for farmers and other users		1	x	x	x
URQ-6	General	The web tool shall be multilingual		1	x	x	x
URQ-7	General	The web tool shall contain user management		1	x	x	x
URQ-8	General	The web tool shall contain a search functionality on address		1	x	x	x
URQ-9	General	The web tool may provide the possibility to see info of other action labs		3	x	x	x
URQ-10	General	Farmers should receive e-mail notifications with a link to the WaterProtect App		2	x		

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ID	Category	User requirement	Performance	Priority	Belgian use case	Italian use case	Romanian use case
URQ-11	Input	The tool should contain a load procedure for uploading monitoring data of a particular region		2	x	x	x
URQ-12	Input	The tool shall use an automatic load procedure for loading discharge and precipitation data.		1	x		
		Maps					
URQ-13	Data	The web tool shall contain the following basis set of maps: - Monitoring stations - Water courses - Agricultural land use - Potential erosion for agricultural parcels - Drainage areas linked to the monitoring stations -Risk map with demarcation critical areas for runoff of substances to surface water		1	x	x	
URQ-14	Data	The web tool shall contain the following basis set of maps: - Monitoring stations - nitrate sensitive zones - Water courses - Agricultural land use -Risk map with demarcation critical areas for runoff of substances to surface water		1			x
URQ-15	Data	The web tool should contain following maps: - groundwater protection zones - groundwater catchment map - sewerage map - Soil type map - Topographic map		2	x	x	x

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ID	Category	User requirement	Performance	Priority	Belgian use case	Italian use case	Romanian use case
URQ-16	Data	The web tool should contain following maps: - groundwater catchment map - Soil type map - Topographic map -administrative areas		2			x
URQ-17	Data	The web tool may contain following maps: - map of applied measures with an indication which measures had a positive effect - map with disharge monitoring stations - map with protected areas - map focus areas - Map with water storage capacity of the soil		3	x	x	
URQ-18	Data	The web tool may contain following maps: - map of applied measures with an indication which measures had a positive effect - map with protected areas		3			x
		Monitoring data					
URQ-19	Data	The tool shall contain the whole set of substances and visualize only the problem substances		1	x	x	x
URQ-20	Data	The tool may contain also the commercial product names, next to the active substances		3	x	x	
URQ-21	Data	The tool shall contain nitrates		1	x	x	x
URQ-22	Data	The tool may contain phosphates and suspended matter		3	x	x	x
URQ-23	Data	The tool shall contain discharge data		1	x		
URQ-24	Data	The tool shall contain precipitation data		1	x	x	

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ID	Category	User requirement	Performance	Priority	Belgian use case	Italian use case	Romanian use case
		Measures data					
URQ-25	Data	The web tool shall contain a set of measures with a detail description for each measure in pdf format		1	x	x	x
		Standards					
URQ-26	Program	The tool shall contain the following environmental standards: - Evalution of the average concentration using the annual average of the selected dataset against the PNEC - Evaluation of the max.concentration using the yearly maximum of the selected dataset against the MAC-EQS - Evaluation of the average concentration using the annual average of the selected dataset against the drinking water standard of 0,1 µ/l	on-the-fly	1	x	x	
URQ-27	Program	The tool shall contain the following environmental standards: - Evaluation of physical-chemical indicators (nitrates, nitrites, Dissolved Oxygen, Ph, CBO5) according to the Water Framework Directive – Directive 2000/60/EEC, the Normative regarding the classification of surface water quality - The classification of the Water Framework Directive – Directive 2000/60/EEC (DCA) provides a system for classifying the surface water quality into five categories of quality: Quality class 1: quality category - very good quality, level of impurities - absent, representation colour is blue. Quality class 2: quality category - good quality, level of impurities - low, representation colour is green. Quality class 3: quality category - moderate, level of impurities - moderate, representation colour is yellow. Quality class 4: quality category - satisfactory, level of impurities - critical, representation colour is orange. Quality class 5: quality category - degraded, level of impurities - heavy, representation colour is red.	on-the-fly	1			x

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ID	Category	User requirement	Performance	Priority	Belgian use case	Italian use case	Romanian use case
URQ-28	Program	The web tool shall not provide the possibility to use user defined standards	on-the-fly	1	x	x	x
		Measures		1			
URQ-29	Program	The user shall be able to click on a particular measure to view detail measure info.	on-the-fly	1	x	x	x
URQ-30	Program	The user should be able to register certain measures planned at a particular location on a map	on-the-fly	2	x	x	x
URQ-31	Program	The web tool should be able to determine the applicability of a measure on a certain location, visualised in spider diagram or barchart	on-the-fly	2	x	x	x
URQ-32	Program	The web tool may give an indication of the possible effect of the measure on a certain location (field)	on-the-fly	3	x	x	x
		Visualizations					
URQ-33	Program	The web tool shall be able to generate a graph which visualises: - time series of monitoring data for a substance at a particular location - indication of the environmental standard (line)	on-the-fly				x
URQ-34	Program	The web tool should be able to generate the following visualisations: - Graph with average and max. measurement per month, including annual average for a substance at a particular location - Pie chart of land use for the catchment associated with a particular location	on-the-fly				x

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ID	Category	User requirement	Performance	Priority	Belgian use case	Italian use case	Romanian use case
URQ-35	Program	The web tool shall be able to generate a graph which visualises: - time series of monitoring data for a substance at a particular location - the precipitation data - the river discharge data - indication of the environmental standard (line) The user shall be able to deselect the precipitation data and the river discharge data	on-the-fly	1	x	x	x
URQ-36	Program	The web tool should be able to generate the following visualisations: - Graph with average and max. measurement per month, including annual average for a substance at a particular location - Graph with average and max. precipitation data per month, including annual average for a substance at a particular location -Graph with average and max. discharge data per month, including annual average for a substance at a particular location - Pie chart of land use for the catchment associated with a particular location - Pie chart of erosion sensitivity for the catchment associated with certain location	on-the-fly	2	x	x	x
URQ-37	Output	The user shall be able to download: - monitoring data of a substance at a certain location for a particular period - precipitation data at a certain location for a particular period - discharge data at a certain location for a particular period	on-the-fly	1	x	x	x
URQ-38	Ouput	The web tool shall provide data downloads in csv format	on-the-fly	1	x	x	x
URQ-39	Ouput	The web tool may be able to create a pdf report with relevant info & graphs of a certain location	on-the-fly	3	x	x	x

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2.2.6 Conclusions

- Stage 1 (version 1) requires the user requirements with priority one
- Stage 2 (version 2) shall contain the user requirements with priority two

The delivery of the first version is foreseen at the end of 2018 and the delivery of the second version at the end of 2019.

The following user requirements with priority 3 shall not be implemented in the WaterProtect project:

- ***URQ-9 The web tool may provide the possibility to see info of other action labs***
  Other action labs can consult the general part of the WaterProtect which requires no login. The functionalities which requires a login are not open for other action labs.

- ***URQ-17 & URQ-18 The web tool may contain following maps***
  - map of applied measures with an indication which measures had a positive effect
  - map with disharge monitoring stations
  - map with protected areas
  - map focus areas

- ***URQ-20 The tool may contain also the commercial product names, next to the active substances***
  The market of the commercial pesticide products is changeable and at the moment it is unclear how to standardize updates the information.

- ***URQ-22 The tool may contain phosphates and suspended matter***
  Phosphates and suspended matter are seen as background information for the tool.

- ***URQ-32 The web tool may give an indication of the possible effect of the measure on a certain location (field)***
  This requirement is relevant for the farmers. To give an indication of the possible effect of a measure on a certain location is difficult to calculate and requires a lot of literature study. Because of budget and time this requirement cannot be implemented in the current WaterProtect project.

- ***URQ-39 The web tool may be able to create a pdf report with relevant info & graphs of a certain location***

The main focus of the web tool is to use the application as a collaborative management tool in a interactive way between different stakeholders. This requirement is optional to promote the usage of the tool.

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User requirement

Action lab: *Ballycanew and Castledockrell (IE)*

Per-Erik Mellander and Owen Fenton

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3 Ballycanew and Castledockrell (IE)

3.1 General description

3.1.1 Objective

There is at present no existing tool available to elucidate nitrate and pesticide risk assessment in Ireland. Within the Irish Actionlab a risk assessment tool will be developed for catchment scale (ca. 10km^2) in County Wexford. Added functionality based on stakeholder needs in terms of visualisation, input data and outputs will be developed over time and incorporated into the final product.

The overall objectives of the tool are:

- To provide functionality, other than scientific-only functionality, that stakeholders actually need for their specific purpose (education, demonstration etc…) within a nitrate pesticide model
- To support risk based decisions in order to inform stakeholders on effective catchment management and mitigation of nitrate and pesticide pollution to water in Ireland
- To support water managers to identify the most cost-effective measures to mitigate pollution of water
- To support knowledge transfer for an increased uptake by farmers to implement identified measures.

The benefits of the tool are:

- That it will be constructed based on a stakeholder collaboration and built on research outcomes, available data and existing knowledge
- It is more likely to be used if stakeholders are involved in the developing of the tool
- That it will also have a demonstration purpose
- It brings stakeholders together for a common goal in reducing pesticides and nitrate loss to water
- It increases local engagement by sharing data from participatory monitoring.

3.1.2 Concept of use

3.1.2.1 Use case

The Irish Actionlab is focused on farmland within County Wexford, in the south-east of Ireland. Detailed studies are made within two data rich catchments with typical settings for the region. These catchments will be used to scale up the water risk assessment to a regional scale. In one catchment the impacts on water resources are mainly nitrate loss to groundwater (and possibly pesticide) in the uplands and pesticide loss to surface water and perched groundwater. In the other catchment the impact on water resources are mainly nitrate (and possibly pesticide) loss to groundwater and to surface water via belowground pathways, and pesticide loss to surface water *via* quick flow pathways during rain events. The sources of nutrients (nitrate and phosphorus) are

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mainly from inorganic/organic fertilizers and from farmyards and septic tanks. The sources of pesticides (mainly MCPA) are from crop spraying. There are also microbial and pharmaceuticals loss to water from organic fertilizers and septic tanks.

Water managers, farm advisors and researchers will all need varied functionality to provide them with the necessary outputs for their respective function. For example scientists and regulatory stakeholders may use the tool to identify the risk of nitrate and pesticide loss to surface and groundwater at farm or catchment scale. The tool in that case would support the identification of cost-effective mitigation measures. In terms of education and demonstration on the ground in catchments it could serve as a tool for farmers meetings and discussion groups to increase the uptake of mitigation measures.

3.1.2.2 WaterProtect Iris Actionlab platform

The WaterProtect Irish Actionlab will develop a platform to:

- Visualise risky areas and times for nitrate and pesticide pollution
- Assess suitable measures aiming at mitigating nitrate and pesticide loss to water
- Improve farmer uptake of suitable mitigation measures

3.1.2.3 Conceptual scheme

- The envisaged model will be built on high temporal and spatial resolution data together with expert opinion
- Researchers aim to develop a risk model for Irish conditions with input from multiple stakeholders – *e.g.* Wexford County Council, Glanbia Ingredients Ireland, Knowledge Transfer specialists and with interaction by the Environmental Protection Agency, Department of Agriculture Food and the Marine, Irish Water and farmers
- Data collected at various scales on soil physical and chemical properties, topography, land use, land management and hydro-chemometrics will be used as inputs together with data gather through expert opinion
- Provision of data will be from a variety of sources including the Agricultural Catchments Programme which will provide high resolution data used to build the model for focused study catchments. Other stakeholder will feed their respective datasets into this framework.

3.1.3 Users and user interface

- The interface will remain simple. It will be developed to enable someone with low technical expertise to interact with the tool. Ultimately it will require only very basic computational skills for use on PC
- Different stakeholders will use the tool for different functions e.g. it could be used as a demonstration tool to point out hotspot areas or farm typologies, it could be used as an educational tool for school children, it could be used to guide industry with respect to high and low perceived areas of pollution

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- Primary users to support activities and policy (users who will deliver data to the project) are: Teagasc, Wexford County Council, Glanbia Ingredients Ireland, Environmental Protection Agency, Department of Agriculture Food and the Marine and Irish Water
- Secondary users, who consult the tool occasionally, are Teagasc farm advisors and farmers.

3.1.4 Other

Important requirements are that user management need to take into account IP and confidentiality of the data used both in the model and exported for reports and visualization.

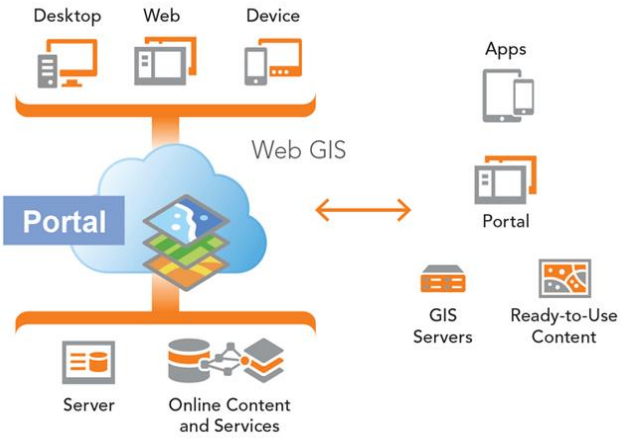
3.2 Specific requirements

3.2.1 Approach for UR collection

URs have been discussed with partners and with a few stakeholders. A formal partner/stakeholder meeting will be organised in March 2018 to further identify all potential users and to gather all needed information for the URs. A discussion will be built around a number of prepared questions and a presentation of the likely output and potential uses of this output. We suggest that the URs will be revisited in a later stakeholder meeting. Finally the URs will be published on the Irish Actionlab webpage (http://water-protect.ie/).

3.2.2 Technical specifications

1. Model: the model will generate spatial water quality data to build ArcGIS shape-files.
2. Database: the shape-files will be used in an ESRI online database together with ready-to-use background maps.
3. Portal: a web portal for Arc GIS will produce maps to be viewed on a desktop, laptop, or mobile device.



Concepts of web GIS (http://www.esri.com/esri-news/arcuser/winter-2014/portal-for-arcgis-101).

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3.2.3 Functional specifications

3.2.3.1 Stakeholders/actors

The online tool will be publically available. It aims to be viewed by farmers and used by stakeholders such as Teagasc research and knowledge transfer, local authorities (Wexford County Council), food producers (Glanbia Ingredients Ireland), water services (Irish Water) and water regulators (Environmental Protection Agency and the Department of Agriculture Food and the Marine).

3.2.3.2 General specifications

UR-IRE00x: Shall be able to investigate and visualise Nitrate and Pesticide (limited to those being investigated in the project) risk areas (catchment to county scale) to both surface waters and groundwater based on model outputs.

UR-IRE00x: Shall be able to visualise risk areas of Nitrate and Pesticide (limited to those being investigated in the project) to both surface waters and groundwater at county scale based on model outputs

3.2.3.3 Input specifications

UR-IRE00x: Shall allow editing of data based on local knowledge (e.g. land use, soil conditions, N fertilizer use).

UR-IRE00x: Shall not allow input data and therefore is a demonstration and educational tool.

3.2.3.4 Output specifications

UR-IRE00x: Shall generate export data tables and maps

UR-IRE00x: Shall generate maps

3.2.4 UR matrix

Provide an overview of the UR in a table

ID	Category	UR	Performance	Priority
URQ00x	Input	Data from model	On-the -fly	1
URQ00x	General	Web application	On-the –fly	1
URQ00x	Viewing	Thematic map	On-the –fly	1
URQ00x	Export	Export of map and table	On-the -fly	1

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3.2.5 Conclusions

The URs are different for different users. For example scientists and regulatory stakeholders may use the tool to identify the risk of nitrate and pesticide loss to water at farm or catchment scale and require top level use. For education and demonstration it is simply a visualisation tool at county level.

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User requirement

Action lab: *Vester Hjerk (DK)*

Erling Andersen[1], Peter Stubkjær Andersen[1], Andreas Aagaard Christensen[1] , Lone Søderkvist Kristensen[1] and Anker Lajer Højberg[2]

[1]University of Copenhagen
[2]Geological Survey of Denmark and Greenland

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4 Vester Hjerk (DK)

4.1 General description

The tool to be used in the Danish WaterProtect Action Lab is the dNmark Landscape tool developed under the auspices of the Danish nitrogen research alliance (dNmark). The tool is designed for use in local catchments and tested in five case areas in the period 2016-2018 (http://dnmark.org). A short description of the tool can be found in the factsheet in Annex 1.

4.1.1 Objective

The overall objective of the tool is to provide a scientifically based dialog platform to foster good collaboration between key actors for identifying optimal solutions at catchment scale to reduce nitrate emissions from agriculture to groundwater and surface water systems. Specific objectives include:

- Visualisation of water quality data from national databases and local measurements
- Include relevant soil-crop-management data at a scale relevant to the farmers, e.g. field scale or less
- Provide "on-the-fly" calculations of nitrate leaching under current and alternative management scenarios
- Take transport pathways via drainage into consideration

The benefit and goal of the tool is that it will be designed to enable local stakeholders and communities to assess the effect of their land use practices on N-leaching and emission by making visualization, assessment and prediction functions available in an easily accessible interface.

The tool will build on the following assumptions: (1) That lack of information is a key driver for unsustainable farm scale nitrate management practices, and (2) That farm scale nitrate management is systematically suboptimal to catchment / landscape scale management practices. Therefore, the tool is designed to supply information and support decision making at appropriate scales.

4.1.2 Concept of use

4.1.2.1 Use case

The Danish pilot is Vester Hjerk waterworks in the town of Roslev (Skive municipality, NW Denmark), which is a small waterworks with a groundwater abstraction license of approximately 30,000 m^3/year in an area dominated by intensively managed agriculture (covering 85% of the area). The capture zone of the waterworks has been identified as a nitrate vulnerable zone and since the 1980'ties the nitrate concentration has been steadily increasing. In recent years, the nitrate concentration has exceeded 50 mg NO3/l in a few samples and in the past 10 years it has generally been above 37.5 mg NO3/l, which is the limit at which actions must be taken according to the WFD.

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The user cases for the Vester Hjerk Action Lab are currently under development. Three possible scenarios/user cases can be envisaged in which the collaborative tool can be used: (1) Improved land use and management within the current area of water extraction to improve water quality at the waterworks; (2) A scenarios with a new location of the water extraction site within the water supply area; and (3) Merger with neighbouring waterworks. The usages of the tool will be similar in all three user cases, but focusing on different areas.

Outside WaterProtect the Landscape Tool is expected to be developed further to be usable by agricultural advisors in catchment planning.

4.1.2.2 The landscape model

Currently, the Landscape Tool only deals with leaching of nitrogen to surface waters. A major challenge in WaterProtect is to develop the Landscape Tool to predict nitrogen leaching to the ground water based on inputs from hydrological models. The implementation of this is not yet planned in details.

The current version of the dNmark Landscape Tool consists of five modules: (1) The pre-processing module prepares data for calculation. (2) The calculation module estimates the leaching and retention for 20 by 20 meter grid cells and outputs a landscape scale map showing the results. (3) The interface module consists of a selection tool and an array of drop-down menus, allowing the user to select a set of grid cells and change the input data and the land use and management of the selected cells. (4) The recalculation module re-calculates leaching and retention estimates on a cell-by-cell basis. (5) The comparison module compares the results from the status quo calculation with the scenario that was set up using the interface module. An overview of the modules and their content is shown in Figure 5.

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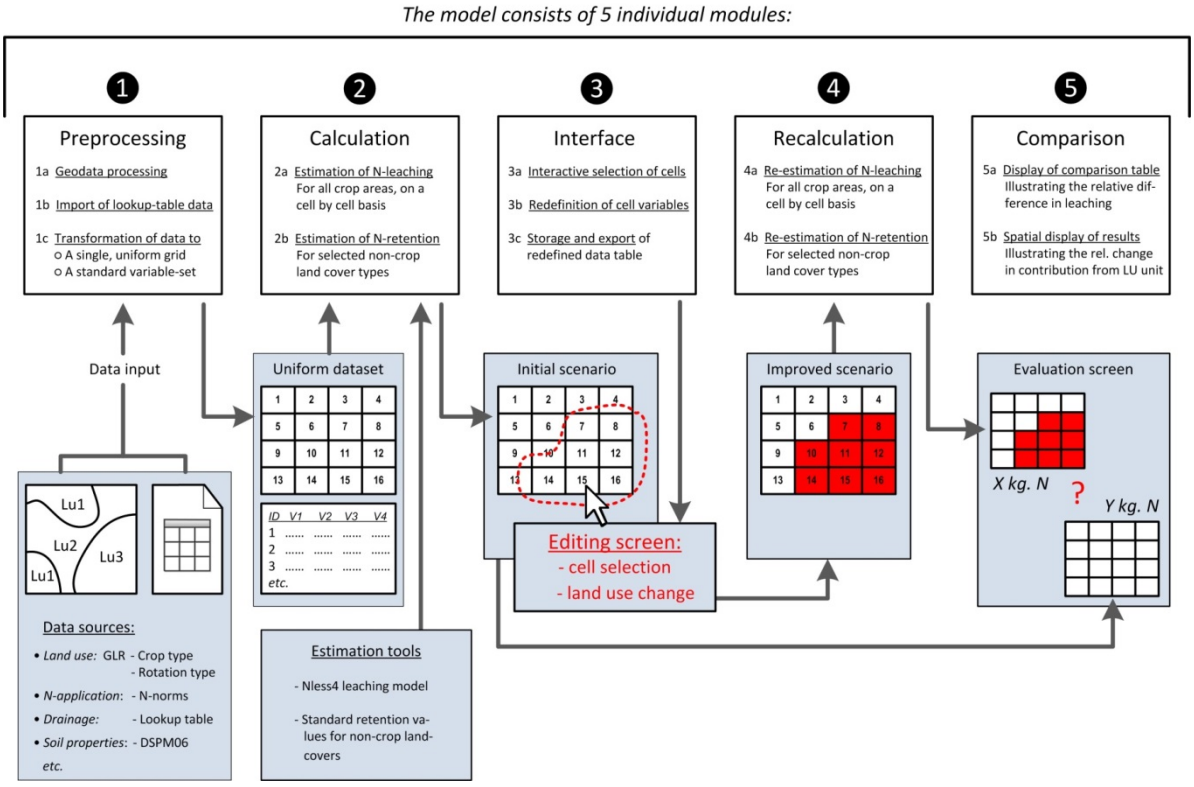

Figure 5. Overview of the modules of the dNmark Landscape Tool (Christensen et al., 2017)

4.1.2.3 Usage and required capabilities/functionalities

In WaterProtect the Landscape Tool will potentially be used in two different ways: (1) On-farm application with single farmers to identify management options at farm and field level and, (2) in workshop settings with farmers and other local stakeholders gathered to identify alternative spatially explicit options for water extraction based on common discussion and debate.

The basic data in the tool are data from national databases, Table 1, but the tool supports computer aided correction of data based on local knowledge and expertise – so called "digital transdisciplinary" (Christensen, 2017). This is needed both to improve the precision and relevance of the data and to create ownership to the data and the calculated estimates and results.

The tool supports a process of knowledge integration and accumulation regarding scenarios for future changes in land-use and management. This is needed to allow the farmers and other stakeholders to provide their own solutions to reach the targets for reduction of nitrogen flows to recipients.

In the context of environmental management, collaborative planning represents an approach to land use planning where stakeholders lead and own the planning process. The Landscape Tool is designed to support such a process, where farmers and other stakeholders in collaboration seek solutions on nitrogen issues at the local scale. As such, the tool supports a process where the designed solutions are co-authored by farmers, making the solutions more likely than general

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regulation to reflect local opinion, expertise, landscape and soil features as well as aspirations and plans for future agricultural land use.

Table 1. Overview of main data sources for the dNmark Landscape Tool.

Input data includes:	Source	Coverage
1. Crops grown	GLR	National
2. Permanent non-agricultural land use types	FOT	National
3. Permanent agricultural land use types	GLR	National
4. Field irrigation status (irrigated: yes / no)	GLR	National
5. Soil type (Jb nr.)	Greve et al.	National
6. Clay and organic content in soil (%)	Greve et al.	National
7. Manure share of fertilizer application (precipitation)	Conterra/GLR	Case-specific
8. Climate grid (precipitation)	DMI	National
9. N-application norms	PDIR	Non-specific
10. Drainage figures for crop-soiltype combinations	AAU	Non-specific
11. Retention in watershed	GEUS	National

Sources: GLR: Danish IACS; FOT: kortforsyningen.dk; Greve et al., 2007; Conterra: http://www.conterra.dk; DMI: The Danish Meteorological Institute; PDIR: The Danish Agricultural Agency; AAU: University of Aarhus; GEUS: The Geological Survey of Denmark and Greenland.

4.1.3 Users and user interface

In WaterProtect the tool will be used by project partners only. In workshops, staff from UCPH will be present and run the tool. Beyond WaterProtect it is planned to develop the Landscape Tool further to be used by agricultural advisors or persons with similar qualifications. We can expect that:

- The users have a relatively high education level and experience in using computer tools of similar type as the Landscape Tool.
- The key users will use the tool several times a week, but some users might only use it monthly or even less frequent.
- That it must be possible to access and run the tool in standard browsers on standard computers.

4.1.4 Other

Data on soil type, on clay and organic content and on drainage figures on soil-crop combinations (points 5, 6 and 10) are not public due to disclosure rules. However, this is not an issue for the work in WaterProtect as project partners only will be operating the tool.

It is planned that the Landscape Tool in future projects will be developed to include other public goods than water.

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4.2 Specific requirements

4.2.1 Approach for UR collection

The present and earlier versions of the Landscape Tool have been tested in 10 workshops in five case areas in the dNmark project. Feedback from the local stakeholders at these workshops has provided extensive knowledge of shortcomings and potentials for further developments with respect to both improvements of the technical functionalities as well as features required to enhance the engagement of the local stakeholders.

To supplement the knowledge from the workshop, a less comprehensive survey was carried out by interviews of local and national farmer advisories with extensive experience on N-management including catchment area approaches. The purpose of these interviews was to obtain input on requirements from professionals working at the catchment scale, rather than having focus on the individual farms. In total, this approach yielded the 26 URs described and assessed below.

4.2.2 Technical specifications

UR-DK01: Grid cell level inputs

UR-DK02: On the fly calculations

UR-DK03: Geo-processing service, available through web-browsers

UR-DK04: User management system to handle individual users with options for data disclosure.

UR-DK05: Detailed logging of data corrections and scenarios

4.2.3 Functional specifications

4.2.3.1 Stakeholders/actors

The Landscape Tool is a collaboration tool used in processes between local stakeholders. The ideal scale of use is local catchment level and involves use of knowledge from different sources by mainly the local landowners and farmers.

In WaterProtect the developers of the tool will run the Landscape Tool. Beyond WaterProtect the primary users of the Landscape Tool are the local catchment officers that through their work have the main responsibility of assuring appropriate actions in the catchment in relation to possible reductions of nutrient loads to surface and ground waters. The catchment officers are the operators of the Landscape Tool.

The secondary stakeholders are the landowners (mainly farmers) in the local catchment. The landowners will work together with the catchment officers to reach an agreement on future scenarios and land management.

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Tertiary stakeholders are other local inhabitants and land users including NGOs that may have an interest in the management and development of the local case area. These stakeholders will provide input to the process.

Finally, external stakeholders are national authorities e.g. the environmental agency, the agricultural agency and the nature agency. The agencies may give input to the development of scenarios as well as future direction and goals for the nutrient loads in specific catchments.

4.2.3.2 Functional specifications

The functional specifications are listed below. This is not an exhaustive list but a selection of functional specifications that are central to the Landscape Tool in the current user case(s).

General specifications

UR-DK06: Shall be able to estimate emissions to both surface waters and groundwater based on appropriate models.

UR-DK07: Shall take landscape variations (soils, hydrology, climate, land use etc.) into account in the model estimations.

UR-DK08: Shall be able to function at different spatial scales from farm level to catchment level.

UR-DK09: Shall be used in workshop situations with several stakeholder interactions and input.

UR-DK10: Shall be used by trained (catchment) consultants and other relevant personal in workshop situations.

UR-DK11: Shall be accompanied by a process description regarding the use of the tool in workshop situations.

UR-DK12: Shall be able to calculate results within reasonable time (e.g. below 5 minutes in workshop situations).

Input specifications

UR-DK13: Shall allow editing of data based on local knowledge (e.g. land use, soil conditions, actual N fertilizer use).

UR-DK14: Shall specify data source type and allow users to assign type (e.g. user generated data vs. expert generated data).

UR-DK15: Shall use most recent Danish retention mapping at catchment level (id15).

UR-DK16: Shall consider drainage e.g. through input of modelled estimates for drained and not drained areas.

UR-DK17: Shall allow transparency regarding sources of input data.

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UR-DK18: Shall allow selection of waterbodies in focus based on modules (e.g. ground water module or surface water module, or both)

Output specifications

UR-DK19: Shall generate export data (leaching) at catchment level (ID15).

UR-DK20: Shall allow easy comparison with other result estimates and measurements of leaching at catchment and farm levels.

Functionality specifications

UR-DK21: Shall allow easy selection of case areas (e.g. catchments or farms).

UR-DK22: Shall allow easy choice of scale of intervention (catchment, farm, field, pixel).

UR-DK23: Should take into account the dynamic effects (synergies, trade-offs) between different measures in the modelled results.

UR-DK24: User interface should be simple and easy to use.

Visualization specifications

UR-DK25: Shall use easy-to-read maps for illustrating a variety of scenarios (land use) and their consequences in terms of the output (leaching to surface waters and groundwater).

UR-DK26: Maps and reports of leaching to surface waters, leaching to groundwater, retention and N loading to coastal waters should be generated.

4.2.4 UR matrix

ID	Category	UR	Performance	Priority
01	Technical	Grid cell level inputs	Not relevant	1
02	Technical	On the fly calculations	Not relevant	1
03	Technical	Available through web-browsers	Not relevant	2
04	Technical	User management system including individual data access	Not relevant	3
05	Technical	Detailed logging of changes	Not relevant	3
06	Functional - general	Assess emissions to both surface waters and groundwater	On-the-fly	1
07	Functional - general	Account for landscape variation in model estimations	On-the-fly	1

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08	Functional – general	Scales from farm level to catchment level	On-the-fly	1
09	Functional - general	For workshop with several stakeholder inputs	On-the-fly	1
10	Functional - general	Shall be used by trained consultants	On-the-fly	2
11	Functional - general	Guidance on use of the tool in workshop situations	Not relevant	3
12	Functional - general	Calculation time < 5 minutes in workshops	On-the-fly	2
13	Functional - input	Allow editing of data based on local knowledge	On-the-fly	1
14	Functional - input	Shall specify data source type	On-the-fly	3
15	Functional - input	Shall use most recent Danish retention mapping	Not relevant	1
16	Functional - input		Not relevant	1
17	Functional – input	Shall allow transparency regarding sources of input data	Not relevant	2
18	Functional - input	Shall allow selection of waterbodies in focus based on modules	On-the-fly	1
19	Functional - output	Shall generate data for export	On-the-fly	3
20	Functional - output	Shall allow easy comparison with other result estimates	On-the-fly	1
21	Functional - functionality	Shall allow easy selection of case areas	On-the-fly	2
22	Functional - functionality	Shall allow easy choice of scale of intervention	On-the-fly	1

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23	Functional - functionality	Shall handle dynamic effects between measures	On-the-fly	3
24	Functional - functionality	User interface should be simple and easy to use	Not relevant	2
25	Functional - visualization	Shall use easy-to-read maps to illustrate results	On-the-fly	1
26	Functional - visualization	Maps and reports on results should be generated	Over-night	3

Priority: a scoring from 1 to 3, where 1 is “need to have” and 3 is “nice to have”

4.2.5 Conclusions

Our assessment of why some URs have low priority and which URs are important for the development of the tool, reflects the needs within WaterProtect and the resources available.

Priority 1: Is of high importance for WaterProtect and we assess that the needed resources is available.

Priority 2: Is similarly very relevant in WaterProtect, but it is uncertain if the resources are available, and the URs may not be realised within the WaterProtect.

Priority 3: Of less relevance for WaterProtect, and will not be implemented.

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User requirement

Action lab: *Llobregat (ES)*

Authors
Enric Queralt- CUADLL
Vinyet Solà - CUADLL

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 727450

5 Llobregat (ES)

5.1 General description

The purpose of the tool is to help farmers and other users to know more about the chemical and quantitative state of groundwater and the quality of irrigation water. This information will be very useful to take decisions to apply good agricultural practices. Other objectives of the tool are to integrate all data related with water in a single database and share data with all users. The tool has to be viewer-friendly.

The benefits of this new tool are fast access to data, fast graphical information and being easy to understand.

The easy visualization of data monitoring allows checking and evaluating the impact of the application of best agricultural practices.

In addition, water supply companies will have more information about groundwater because they will have information from other wells close to their wells. The knowledge of drinking water buffer wells will grow and their exploitation can improve.

5.1.1 Concept of use

The Spanish case is an aquifer of 120 km^2 with two channels of surface water for irrigation: Canal Infanta (left) and Canal de la Dreta (right). Agrarian activity occupies about 3350 ha and there are wells for drinking water. CUADLL, CPABLL, ACA, AB and other operators monitor groundwater quality. CPABLL is familiar with the type of agrarian activity and promotes best agrarian management practices. The aim of this work package is to create a tool that makes it possible to bring together all information and data about quality and agrarian activity.

CUADLL has an old Geographic Information System (GIS) made in 2002. New software (QGIS) will update the current GIS. QGIS is an open source platform that works in a browser. The purpose is to update this database and make it available to farmers and users. The new version of GISWUA will integrate new sources of information and more new data because it has a global vision (for instance the new version will have information about irrigation water and surface water) as these types of water interact with groundwater.

The database has to consist of three types of information:

- Geographic information
- Structural data
- Time data information: Data level, chemical data and flowmeter data.

- Provide an action lab for specific use in the case in which the tool will be used:

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List of chlorides, pesticides and nitrates in water irrigation and impact on groundwater and water supply wells.

- Describe in general terms what components the system is expected to have and how they will be used – include a schematic representation. Describe the environment in which the system is to operate

The system is made up of QGIS software. The system works in a browser and there will be users with several types of privileges: 1) viewer, 2) editor, 3) administrator

- State main capabilities/functionalities and why they are needed

Qgis is a free and open source Geographic Information System with a lot of functionalities and capabilities. This software is user-friendly. The data will be available for all users including farmers. These people can find their nearby data and check the quality of their zone. The editor has a good tool for importing and managing all the data. Finally, the administrator can manage profiles and the tool in general.

- Describe the processes that the tool will support, how and to what effect (impact of the tool for the users)

Query quality parameters by site and time.

Improve fertilization through knowledge of irrigation water quality.

- Describe the different databases relevant for the tool and the relationship with the different components - include a schematic representation

The database will have the following structure:

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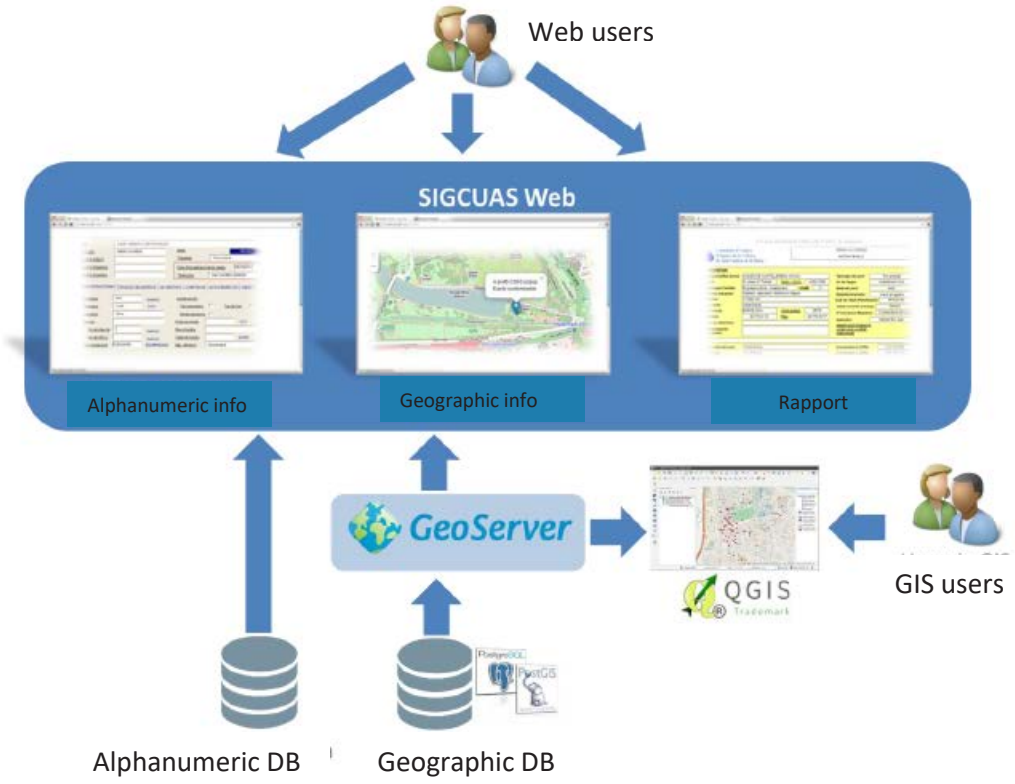

Database structure

The administrator makes the structure, the web users are the editors and the GIS users are the viewers.

Detail of the data: **Geographic and alphanumeric information**

a) Area:

Polygon 1: monitoring plan area.
Polygons with water bodies: Surface water basin
Aquifers

b) *Polyline*: Rivers, etc.

c) *Water points:* Wells, piezometers, source, river control points and in general points where you can sample water (as the primary table). They should be properly identified:

- Location (x, y, z)
- Type of water point or sampling site (they should be clearly differentiated in the collaborative tool):
  - Surface water
  - Groundwater
  - Drinking water
  - Other (effluent wastewater, recharge water, reclaimed water, etc.)
- Depth, diameter, aquifer, use, state, etc. (if groundwater)
- Water body
- Municipality
- Optional as secondary tables (pictures, inspection reports, ownership)

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d) Parameters:

a. *Water quality:*

Chemical parameters: List of chemical parameters analysed for several plans. Required in GAL: pesticides, nitrogen species (including isotopes), pesticides, transformation products, etc.

The chemicals monitored may change in line with the problems of the different action labs.

Physical parameters: Temperature, pH, Eh/ redox, conductivity, dissolved oxygen

b. *Quantity parameters:* Piezometric levels (aquifers)
Flow (m3/s) (rivers)
Meteorological data (rainfall, temperature)

There will be other layers that may be of interest, such as petrol stations, aboveground railways, highways, road topography, agricultural plots, etc.

To import data each operator will have sheet and file templates. The editor will be able to import data automatically or manually. In addition, the editor can modify the template for the operators. The template manages point information and parameters by code. There are also lists linking codes and data.

To export data the tool can search for data and generate new data by point, time, parameter, etc. In addition, in the case of chemical parameters the search can advise about a threshold value and report it.

5.1.2 Users and user interface

- user characteristics: technical expertise, education, age

CUADLL employees will be the administrator and editor of the tool. Other participants in the Waterprotect project will be viewers. They contribute data and this data will always be entered by CUADLL.

- frequency of system usage

Data will be updated on a monthly basis and all users can access the tool online whenever they want.

- where the system is expected to be used (i.e. web/stand-alone, pc/tablets/smartphone)

Web, PC and tablet (no specific viewer for smartphone)

5.1.3 Other

Other requirements, assumptions or dependencies that need to be taken into consideration in the development, e.g. confidentiality of data collected by farmers that cannot be stored in national db; in this case the tool shall contain a user management system and you need to include this requirement in the UR list.

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The database has information such as the name/address of the wells' owners and their information is for internal use only. The rest of the information is for everyone because we consider that it is environmental information.

ACA has 20 wellpoints to control the quality of groundwater. CUADLL has more than 150 wellpoints.

CSIC will review all research studies involved in the Llobregat site and will provide its data for inclusion in the GISWUA tool.

CPABLL has information about surface water irrigation and groundwater irrigation.

The AB water utility company follows Spanish parameters regulated in Royal Decree 140/2003. In addition, it follows parameters regulated by the EPA which are not regulated in Spain.

5.2 Specific requirements

5.2.1 Approach for UR collection

Selected primary stakeholders and the WaterProtect partners have provided input from which the overall structure of the tool has been designed as basis for the further development. This structure will be presented and discussed with farmers and others stakeholder in an upcoming workshop. After this feedback, the final structure and design of the tool will be defined and it will be made with the participation of all stakeholders. A second follow-up workshop is planned at a later stage to discuss the developments carried out and receive input adjustments.

Finally, when the web tool will be running, viewers and consultancies are welcomed to give their opinion.

5.2.2 Technical specifications

Elements that make up the architecture:

- Client browser layer composed of open source frameworks and libraries:

- BOOTSTRAP: This is a framework or set of tools for website design. It contains templates for designing forms, buttons, navigation menus, etc. and all HTML and CSS elements. It is currently one of the most used frameworks because it is highly modular and facilitates the responsive design of websites.
- ANGULAR: It is a JavaScript framework maintained by Google. The goal is to develop applications that are easier to maintain and test. It is based on increasing browser capabilities with model-view-controller (MVC). Its strongest point is disassociating the part of the client from the server side so they are totally independent parts and this fosters development in parallel and also reuse of modules.

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- OpenLayers: It is a JavaScript library for displaying map data in web browsers as slippy maps. It provides an API to access different sources of map data using WMS, WFS, etc. It has a developers community behind it which makes it the most used option for the representation of GIS viewers.

- Server:

- GeoServer: We will use GeoServer as a map server. GeoServer is also open source and is specially designed to foster interoperability as it always uses open standards. It is very flexible with both input (PostGIS, Shapefile, etc.) and output (WMS, WCS, WFS, etc.) formats. It greatly facilitates data publication and maintenance.
- Geoserver needs JDK to work because it has been developed in Java (in this case and for compatibility issues we will use JDK 1.8).
- Node.js: It is a cross-platform environment for the server layer based on the Google V8 engine and open source. It uses asynchronous inputs and outputs, which is why it is especially suitable for web environments. Node.js will allow us to run JavaScript code on the server and through REST services implement all the necessary business logic.

- Data layer:

- We will use the PostgreSQL database for alphanumeric data and its PostGIS extension for geographic data. This database is also open source and is very widespread for GIS open source because it integrates seamlessly with GeoServer and OpenLayers. To reset the database, we will store the pictures in the operating system and only store the reference in these databases.
- To migrate and maintain geographic data we will use the QGIS desktop tool, which is a powerful geographic tool that will allow us to perform all the necessary maintenance tasks.

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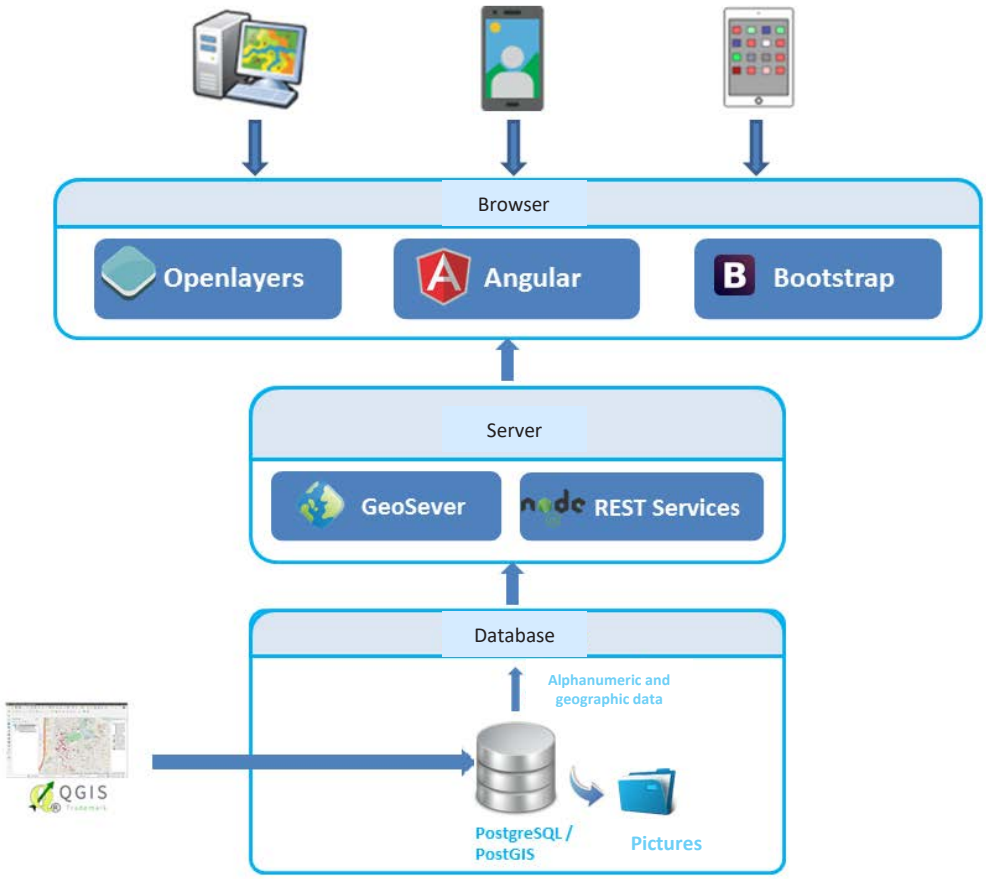

5.2.3 Functional specifications

5.2.3.1 Stakeholders/actors

Editors are CUADLL employees. Viewers are everyone, specifically farmers, CPABLL and CSIC employees, water utility employees, administration and students (see definition).

5.2.3.2 Functional specifications

Use in the formulation of the URs the following words:

- Shall : to indicate that the definition is an absolute requirement
- Shall not: indicates that is an absolute prohibition of the spec
- Should: is equivalent to recommend, means that there are valid reasons to ignore a particular requirement, but the implications need to be weighed
- Should not: is equivalent to not recommended, means that a particular behaviour may be acceptable or useful, but again, the implications need to be weighed.
- May: means optional

General specifications

The proposed solution consists of a relational database based on PostgreSQL. The first advantage is that it is made up of open source so it does not depend on the application as in Access. It is also

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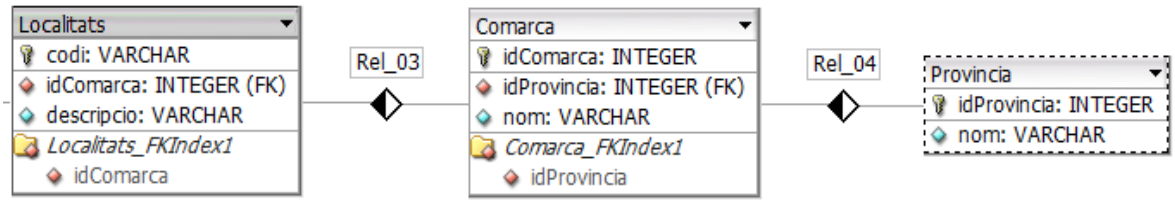
cross-platform, which means that independently of the operating system (different versions of Windows or Linux systems, Ubuntu, Fedora, etc.) operation will be exactly the same for all. This means that it will not be necessary to adapt the operating system to the application, but rather it will work independently of the chosen system.

The new data model will be a totally related model based on a set of tables that contain the information related to each other; the following image shows an example:



In this example a locality is related in a region whereby the first one stores the main key of the second; the value of the idComarca (foreign key) can be seen in the Localities table. This relationship assures us that there is no incongruity in the data, since it is impossible for there to be a location that does not have a correct region; one could not add a key that is not found in the other table (referential integrity rule). The same would apply between Comarca and Provincia. As can be seen, if the external keys also create an index, they are not used directly in the user field but rather are there to make search queries faster in the database.

This model offers other advantages:

- It does not depend on a single file since its capacity to grow is limited by the capacity of the server.
- Multiple users can access simultaneously without slowing down the system and from different platforms.
- Adding an image of the database status to each transaction. This allows for faster and more consistent transactions.
- As it is open source, it allows many more features in the project from different languages.
- It is easily scalable, upgradeable and expandable.

It operates correctly in transactions with large amounts of data.

Another advantage that deserves special mention is standardization of the database. This consists of applying a series of rules to the organization of the database that improves its operation. Some examples:

- Avoids redundant data, wasting disk space and creating maintenance problems. So if you want to change the data, they have to be changed only in one place.
- Protects the integrity of the data, i.e. the data are correct and the information is correct.

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- Does not allow the information to be in tables that do not correspond.

Although it is internal organization of the database it has a strong impact on the user. It increases the system's speed, improves the security and efficiency of transactions so there is no loss of data or inconsistent data and reduces database space.

5.2.4 UR matrix

Provide an overview of the UR in a table

ID	Category	UR	Performance	Priority
1	Technical	--	Operating system: Windows server 2016 Storage: C//:40 GB D//: 500 GB GIS	1
2	General			
3	Input	Import data	Templates from operators and specific program to import data	1
4	Output	Through searches	Personalize easy and pre-set searches	1
5	Functionality	Import, manage and export data		1
6	Visualization	Geographic reference of data	Open source access GIS	1

5.2.5 Conclusions

For the moment, our priority is to create the structure of our GISWUA database, which allows grouping all data in one tool. The templates for importing data are also important.

In a future stage, the priority will be the viewer and data searches in the GISWUA.

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User requirement

Action lab: *Gowienica Catchment (PL)*

Wojciech Paciura, Anna Kuczyńska

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 727450

6 Gowienica Catchment (PL)

6.1 General description

In PGI-NRI commercial software Oracle, Esri, Hexagon is used for many geological fields. These are the standard solutions for the PGI and most administration in Poland, therefore implementing a completely new open source environment for the Waterprotect project would not make sense and would unnecessarily complicate the IT. In addition, it would make it more difficult to update and use data in such a separate environment. PGI-NRI now makes publicly available, free of charge, data from our databases. An example of this approach is application called GeoLOG, which is available on the App Store and Google Play, also as a web application: https://geolog.pgi.gov.pl and the web site with map services: http://uslugi_gis.pgi.gov.pl/ and Download Manager for .shp files download: http://dm.pgi.gov.pl/.

6.1.1 Objective

Based on our initial research among our stakeholders, the overall objectives of the tool are:

- Fast and convenient access to data gathered from many national and local databases that will be continuously updated, including fields of hydrology, hydrogeology, meteorology, agronomy, landscape and many more;
- Visualisation of the above data;
- Provision of data for better water management and more rational use in the catchment area.

6.1.2 Concept of use

- The system will use several components:
    - Own database containing data from stakeholders involved in the project.
    - Data from other providers in the form of network services
    - Web application that integrates data from multiple sources

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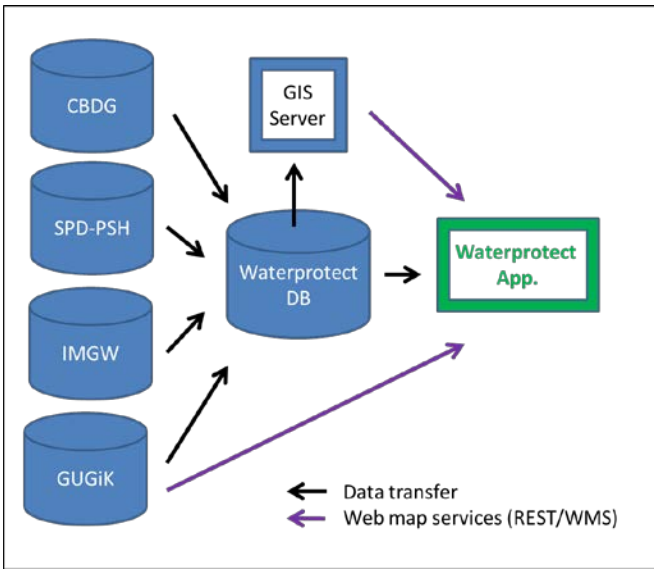

- Processes that the tool will support:

Process	User
Environmental decision/licensing	Regional Water Management Authority, Regional Directorate of Environmental Protection, local authorities
Development of fertilizers' plans	West Pomeranian Farmers Advisory Centre
Delineation of drinking water protection areas	Regional Water Management Authority, Szczecin Water Services , West Pomeranian Water Services
Development of mitigation measures	Regional Water Management Authority, Szczecin Water Services , West Pomeranian Water Services, local authorities
Water and wastewater planning	local authorities (Warnice Borough, Stargard Borough, Stargard City, Szczecin City)
Optimization of water supply activities	local authorities, Szczecin Water Services , West Pomeranian Water Services
Controlling of illegal sewage discharges	Voivodenship Inspectorate for Environmental Protection, local authorities
Environmental monitoring	Voivodenship Inspectorate for Environmental Protection, Regional Water Management Authority, local authorities, academic and research, West Pomeranian Farmers Advisory Centre

- Fast and convenient viewing of data gathered from many national and local databases that will be continuously updated, from various fields: hydrology, hydrogeology, meteorology, and more. Wide access to such data will be very helpful for different groups of users in making business decisions. The tool will:
    - Improve accessibility to data;
    - Combine all available data;
    - Harmonize data;
    - Visualize data;

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  - Can be integrated with other GIS system used by Waterprotect users, in which more advanced analyses can be made.
- Different databases relevant for the tool:
  - CBDG: geological maps, base maps, various types of geological data,
  - SPD-PSH: monitoring data, hydrogeological maps,
  - IMGW: meteorological data,
  - GUGIK: general geographic data, cadastral data
  - GUS: data on land use form
  - ARiMR: structure of animal breading

6.1.3 Users and user interface

To define users and user interface, at the beginning of the project a questionnaire was developed and distributed among potential users of the tool to define their general needs and experience in using GIS tools. Summary of the questionnaire is presented below.

6.1.3.1 General characteristics of users affecting specific requirements:

Specify your status.

Answers	Quantity
Other	5
Government administration	3
Agricultural sector	2
Local government	1

Do you have an environmental database used by many employees?

Answers	Quantity
Yes	8
No	2
I do not know	1

How often do you use it?

Answers	Quantity
Every day	5
I do not use it	4
Once a week	1
Seldom	1

What database do you use at work?

Answers	Quantity
MS Access	5
Oracle	5

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MS SQL Server	4
MySQL	2
I do not know	2

Are you using your own spatial data resources?

Answers	Quantity
Yes	10
No	1

How do you collect your spatial data?

Answers	Quantity
SHP files	8
Personal geobase	5
Professional geobase	3
I do not know	2

Are you using web map services, if so, which one?

Answers	Quantity
WMS	8
WFS	3
KML	2
REST	1
CSW	1
I do not use it	2

What tools do you use to work with spatial data?

Answers	Quantity
ArcGIS	7
Geomedia	4
MapInfo	2
Q-gis	3
Other	1

Other: Surfer

Web mapping applications that you use?

Answers	Quantity
Geoportal.gov.pl	11
Google Maps	10
Other	*

* Other:

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- OpenStreetMap https://www.openstreetmap.org/
- Union of County of West Pomeranian Voivodeship http://zcpwz.e-mapa.net/
- National Protection Information System against extraordinary threats (ISOK) http://mapy.isok.gov.pl/imap/
- Map viewer of Main Directorate for Environmental Protection (GDOŚ) http://geoserwis.gdos.gov.pl/mapy/
- Map viewer of Main Inspectoriate for Environmental Protection (GIOŚ) http://mapy.gios.gov.pl/prtr/
- Inspire Map viewer of GIOŚ http://inspire.gios.gov.pl/portal/index.php?profile=17010&projection=EPSG%3A2180
- Western Poland Map Archive http://mapy.amzp.pl/tk25.cgi?11,36,50,99
- Map viewer of National Water Management http://geoportal.kzgw.gov.pl/imap/
- Map viewer of Central Geological Database (CBDG) http://bazagis.pgi.gov.pl/website/cbdg/
- Archival maps of Poland and Central Europe http://igrek.amzp.pl/
- Google Earth https://www.google.pl/intl/pl/earth/
- Corine Land Cover http://land.copernicus.eu/pan-european/corine-land-cover/clc-2012/view
- Data Processing System of the Polish Hydrogeological Service http://192.168.1.160/PSHv8/

What other web applications do you use at work?

- Database of environmental impact assessments http://bazaoos.gdos.gov.pl/web/guest/home
- Adam Mickiewicz University in Poznan Faculty of Geographical and Geological Sciences http://wngig.amu.edu.pl/

Which online websites do you like the most:

Answers	Quantity
E-mail	11
Facebook	3

Do you use mobile devices to work with data, if so what?

Answers	Quantity
GPS	8
Smartphone	7
Tablet	2

6.1.3.2 Functionalities expected by users from the tool

Requires for the application	Yes	No
Viewing data - Tabular statements	10	1
Viewing data - Charts	8	3

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Viewing data - Single thematic maps	10	1
Viewing data - Map sets aggregating information from different areas	8	3
Queries directly to the database	10	1
Import (load) WMS services into your application	9	2
Export .jpg or .png pictures from map composition created by user in application	10	1
Export results of search as a .xls or .csv files	10	1
Additional functionality	*	

*Additional functionality:

- Spatial analysis

6.1.3.3 User needs for data

What data would you like to access?	Yes	No
Groundwater	9	2
Surface waters	10	1
Land use	7	4
Forms of nature protection	8	3
Satellite imagery	9	2
Topographic base maps	9	2
Weather data	5	6
Other	*	

* Other:

- Soil maps
- Data on land use form Central Statistical Office
- Soil and shallow groundwater monitoring (subcutaneous water)
- Groundwater and surface water:
    - Point of water intake,
    - The volume of water consumption,
    - Monitoring of the quality of these waters
    - Information from the water cadaster
    - Discharges of sewage to the water or to the ground
    - Volume of wastewater entering the treatment plant
    - Volume and quality of water discharged from treatment plants to receivers
- Agriculture:
    - Structure of agricultural land use
    - Data on sowing
    - Farmers' livestock
    - Fertilization

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6.2 Specific requirements

6.2.1 Approach for UR collection

Based on our experience, we have created a form of an interactive PDF file. The poll was sent to all institutions that are supportive partners to the project and those identified as potential users of the tool. Sending e-mails with a request fill in the questionnaire was not successful, therefore direct contact with over 20 potential users made. In total 11 replies were received, most of which confirmed PGI's suggestions regarding the initial content of the planned database and the functionality of the application.

6.2.2 Technical specifications

It is planned to use a standard IT environment and standard application solutions PGI-NRI.

- TRQ-001 VMware virtual server environment for databases and applications.
- TRQ-002 Production Database: Oracle.
- TRQ-003 Publication Database: MS-SQL Server.
- TRQ-004 Server for spatial data: ArcGIS Server.
- TRQ-005 The application will use the REST services from ArcGIS Server to display maps.
- TRQ-006 The application will be available free of charge.
- TRQ-007 The application will not require a login.
- TRQ-008 The application can be used on mobile devices but because of the map component not on devices with very small screens.

6.2.3 Functional specifications

6.2.3.1 Stakeholders/actors

1. Regional Water Management Authority in Szczecin – RZGW is a competent authority for water management in the area. Specific responsibilities related to the project are:
   - identification of significant anthropogenic pressures and evaluation of their impact on surface water and groundwater in the water region,
   - defining waters vulnerable to pollution from agriculture sources,
   - defining area extent of Nitrate Vulnerable Zones
   - developing plans for water use conditions for water region,
   - development of economic analyzes related to the use of water in the water region,
   - preparation and maintenance of lists of protected areas
   - preparation of flood protection studies in river basins,
   - drafting flood protection plans for water region,
   - coordinating actions related to flood protection and drought
   - running a water cadaster for water region,
   - carrying out control of water management,
   - planning projects related to reconstruction of ecosystems degraded by the exploitation of water resources,

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2. Voivodship Inspectorate for Environmental Protection (WIOŚ) in Szczecin is a competent authority for monitoring of water quality in the River Basins of the Water Framework Directive and Nitrate Vulnerable Zones as well as monitoring of implementation of BMPs. Specific responsibilities related to the project are:
    - carrying out the tasks of the state monitoring of the environment defined by the Chief Inspector of Environmental Protection, organizing and coordinating the voivodship monitoring of the environment, carrying out environmental quality studies, observation and assessment of its state and its changes,
    - development and implementation of analytical-research and control-measurement methods,
    - control of entities whose activity may cause the occurrence of a major accident,
    - ensure compliance with environmental regulations and rational use of natural resources,
    - control of the operation of installations and equipment for the protection of the environment against pollution,
    - monitoring of compliance with decisions determining conditions of use of the environment,
    - conducting administrative proceedings in connection with breach of environmental protection requirements, including,
3. Local authorities (Warnice Borough, Stargard Borough, Pyrzyce County, Stargard City, Szczecin City) – are responsible for wastewater policy planning and its execution on a local scale, issuing water permits.
4. Research centres: West Pomeranian University of Technology (ZUT); Institute of Technology and Life Sciences (ITP), Polish Geological Institute – National Research Centre (PIG-PIB) – are responsible for monitoring of water quality, act as advisory service to local authorities
5. Water companies (Szczecin Water Services and West Pomeranian Water Services) are responsible for provision of good quality water for society. They can also develop mitigation measures to be applied within protection zones.
6. West Pomeranian Farmer's Advisory Centre (ZODR) – agricultural advisory services covering agricultural, rural development, agricultural markets and rural households. It aims at improving the level of agricultural incomes and improving the market competitiveness of agricultural holdings, promoting sustainable rural development and improving the professional qualifications of farmers and other rural residents .
7. Regional Directorate for Environmental Protection (RDOŚ) - responsible for conducting environmental decision-making, issuing opinions in the course of environmental decision-making, including Natura 2000 sites and environmental impact assessments carried out by other bodies.

6.2.3.2 Functional specifications

General specifications

- URQ-001 Web application (RWD standard), available on devices with small screens - *shall*

Viewing data specifications

- URQ-002 Tabular statements - *shall*

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- URQ-003 Charts - sholud
- URQ-004 Single thematic maps - *shall*
- URQ-005 Map sets aggregating information from different areas - *shall*
- URQ-006 Queries directly to the database - *should*

Functionality

- URQ-007 Spatial analysis - *may*

Import data specifications

- URQ-008 Load WMS services into application - *shall*

Export data specifications

- URQ-009 Export map composition created by user in application as a .jpg or .png pictures or other way - *shall*
- URQ-010 Export results of search as a .xls or .csv files – *shall*

Data and information

- URQ-011 Groundwater – *shall*
- URQ-012 Surface waters – *shall*
- URQ-013 Land use – *shall*
- URQ-014 Forms of nature protection – *shall*
- URQ-015 Satellite imagery – *shall*
- URQ-016 Topographic base maps – *shall*
- URQ-017 Weather data – *should*
- URQ-018 Agriculture – *shall*
- URQ-019 Sewage management – *shall*

6.2.4 UR matrix

Provide an overview of the UR in a table

ID	Category	UR	Performance	Priority
URQ-001	General	RWD standard a web application	on-the-fly	1
URQ-002	Viewing	Tabular statements	on-the-fly	1
URQ-003	Viewing	Charts	on-the-fly	2
URQ-004	Viewing	Single thematic maps	on-the-fly	1
URQ-005	Viewing	Map sets aggregating information from different areas	on-the-fly	1
URQ-006	Viewing	Queries directly to the database	on-the-fly	2
URQ-007	Functionality	Spatial analysis	on-the-fly	3
URQ-008	Import	Load WMS services	on-the-fly	1
URQ-009	Export	Export map	on-the-fly	1
URQ-010	Export	Export results of search	on-the-fly	1
URQ-011	Data	Groundwater	on-the-fly	1
URQ-012	Data	Surface waters	on-the-fly	1

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URQ-013	Data	Land use	on-the-fly	1
URQ-014	Data	Forms of nature protection	on-the-fly	1
URQ-015	Data	Satellite imagery	on-the-fly	1
URQ-016	Data	Topographic base maps	on-the-fly	1
URQ-017	Data	Weather data	on-the-fly	2
URQ-018	Data	Agriculture	on-the-fly	1
URQ-019	Data	Sewage management	on-the-fly	1

6.2.5 Conclusions

The standard features of the map application, such as layer transparency, zoom-in, zoom-out pan etc., are not described in detail. Spatial analysis should be done in specialized, dedicated desktop GIS software.

A detailed description of the hydrogeological and other data that will be used in the project will be identified during later project work.

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Appendix A: Questionnaire of Belgian use case

Introduction

The WaterProtect-EU tool integrates maps and monitoring data of one area on a transparent and userfriendly way. Area information can be consulted in an intuitive manner to facilitate informed consultation with farmers about appropriate measures.

In the long term, the tool aims to unlock knowledge about applicability of measures and to visualize the progress of project (implementation of measures) in the area.

A demotool has been developed that partly fulfills these objectives. Use Chrome as a web browser to view this demo tool at: https://waterprotecteu.marvin.vito.be/

You can consult a short description of the functionalities of these demotool in the accompanying document 'Description WaterProtect-EU demotool'.

Through the following questionnaire we will try to understand how this tool can be further developed to meet your expectations.

Questionnaire

1. Contact information

Name: _____
Organisation: _____
Email: _____

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Maps

2. Which maps are important for the tool?

	Very important	Important	Less important	Not important	No idea
Monitoring stations					
Water courses					
Agricultural Land Use					
Potential erosion for agricultural parcels					
Drainage areas linked to monitoring stations					
Drainage map (map shows flowlines in the landscape where the water flows after a rainfall, taking into account the topography and the waterways)					
Groundwater protection zones					
Groundwater vulnerability map					
Nitrate-sensitive zones					
Risk map with demarcation critical areas for runoff of substances to surface water					
Maps with implemented/planned measures to improve water quality					

Other important maps? Please specify:

Water quality data

3. For which substances would you like to retrieve information?

- ☐ Bentazon
- ☐ Terbutylazine
- ☐ Dimethenamide
- ☐ Linuron
- ☐ Metobromuron
- ☐ Metazachlor
- ☐ Metolachlor
- ☐ Metribuzin

Other substances? Please specify:

The tool provides the following environmental standards:

- Evaluate average concentration using the annual average of the selected dataset against the AA-EQS
- Evaluate maximum concentration using the yearly maximum of the selected dataset against the MAC-EQS
- Evaluating the average / maximum concentration against a default value entered by the User

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4. Are there other relevant environmental standards needed?
   - ☐ Yes
   - ☐ No
   - ☐ No idea

If yes? Please specify:

5. The tool shows the measured concentrations of plant protection products for the different measurement stations. Are there other water quality data needed?
   - ☐ Yes
   - ☐ No
   - ☐ No idea

If yes? Please specify:

Measures

6. Which information about the measures do you consider important for the tool?

	Very important	Important	Less important	Not important	No idea
Description					
Impact					
Benefits					
Specifications (points of attention)					
Suitability					
Cost info					

Other info? Please specify:

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7. If you find cost information important, what information would you like to include in the tool?
   - ☐ Costs in order of magnitude, eg €, €€, €€€
   - ☐ Amounts
   - ☐ Detail info
   - ☐ No idea

8. Would you like to indicate in the tool what measures are planned in an area and when?
   - ☐ Yes
   - ☐ No
   - ☐ No idea

9. Do you want the tool to suggest a number of possible measures?
   - ☐ Yes
   - ☐ No
   - ☐ No idea

If yes, certain calculation rules should be established to derive what measures are possible. Can you please give some examples?

Visualizations

When selecting an environmental standard for a particular substance, the measurement stations will be colored according to the evaluation against this standard. Additionally you can view the measurement data from each measurement station in graphical format.

10. How relevant are the following visualizations?

	Relevant	Not relevant	No idea
Time series of monitoring data for particular substance, at a particular location			
Time series of river discharge data at a particular location			
Time series of precipitation data at a particular location			
Graph with average and maximum measurement per month, including annual average for particular substance at a particular location			
Graph with average and maximum measurement per month, including annual average for discharghes at a particular location			
Graph with average and maximum measurement per month, including annual average for precipitation at a particular location			
Pie chart of land use for the catchment associated with a particular location			
Pie chart of erosion sensitivity for the catchment associated with certain location			

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11. Are there any other relevant graphs that are not listed in the list above?
    - ☐ Yes
    - ☐ No
    - ☐ No idea

If yes, please specify which graphs?

Export data

12. What data do you want to export for a particular monitoring station?
    - ☐ No data
    - ☐ Monitoring data of a substance
    - ☐ Precipitation data
    - ☐ Discharge data
    - ☐ Time series (graph) of measurements of a particular substance
    - ☐ Time series (graph) of precipitation data
    - ☐ Time series (graph) of discharge data
    - ☐ Pie chart of land use
    - ☐ Pie chart of erosion sensivity

Other, please specify?

13. Would you like to download data or information?
    - ☐ Yes
    - ☐ No
    - ☐ No idea

If yes, for which purposes?

14. Is there a need to provide a pdf report with the related charts for a particular measurement station?
    - ☐ Yes
    - ☐ No
    - ☐ No idea

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15. Would you like to download an overview of the planned measures for a particular area?
    - ☐ Yes
    - ☐ No
    - ☐ No idea

If yes, please specify which information is relevant for this report?

General

16. Through what medium would you use the tool?
    - ☐ Computer
    - ☐ Tablet
    - ☐ Smartphone
    - ☐ No idea

17. What are your overall expectations of the tool?

Thank you for your cooperation!

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Appendix B: Results of the Belgian questionnaire

General results

Participants

The questionnaire was sent to Flanders Environment Agency, De Watergroep and Inagro. Figure 4 gives an overview of the % participants per organisation.

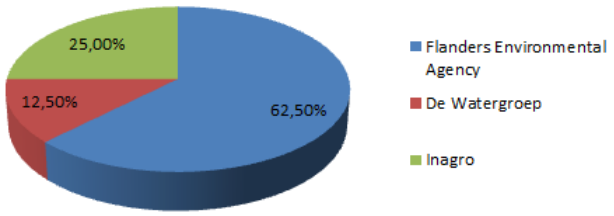

Figure 6: % participants per organisation

What are the expectations of the WaterProtect tool?

- Farmers can consult easily information to take appropriate measures.
- The output of the tool, such as visualizations and reports, needs to be clear and easy to understand for explaining a particular problem, f.i. the problem of PPP in the waterways, to the farmers.
- The tool need to be userfriendly for the farmers so that they can use the tool with limited explanation.
- The tool should be able to give a picture of the most recent measurements and exceedances, and with a simple click-through the user can retrieve the underlying data.
- The tool should be able to give a clear view of the situation in the catchment and the impact of the measures.

Which medium will be used to consult the WaterProtect tool?

The users choose mostly the PC (76,19%) for consulting the WaterProtect tool, and less the tablet (11,90%) and smartphone (11,90%).

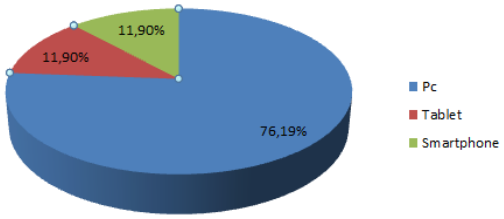

Figure 7: % of medium used for consulting the WaterProtect tool

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Available maps in the tool

Which maps are important?

Figure 6 gives an overview of the most important maps.

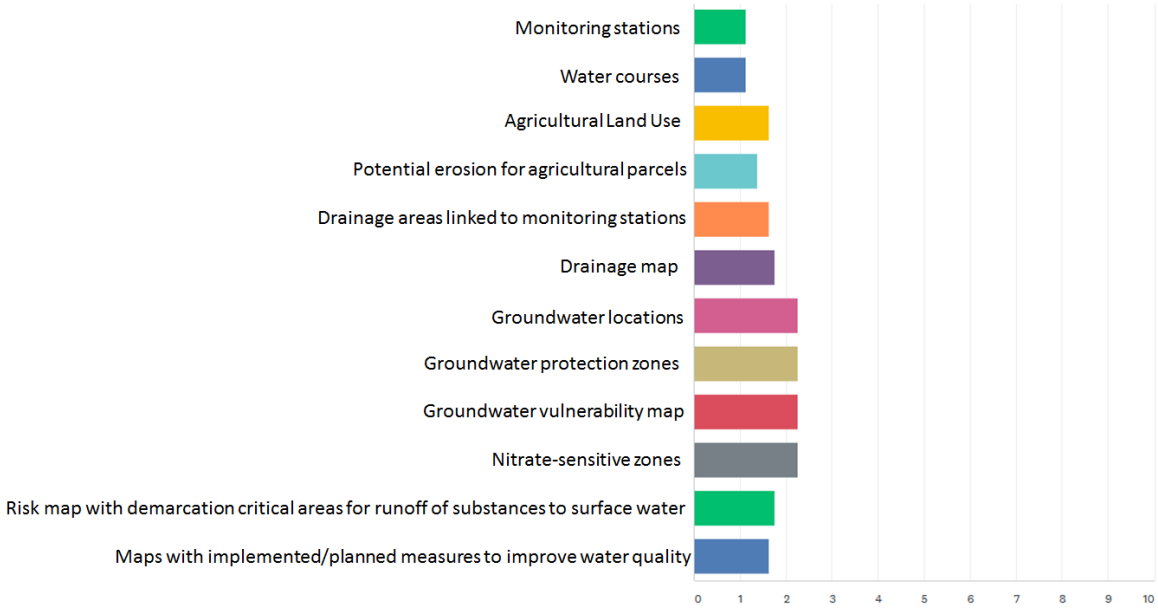

Figure 8:Overview of the most important maps

Water quality data

The following substances need to be available in the WaterProtect tool:

- Bentazon
- Terbutylazine
- Dimethenamide
- Linuron
- Metobromuron
- Metazachlor
- Metolachlor
- Metribuzin

Other relevant environmental standards are:

- PNEC
- Drinking water standard, f.i. for PPP

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Other relevant water quality data that might be interesting are:

- Nitrate
- Phosphate
- Nitrogen
- Phosphor
- Suspended matter

Measures

The most important information of measures are the specifications with points of attentions, cost info and the benefits. Figure 7 gives an overview of the information according their importance.

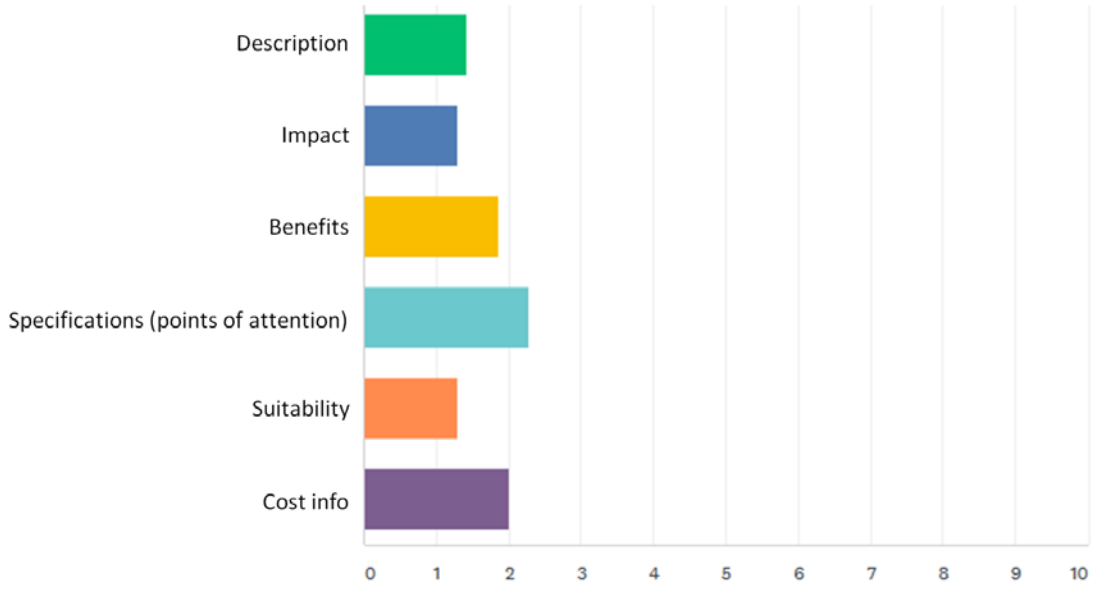

Figure 9: Most important information of measures

Cost information will be expressed in order of magnitude, eg €, €€, €€€.

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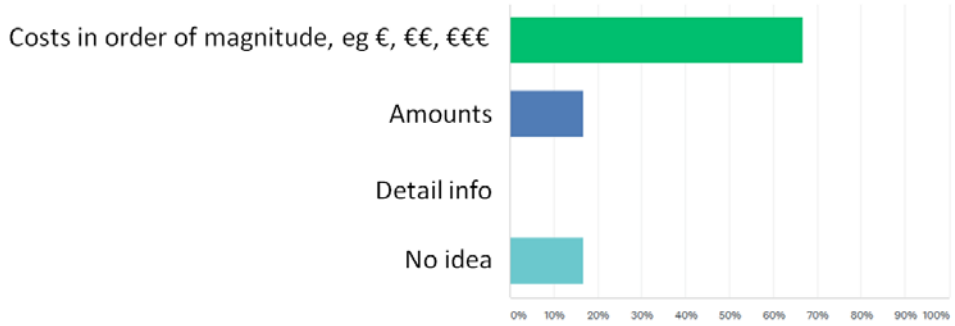

Figure 10: What cost information is relevant?

85% of the users prefer that the tool should be able to indicate what measures are planned in the catchment and when. And for 71% of the users it is important that the tool should be able to suggest a number of possible measures.

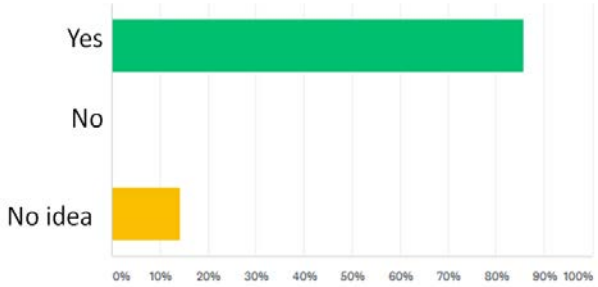

Figure 11: % users who wants that the tool indicates what measures are planned and when

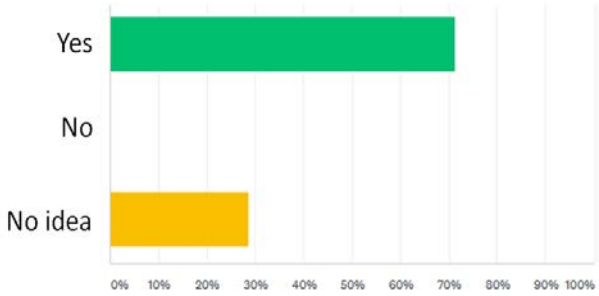

Figure 12: % users who want that the tool suggest a number of possible measures

Visualizations

The following visualizations are relevant for the WaterProtect tool:

- Time series of monitoring data for particular substance, at a particular location
- Time series of river discharge data at a particular location
- Time series of precipitation data at a particular location
- Graph with average and maximum measurement per month, including annual average for particular substance at a particular location
- Graph with average and maximum measurement per month, including annual average for discharghes at a particular location
- Graph with average and maximum measurement per month, including annual average

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for precipitation at a particular location

- Pie chart of land use for the catchment associated with a particular location
- Pie chart of erosion sensitivity for the catchment associated with certain location

The most important visualizations are the monitoring data. The user must be able to check or uncheck monitoring data, river discharge data and precipitation data in the tool.

Export data

Most relevant data to export are monitoring data of a substance, time series of measurements of a particular substance and a pie chart of erosion sensivity. Figure 11 gives an overview of the importance of the data for exporting.

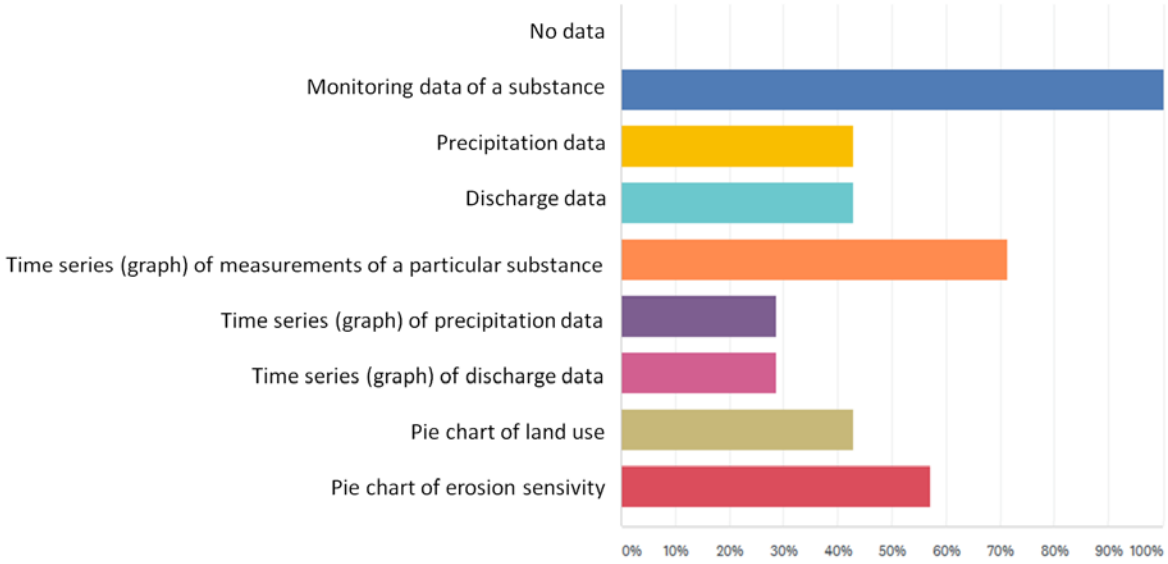

Figure 13:What data is important for export?

Most users are of the opion that the tool should be able to generate a pdf report with relevant graphs for a monitoring station, and to download an overview of planned measures.

The purpose for exporting data are:

- Reporting, discovering trends
- Further data processing in excel
- Use the management information in the meetings with the farmers
- Integration in models
- To investigate the link between exceedances for particular substances and the crops in the area.

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Appendix C: Results of the Italian questionnaire

Participants

1. Catholic University
2. ARPA-ER
3. APCS
4. Consorzio fitosanitario
5. Coldireti
6. Confagricoltura
7. IRETI
8. Consorzio di bonifica

Maps

Which maps are important for the tool?

	Very important	Important	Less important	Not important	No idea
Monitoring stations	xxxx	xxx			
Water courses	xxxxxxx				
Agricultural Land Use	xxxxx	xx			
Potential erosion for agricultural parcels	xxxx	x	xx		
Drainage areas linked to monitoring stations	xxx	xx	x	x	
Drainage map (map shows flowlines in the landscape where the water flows after a rainfall, taking into account the topography and the waterways)	xxx	xxxx			
Groundwater protection zones	xxxx	xx	x		
Groundwater vulnerability map	xxxxx	x	x		
Nitrate-sensitive zones	xxxxx	xx			
Risk map with demarcation critical areas for runoff of substances to surface water	xxx	xxx			x
Maps with implemented/planned measures to improve water quality	xxxx		x	x	x

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Other important maps? Please specify:
soil litology maps; additional water contamination sources (indistry, biogas facilities, livestock production)

Water quality data

	Pesticides	Nitrates	
For which substances would you like to retrieve information?		xxxx	
	Yes	No	No idea
Are there other relevant environmental standards needed?		xxxx	xxxxx
	Yes	No	No idea
The tool shows the measured concentrations of plant protection products for the different measurement stations. Are there other water quality data needed?	xxxx	xx	x

If yes? Please specify:
benzine, trichloroethylene; organohalogen substances; conductibility, isotopy, redox potential; NH4+, groundwater static level; pH

Measures

Which information about the measures do you consider important for the tool?

	Very important	Important	Less important	Not important	No idea
Description	xxxx	xx			x
Impact	xxx	xx			xx
Benefits	x	xxxxx	x		
Specifications (points of attention)	xx	xxx			xx
Suitability	xx		x		xxxx
Cost info		xxxx	x	x	x

	Costs in order of magnitude, eg €, €€, €€€	**Amounts**	**Detail info**	**No idea**
If you find cost information important, what information would you like to include in the tool?	xxxx	xx		x
	Yes	No	No idea	
Would you like to indicate in the tool what measures are planned in an area and when?	xxx		xxxxx	

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	Yes	No	No idea
Do you want the tool to suggest a number of possible measures?	x		xxxxxx

If yes, certain calculation rules should be established to derive what measures are possible. Can you please give some examples?
Data export

Visualizations

How relevant are the following visualizations?

	Relevant	Not relevant	No idea
Time series of monitoring data for particular substance, at a particular location	xxxxxxx		
Time series of precipitation data at a particular location	xxxxxxx		
Graph with average and maximum measurement per month, including annual average for particular substance at a particular location	xxxxxxx		
Graph with average and maximum measurement per month, including annual average for precipitation at a particular location	xxxxxxx		
Pie chart of land use for the catchment associated with a particular location	xxxxxx	x	
Pie chart of erosion sensitivity for the catchment associated with certain location	xxxxx	x	x

	Yes	No	No idea
Are there any other relevant graphs that are not listed in the list above?	xx	xxxx	x

If yes, please specify which graphs?
The presence of zootecnical sector in the area; daily temperature

Export data

What data do you want to export for a particular monitoring station?

	Relevant
No data	x
Monitoring data of a substance	xxxxxxx
Precipitation data	xxxxxx
Discharge data	xxxxx
Time series (graph) of measurements of a particular substance	xxxxx
Time series (graph) of precipitation data	xxxxx
Time series (graph) of discharge data	xxxxx
Pie chart of land use	xxxxx
Pie chart of erosion sensivity	xxxx

Other, please specify?
The presence of zootecnical sector in the area

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	Yes	No	No idea
Would you like to download data or information?	xxxxxxx		

If yes, for which purposes?
Deep description of the water system; descriptive environmental analisies; deep knowledge of ground water quali-quantitative status; future elaboration; research

	Yes	No	No idea
Is there a need to provide a pdf report with the related charts for a particular measurement station?	xxxxxx		x

	Yes	No	No idea
Would you like to download an overview of the planned measures for a particular area?	xxxxxxx		

If yes, please specify which information is relevant for this report?
All the available data and graphics; all the parameters and their time evolution

	Computer	Tablet	Smartphone	No idea
Through what medium would you use the tool?	xxxxxxx		x	

What are your overall expectations of the tool?
Utility and friendly use for all the stakeholders; friendly use and low costs; open source and friendly use; stakeholders update; keep updated

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Appendix D: Fact sheet on the landscape tool (DK)

dNmark research alliance

Summary

The dNmark landscape model is developed to enable local stakeholders (e.g. farmers) to engage directly in developing landscape scenarios in the context of nitrogen management. The model allows the users to visualize the landscape impacts of suggested improvements of e.g. future land use, crop rotations, and fertilizer application through a geographical interface, and to calculate estimations of the associated changes in the nitrogen leaching. Excess nitrogen is a key threat to ecosystem functioning, impacting the ability of landscapes to provide ecosystem services such as clean water, biodiversity, and healthy living environments to society. Yet nitrogen also represents a key resource for society to assure growth in efficiency and profitability in the agricultural sector. The dNmark landscape model contains detailed information of the most important landscape characteristics (in relation to nitrogen leaching) e.g. soil type, hydrology, and nitrogen retention. Taking the variation of the landscape and the interests of local stakeholders into account in future nitrogen management solutions should ideally allow both a better protection of the environment and a more efficient food production.

Main characteristics of the landscape model

General aspects:

- Model Architecture: a series of Python scripts integrated within an ESRI ArcGIS interface in which data on landscape characteristics and agricultural practices are integrated in 20x20m grid cells:
  - Baseline data can be edited to fit actual conditions and plans for future land use.
  - The N-LES$_4$ model is used for leaching calculations.
- Model input: Crops grown, land use, irrigation, soil data, clay and organic content, precipitation, N application, drainage, retention.
- Model output: Average yearly leaching over a five year period at grid cell level.

Innovative aspects:

- Process focus: Shifting the focus from a hostile relationship between farmers and regulators to a dialogue about locally situated solutions of relevance both at local and national scales:
  - The model can repeat the process steps until the wanted data input and effects are demonstrated.
- Local data input: Improved precision and relevance of estimates due to integration of local scale knowledge.
- Scenario setup: The model is intended to support a process of knowledge integration and accumulation regarding solutions for the future

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Landscape model overview

In the landscape model the total land area is divided into four land use categories (rotational crops, permanent crops, permanent land cover, other areas). Depending on land use type different modelling steps and estimations on retentions and leaching applies (fig. 1).

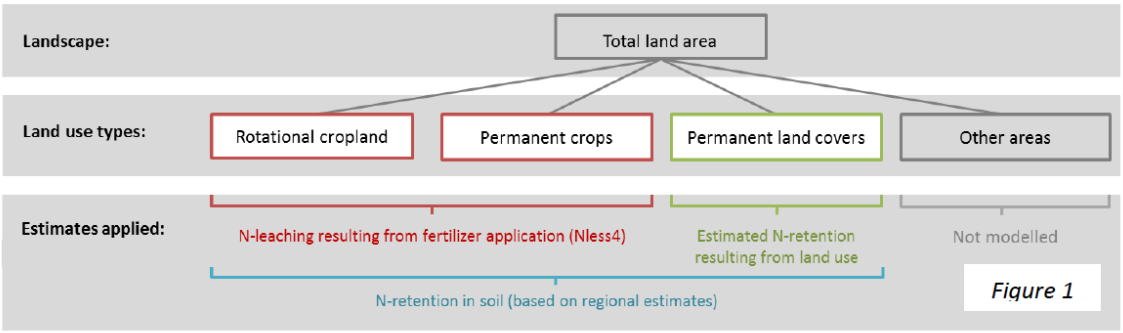

Figure 1

The landscape model consists of five modules: Preprocessing, Calculation, Interface, Recalculation, and Comparison (fig. 2).

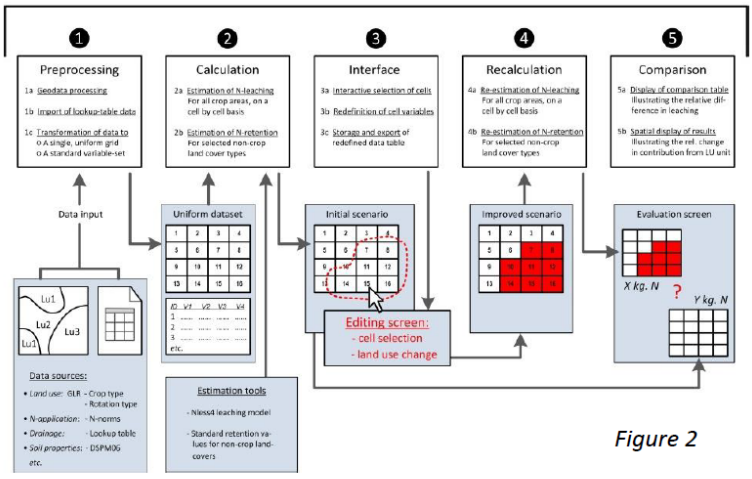

Figure 2

Current model limitations:

- Estimations on N leaching and retention related to permanent land covers are very general.
- Location of drain pipes on agricultural fields is not taken into account.

Future model improvements:

- Integration of difference in manure fertilizer and commercial fertilizer
- Integration of Nitrogen point source data.
- Introduction of larger variety in the possible crop types.

Policy recommendations

- Policies targeting nitrous fertilizer use in Denmark are currently based on broad scale national regulation instruments. It has been suggested to replace this general regulation with a targeted regulation that takes landscape-scale variations in leaching and retention of nitrogen into account. Users of the dNmark landscape model can generate dialogue-based scenarios that seek to solve the challenge of targeted land use management.

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

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http://dnmark.org/wp-content/uploads/2016/06/Fact-sheet-the-dNmark-landscape-model.pdf

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