



## **TRANSNATIONAL INTEGRATED MANAGEMENT OF WATER RESOURCES IN AGRICULTURE FOR EUROPEAN WATER EMERGENCY CONTROL (EU.WATER)**

**Priority Axis:** Protection and Improvement of the Environment

**Area of Intervention:** A.O.L. 1.2 Improve integrated water management and flood risk prevention

**Project Duration:** 36 months

### **Guidelines to organize and upload data and for the standardization of the mapping processes**

**WP3:** Knowledge capitalization and sensitive area maps

**Act 3.1:** Definition of the techniques to organize the common databank and develop water sensitive maps according to common standards (1st Scientific and Technical partnership Forum)

#### **Leader of the activity**

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## 1. Introduction

These guidelines have been prepared by the Aristotle University of Thessaloniki in the framework of the European-funded project EU-WATER. Aim of these guidelines is to help the EU-Water partners to standardize the completion process of the questionnaire (Qs), the mapping process for the development of the GIS platform and the collection of available data regarding water and nitrogen management in the designated target areas of the project. The GIS data development is crucial in order to move to the next steps of the project and thus the procedure must be conducted step by step following the same rules for all partners. The procedure is necessary for the development of vulnerability maps which are the basis for proposing water and nitrogen management strategies.

## 2. Qs completion

Each partner will fill the questionnaire in the excel file which is attached with the guidelines till the date that will be announced the username and password of each partner in order to fill the Qs on line. The completion of the Qs will be performed on line using the Qs platform. An example is given in the following address:

<http://www.eu-water.eu/maps/tab1.php>

username: auth1

password: auth123

## 3. General Guidelines for GIS data development

The development of GIS data has two steps, the first step is to create general maps for the GIS data base and the second step is to combine these maps with other data (e.g. climate data) in order to develop vulnerability maps for water and nitrogen losses from agricultural practices. The development of the GIS data maps is based upon primary data that partners should collect for their target area. Elaboration of the primary data can be performed **using the software ESRI Arc-GIS (Info) with the full extensions of the Arc-Toolbox**. The primary data that each partner has to collect and elaborate are the following:

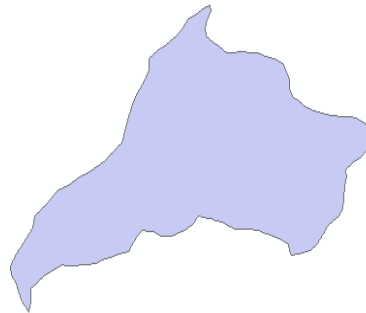
1. A topographic map **with contour lines** (Optimum scale < 1:100.000) in order to develop a Digital Elevation Model – **DEM**. DEM is the final product of this task and if a partner already has a DEM then the topographic map is not necessary.
2. A soil map with USDA soil classification in order to divide the regions in classes from the lighter to heavier soils.
3. Mean monthly meteorological data (12 average monthly values of rainfall and temperature, altitude and coordinates of every meteorological station in the target area).
4. Coordinates of water wells {additional data of the piezometric head (distance between soil surface and water table), water quality data of these wells (nitrogen species) and relative boundaries of the aquifers, **if they exist**}.
5. Water quality data\* (nitrogen species) from water bodies (only lakes and rivers, **if they exist**).

### 3.1 Specific Guidelines for GIS data development (first step) – Thematic layers

The development of the GIS layers that will be imported in the QS and Web-GIS application are the following:

**a. Digital boundaries of the target area (polygon)**

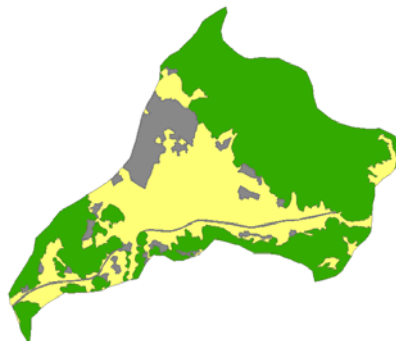
Create a polygon of the target area. This layer will provide the visualization of the boundaries and it is the base on which the following layers will be developed. Attribute table: Region (Name of the Target Area), Area (Area coverage in sq.km)



No.	Region	Area
1	Sarigiol Basin - Western Macedonia	469.2 sq.km

**b. Digital data for Land Uses (polygons)**

Create polygons of land uses of the target area. You will use the four basic classes in order to divide the region in sectors classes (a. artificial surfaces, b. agricultural areas, c. natural and semi-natural areas, d. water bodies). For the development of this layer Corine Land Cover 2000 data can be used from this website: <http://etc-lusi.eionet.europa.eu/CLC2000>. Attribute table: Land uses (one of the four major classes), Area (Area coverage in sq.km)

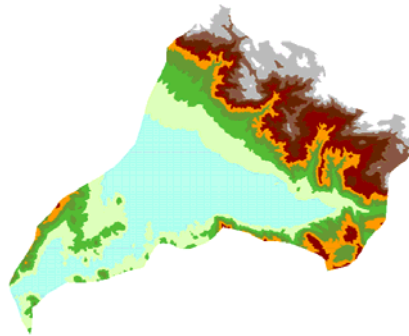


The use of the above information in order to develop the GIS data base is given in a more detailed way in the following section

No.	Land_Uses	Area
1	Artificial surfaces	156.6 sq.km
2	Agricultural areas	265.8 sq.km
3	Natural and seminatural areas	43.8 sq.km
4	Water bodies	3.0 sq.km

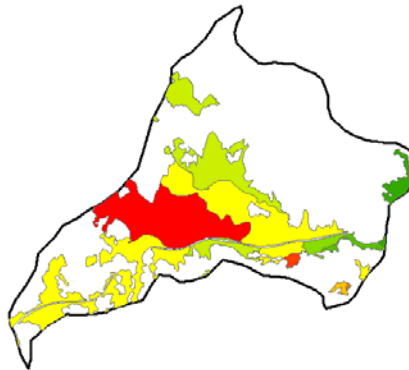
**c. Digital Elevation Model – DEM (raster)**

If there is not a digital elevation model for the studied target area then this layer will be developed using the contour lines from a topographic map.



**d. Digital soil type classes (polygons)**

This kind of soil maps divide the area in sectors, which each partner must digitize as polygons. **Soil type classes is necessary only for the agricultural part of the target area.**



Soil maps of each target area can be found at:

[http://eussoils.jrc.ec.europa.eu/esdb\\_archive/EuDASM/indexes/Europe.htm](http://eussoils.jrc.ec.europa.eu/esdb_archive/EuDASM/indexes/Europe.htm).

USDA classification has different levels of information. The way that each partner is going to classify sectors is not strict and the aim is to create sectors from lighter to heavier soil. Classification depends on general rules. For example, if the region has high homogeneity one can use the three or the five major classes. If not, then one should use a more detailed classification such as the twelve classes below:

Three soil classes:

1. Light: Sand, Loamy Sand, Sandy Loam
2. Medium: Sandy Clay Loam, Loam, Silty Loam, Silt
3. Heavy: Clay, Clay Loam, Silty Clay Loam, Silty Clay, Sandy Clay

or Five soil classes:

1. Light: Sand, Loamy Sand
2. Moderate light: Sandy Loam
3. Medium: Loam, Silty Loam, Silt
4. Moderate heavy: Clay Loam, Sandy Clay Loam, Silty Clay Loam
5. Heavy: Sandy Clay, Silty Clay, Clay

or Twelve soil classes:

1. Sand
2. Loamy Sand
3. Sandy Loam
4. Loam
5. Silty Loam
6. Silt
7. Clay Loam
8. Sandy Clay Loam
9. Silty Clay Loam
10. Sandy Clay
11. Silty Clay
12. Clay

In some cases soil maps have information that corresponds to general physical soil properties such as:

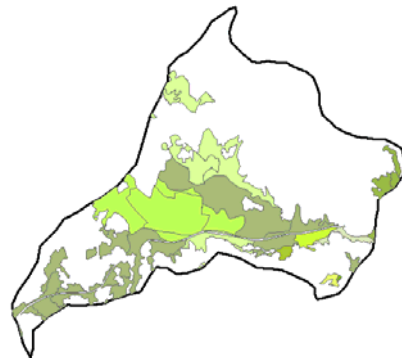
1. Light or medium not well drained<sup>1</sup> lowland<sup>2</sup> soils
2. Heavy not well drained lowland soils
3. Light lowland soils
4. Medium lowland soils
5. Heavy lowland soils
6. Light upland<sup>3</sup> soils
7. Medium upland soils
8. Heavy upland soils

<sup>1</sup>Areas with high water table (<1m below soil surface), <sup>2</sup>Areas located at <10m above sea level, <sup>3</sup>Areas located at >10m above sea level. The threshold of the 10 m is subjective and is flexible for the classification.

The way that each partner is going to classify the sectors of the target area can be discussed after when the respective soil map of the target area is available.

**e. Digital data of agricultural fields-sectors (polygons)**

Using the polygon from Land Uses layer that corresponds to agricultural land, each partner can divide it in sectors that have as much as possible more stable crop rotation (approximately constant percentage of the participant crops in every sector). Attribute table: Crop (% Crop coverage of the sector), Area (sector coverage in ha)



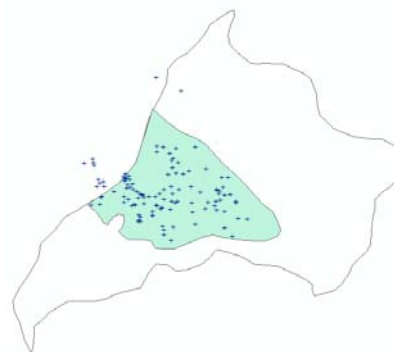
No.	Area (ha)	Wheat	Maize	Potatoes	Vegetables	Rice
1	300 ha	50%	0%	50%	0%	0%
2	260 ha	0%	0%	0%	0%	100%
3	700 ha	0%	0%	0%	100%	0%

**f. Map 6. Digital data of surface waters i.e. lakes, rivers (polygons)**

Digital data of surface waters already exists for the project partners and will be given to them as a polygon shape file. The only thing that the partners have to do is to import information for quality data, if this exists.

**g. Map 7. Digital data for ground waters i.e. waterwells and aquifers (points and polygons)**

This map is a combination of two shape files: one for the water wells (points) and one for relative boundaries of the aquifers (polygon).



Water wells attribute table

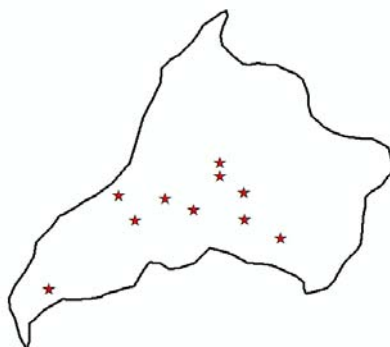
No.	Code	WaterLevel
1	Г3	2
2	243	3
3	67-A	0.8

Aquifer attribute table

No.	Area	WaterLevel
1	138 sq.km	2
2	23 sq.km	3

**h. Digital data of point pollution sources (points)**

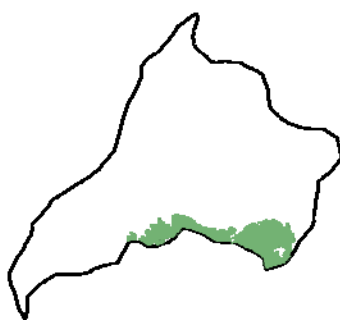
The sites of the major pollution sources. For cities that send waste water to waste water treatments stations one can add **“urban wastes to treatment station”** and not just **“urban wastes”**. Attribute table: Type (the types that have been selected from the questionnaire can be used here)



No.	Type
1	Urban wastes
2	Industrial wastes
3	Cattle breeding wastes
4	Urban wastes to treatment station

**i. Digital data for protected areas (polygons)**

Attribute table: Area (sector area in ha), Type (e.g. forest, wetland etc), Info (Natura2000, Ramsar etc)

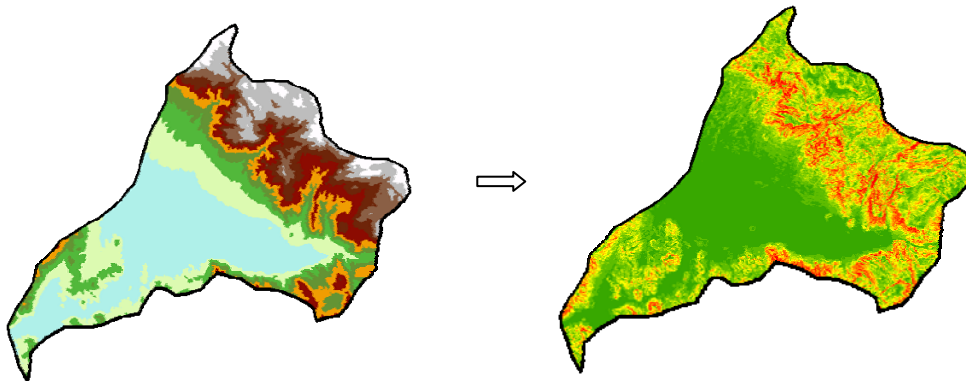


No.	Area (ha)	Type	Info
1	150.6 ha	wetland	Natura2000
2	260.8 ha	forest	Natura2000
3	43.8 sq.km	delta river	Ramsar

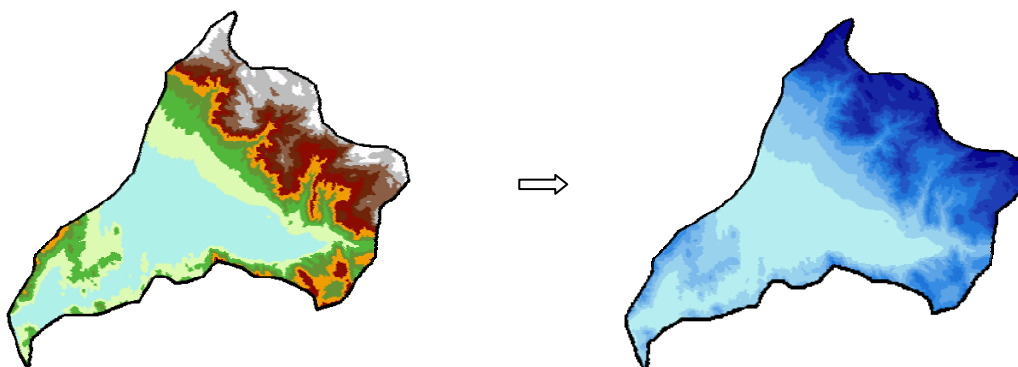
### 3.2 Vulnerability maps development for water and nitrate loses from agricultural practices (second step)

Vulnerability is an intrinsic property of a system that depends on its sensitivity to human and/or natural impacts. In the project's case, this property is referred to the land that is used for agriculture and is defined through its sensitivity to water and nitrogen losses. At this step selection of the constant environmental properties (soil properties, altitude, slope, land use, climatic conditions) that contribute to vulnerability of water from nitrate pollution from agricultural practices will be used. From the GIS data of the first step, two layers the map 3 (DEM) and the map 4 (Soil classes) will be used. Elaboration of map 3 (DEM) can produce new layers such as:

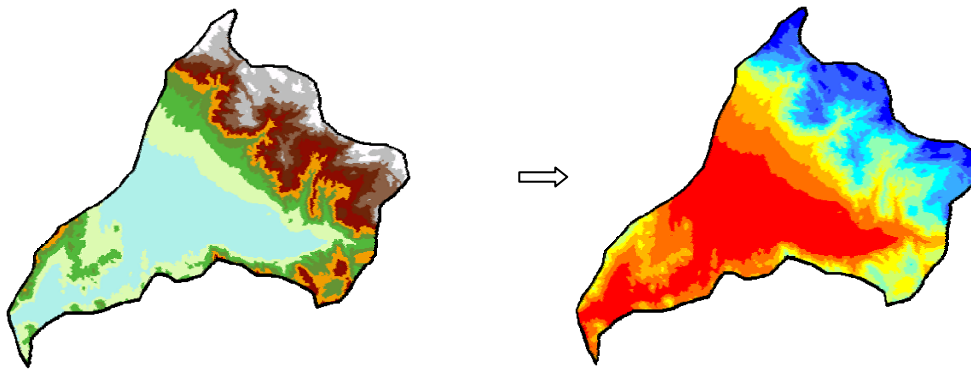
1. DEM → Slope model (automatically with no other data) (raster file)



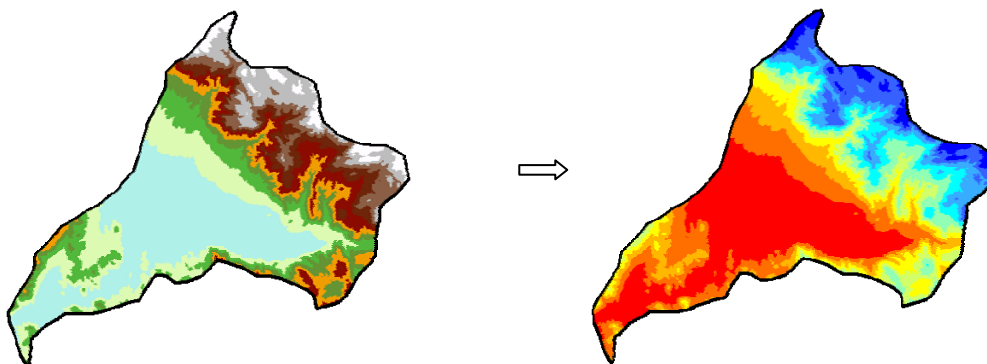
2. DEM → Rainfall model (automatically using rainfall data) (raster file)



3. DEM → Temperature model (automatically using rainfall data) (raster file)



4. DEM → Reference Evapotranspiration model (automatically using temperature and Thornthwaite (1948) method)



The meteorological data that one has to collect must be in the following form:

Station (name) -Elevation 562m - Coordinates (x,y)-Period 1980-2005			Station (name) -Elevation 710m - Coordinates (x,y)-Period 1980-2007		
Month	Rain (mm)	Temp (°C)	Month	Rain (mm)	Temp (°C)
Jan	45	5	Jan	49.5	4.5
Feb	32	6	Feb	35.2	5.4
Mar	34	8	Mar	37.4	7.2
Apr	43	12	Apr	47.3	10.8
Mai	26	19	Mai	28.6	17.1
Jun	20	24	Jun	22	21.6
Jul	15	26	Jul	16.5	23.4
Aug	32	23	Aug	35.2	20.7
Sep	42	18	Sep	46.2	16.2
Okt	36	15	Okt	39.6	13.5
Nov	49	10	Nov	53.9	9
Dec	53	6	Dec	58.3	5.4
Year	427.0	14.3		469.7	12.9

These data will be upload as a pdf file in the Qs in the field Climate and Meteorology. The method that is going to be used for surface integration of rainfall and temperature

in the target area depends on the number of stations and the soil morphology (DEM). Methods for rainfall and temperature integration are kriging, spline, rainfall and temperature gradient etc. After collecting the data, each partner should decide which of these methods is the appropriate for his target area.

The combination of the produced layers in order to develop vulnerability maps for water pollution from nitrogen in agricultural land will be based upon the same concept of the DRASTIC index for vulnerability of aquifers contamination (Adamat et al., 2003; Rahman, 2008) or other nitrogen indices such as GIS NIT-1 (De Paz et al. 2009). Vulnerability mapping is the base in order to develop and apply the Decision Support System (Manos et al., 2009) as indicated in **Work Package 5**.

#### **4. Export data in the GIS data base**

All the procedures will be transacted in the national coordinate system of each target area. All the final products must be converted 1.) in the Global Coordinate System **WGS84** and 2.) in **.kmz format files** in order to be visualized from Google Maps system which is the basic GIS platform used in EU-Water. Examples of layers will be sent to partners in due time in order to have a guide for the GIS data base . For any questions and help for the elaboration of data and GIS maps development, partners can contact:

Vassilis Aschonitis  
Aristotle University of Thessaloniki School of Agriculture  
Department of Hydraulics, Soil Science and Agricultural Engineering  
e-mail: vaschoni@agro.auth.gr

#### **References**

- Al-Adamat, R. A. N., Foster, I. D. L., Baban , S. M. J., 2003. Groundwater vulnerability and risk mapping for the Basaltic aquifer of the Azraq basin of Jordan using GIS, Remote sensing and DRASTIC. *Applied Geography*, (23-4): 303-324.
- Atiqur Rahman, 2008. A GIS based DRASTIC model for assessing groundwater vulnerability in shallow aquifer in Aligarh, India. *Applied Geography*, Volume( 28-1): 32-53.
- De Paz J.M., Delgado J.A., Ramos C., Shaffer M.J, Barbarick K.K., 2009. Use of a new GIS nitrogen index assessment tool for evaluation of nitrate leaching across a Mediterranean region. *Journal of Hydrology*, 365: 183-194.
- Manos B., Papatthanasiou J., Bournaris T. and Voudouris K., 2009. A DSS for sustainable development and environmental protection of agricultural regions. *Environmental Monitoring and Assessment*. DOI 10.1007/s10661-009-0873-1

## **Appendix – Questionnaire**

## Questionnaire (Qs) for data collection on water and nitrogen management in agriculture

**Project Title:** Transnational integrated management of water resources in agriculture for the European WATER emergency control

**Date:** 4 November 2009

**In the framework of:** WP3 "Knowledge capitalization and sensitive areas maps"

**Responsible Partner:** Aristotle University of Thessaloniki, Greece

### Introduction

This Qs has been prepared by the Aristotle University of Thessaloniki in the framework of the European-funded project EU-WATER in order to facilitate the collection of available data regarding water and nitrogen management in the designated target areas of the project. The aim of this task is to standardize the mapping process for the development of the GIS platform.

All partners are requested to fill in the Qs for their target areas. Each question is appropriately explained with added clarifications (red font) wherever necessary. Most questions are straightforward and require a short answer (yes, no, %, quantity etc.); if however, you need to elaborate any of your answers, please expand the size of the cells, as needed.

### General

- 1 Date
- 2 Partner name
- 3 Country
- 4 Name of the target area
- 5 Target area coverage (km<sup>2</sup>)
- 6 Agricultural area coverage (km<sup>2</sup>)
- 7 Total population (No)


- 8 Active population (%) (age>15)
- 9 Number of cities/towns/villages
- 10 Population density (no. / km<sup>2</sup>)


**Production sectors and economic data of the target area**

1 Main production sectors (in terms of employment).

Please give approximate percentage of employment in the most important production sectors of the area (especially in agriculture and Public Services)

	(%)
Agriculture	<input style="width: 100%;" type="text"/>
Mining	<input style="width: 100%;" type="text"/>
Manufacture	<input style="width: 100%;" type="text"/>
Forestry	<input style="width: 100%;" type="text"/>
Energy	<input style="width: 100%;" type="text"/>
Tourism and entertainment	<input style="width: 100%;" type="text"/>
Public Services	<input style="width: 100%;" type="text"/>
other (health, education, communications,trade, other services)	<input style="width: 100%;" type="text"/>
TOTAL	100.00

2 Main production sectors (in terms of income).

Please give the income distribution to the most important sectors

	(%)
Agriculture	<input style="width: 100%;" type="text"/>
Mining	<input style="width: 100%;" type="text"/>
Manufacture	<input style="width: 100%;" type="text"/>
Forestry	<input style="width: 100%;" type="text"/>
Energy	<input style="width: 100%;" type="text"/>
Tourism	<input style="width: 100%;" type="text"/>
Public Services	<input style="width: 100%;" type="text"/>
other (health, education, communications,trade, other services)	<input style="width: 100%;" type="text"/>
TOTAL	100.00

3 Main agricultural products

Please mark the right answer below; if possible, provide type and quantities (tones)

	mark	type and quantity (ton)
Cereals	<input type="checkbox"/>	<input style="width: 100%;" type="text"/>
Fruits	<input type="checkbox"/>	<input style="width: 100%;" type="text"/>
Oil	<input type="checkbox"/>	<input style="width: 100%;" type="text"/>

Wine		
Dairy products		
Vegetables		
other		

4 Livestock heads  
Please give numbers of livestock heads

	System	Heads
Cattle	in pasture	
	stabled	
Pigs	in pasture	
	stabled	
Birds	stabled	
Other	in pasture	
	stabled	

5 Percentage (%) contribution of the target area in the total Gross National Product (GNP) of the country  
Comment (if necessary)

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6 Unemployment rate  
Please mark the right answer

0-5%	
5-10%	
10-15%	
>15%	

7 Is there a development plan for the area?  
Please mark the right answer

Yes	No	Comment (if necessary)

8 Total percentage of enterprises that receive EU grants for agricultural production (i.e. CMO, CAP, Rural Development Program)

%	Comment (if necessary)

**Legislation**

1 Are there any protected sites within the target area? (Places of natural interest, Natura 2000 sites, National Parks, natural heritage areas etc.)

Yes	No	Comment (if necessary)

2 Is the WFD in operation?

Yes	No
<input type="text"/>	<input type="text"/>

3 Have management zones (based on river basins) been developed in the framework on WFD?

Yes	No
<input type="text"/>	<input type="text"/>

4 Is the NFD in operation?

Yes	No
<input type="text"/>	<input type="text"/>

5 Are there any designated "nitrate-vulnerable zones" (NVZs) in the target area in the framework of NFD?

Yes	No
<input type="text"/>	<input type="text"/>

### **Climate and meteorology**

1 Meteorological stations

Do you have monthly data from at least two meteorological stations (number, coordinates, altitude, datasheets)(Minimum parameters monthly rainfall and temperature)? If no, please answer Qs 2-7 below.

Yes	No
<input type="text"/>	<input type="text"/>

If yes, this data will be entered in appropriate form in the database

2 Average Temperature of summer growing season (May to October)

3 Average Temperature of winter growing season (November to April)

4 Average Precipitation of summer growing season (May to October)

5 Average Precipitation of winter growing season (November to April)

6 Average Reference Crop Evapotranspiration of summer period (May to October)

7 Average Reference Crop Evapotranspiration of winter period (November to April)

Value	Unit
<input type="text"/>	°C
<input type="text"/>	°C
<input type="text"/>	mm
<input type="text"/>	mm
<input type="text"/>	mm
<input type="text"/>	mm

## Crops Data

1 Crops / Irrigation / Fertilization. Please fill in the table for the main crops

Crop				
Area (ha)				
Winter or summer crop				
Irrigation method (e.g. drip irrigation)				
Water needs (mm)				
Average crop factor of the growing season for the calculation of evapotranspiration				
Nitrogen fertilization rates and type (kg N/ha) and methods (basal, surface and number of applications)				
Average yield (kg/ha)				
Cost of seeds, fertilizers, pesticides, labor, machinery (€/ha)				

2 Origin of irrigation water (groundwater or surface water)

Groundwater				
Surface water				

3 Irrigation water pricing method

Please mark the right answer

Method A: Cost per ha for every crop (e.g. consumption is not considered)		
Method B: Consumption-based pricing (e.g. type of crop is not considered)*		
Method C: Both consumption and type of crop are considered		
Other method (please describe)		

\*In this method private wells (p.w.) are included (cost based on electric power or oil consumption)

4 Cost of irrigation water

Please give cost of irrigation water for each of the above methods

Crop				
Method A (€/ha for every crop; multiple values)				
Method B (€/m <sup>3</sup> ; single value)				
Crop				
Method C (€/m <sup>3</sup> /crop)				
Other method				

### Pollution sources

#### 1 Point sources

Please mark the point sources identified in the target area

Urban wastes (hospital, hotel, garage, car repair etc.)	<input type="checkbox"/>
Pit active or filled up with various waste types or abandoned used as inert wastes dump	<input type="checkbox"/>
Abandoned waste fields	<input type="checkbox"/>
Industrial wastes	<input type="checkbox"/>
Cattle breeding wastes	<input type="checkbox"/>
Fuel storage tanks (Petrol or gas station)	<input type="checkbox"/>
other (please add)	<input type="text"/>

#### 2 Non-point sources

Please mark the non-point sources identified in the target area

Agricultural practices (spreading of fertilizers and pesticides)	<input type="checkbox"/>
Surge of sea water	<input type="checkbox"/>
Storage and disposal of manure	<input type="checkbox"/>
Stockpiling of materials	<input type="checkbox"/>
Road salting	<input type="checkbox"/>
other (please add)	<input type="text"/>

### Nitrogen management

#### 1 Are there any practices in order to limit nitrogen leaching?

Please mark the right answer

crop rotations	<input type="checkbox"/>
soil winter cover	<input type="checkbox"/>
catch crops	<input type="checkbox"/>
application of dissolved fertilization in irrigation water (e.g. during drip irrigation)	<input type="checkbox"/>
surface application of fertilizers in doses	<input type="checkbox"/>
other (please describe)	<input type="text"/>

#### 2 Are there any Fertilization Plans in place?

Yes	No	Comment (if necessary)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>

#### 3 Is fertilization applied in regions close to water bodies (lakes and rivers)? **Please note that**

minimum restricted distance from water bodies is 2m, while in case of sloppy areas the distance is proportionate to the % of slope (e.g. the maximum distance of fertilization for areas with 5% slope is 5m from water bodies)

4 Are there any rivers and lakes that show eutrophication symptoms or bring high nitrogen fluxes to coastal water and sea?

Yes	No	Comment (if necessary)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>

5 Do soil analysis take place in the target area? If yes, how often?

Yes	No	Comment (if necessary)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>

6 Do manure analysis take place in the target area? If yes, how often?

Yes	No	If yes, how often?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>

7 Which approximately is the average dose of nitrogen in the manure applied in the region?

Yes	No	If yes, how often?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>

8 Have specific limits been set for the application of livestock manure?

kg N/ha

Yes	No	Comment (if necessary)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>

9 Time sampling to collect info and existing water quality data for nitrogen species?

Existing data for nitrogen species		Type of measurements - Sampling frequency
Lakes	<input type="text"/>	<input type="text"/>
Rivers	<input type="text"/>	<input type="text"/>
Water wells (groundwater)	<input type="text"/>	<input type="text"/>

**GIS data** (existing data will be entered in appropriate fields in the GIS platform)

1 Digital Data. Do you have digital data of the following elements?

	Yes	No	
Digital boundaries of the study area (polygon)			upload your .kmz file
Digital data for land use (polygons)			upload your .kmz file
Digital Elevation Model - DEM (raster)			upload your .kmz file
Digital soil type classes (polygons)			upload your .kmz file
Digital data of agricultural fields-sectors (polygons)			upload your .kmz file
Digital data for surface waters i.e. lakes, rivers (polygons)			upload your .kmz file
Digital data for ground waters i.e. waterwells and acquifers (points and polygons)			upload your .kmz file
Digital data of point pollution sources (points)			upload your .kmz file
Digital data for protected areas (polygons)			upload your .kmz file