BIGDATA 4RIVERS
Interreg Europe

Improving the European Rivers Water Quality through Smart Water Management Policies

Joint Analytical Report

cim alto minho
AIMRD Asociación Ibérica de Municipios Ribereños del Duero / Associação Ibérica de Municípios Ribeirinhos do Douro
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LIST OF ABBREVIATIONS

ABBREVIATIONS	
A	
ABA	Water Basin Administration
AIMRD	Iberian Association of Riverside Municipalities of Duero River
ANAR	National Administration of Romanian Waters
ANM	National Meteorological Administration
ANPA	National Agency for Fisheries and Aquaculture
ANPM	National Agency for Environmental Protection
B	
BIGDATA 4RIVERS	Improving the European Rivers Water Quality through Smart Water Management Policies
BSAP	Baltic Sea Action Plan
C	
CAB	The County Administrative Board of Östergötland
CHDuero	Duero Hydrographic Confederation
CIM Alto Minho	Intermunicipal Community of Alto Minho
CIPN	Integrated Nutrient Pollution Control Project
CLE	Local Water Commission
CNAID	National Commission for Protection against Disasters
D	
DC	Directive 2000/60/CE
DS	Health Directorate
DWSMP	Drought and Water Scarcity Management Plan
E	
EPA	Environmental Protection Agency
EAFRD	European Agricultural Fund for Rural Development
EFF	European Fisheries Fund
ERDF	European Regional Development Funds
EYDAP S.A	Athens Water Supply and Sewerage Company
G	
GIS	Geographic information system
Gov.Gaz.	Government Gazette
GSM	Global System for Mobile Communication
I	
ICT	Information Communication Technology
INHGA	National Institute of Hydrology and Water Management
J	
JAR	Joint Analytical Report
JCL	Regional Government of Castilla y León

JMD	Joint Ministerial Decision
K	
KTU	Kaunas University of Technology
L	
LGS	Lithuanian Geological Survey
LHS	Lithuanian Hydro meteorological Service
LSG	Local Stakeholder Group
M	
MP	Management Plan
N	
NDVI	Normalized Difference Vegetation Index
NURE	The National Union of Romanian Entrepreneurs
O	
ORP	Oxidation-Reduction Potential
P	
POM	Programme of measures
PABH	River Basin Arrangement Plan
PMBH	River Basin Management Plan
PNDR	National Rural Development Programme
R	
RB	River Basin
RBD	River Basin District
RBMP	River Basin Management Plan
RCVL	Centre Val de Loire Region
RDFA	Regional Development Fund on Behalf of the Region of Attica
REPD	Regional Environmental Protection Departments
RoA	Region of Attica
ROP	Regional Operational Program
RPACC	Regional Plan for the Adaptation to Climate Change
S	
SEIA	Strategic Environmental Impact Assessment
SSPA	State Service for Protected Areas
SVHC	Substances of very High Concern
SCADA	Supervisory Control and Data Acquisition
W	
WWTP	Wastewater Treatment Plant
WB	Water Bodies
WFD	Water Framework Directive
WSN	Wireless Sensor Network

1. SCOPE OF THE REPORT

This document constitutes the Joint Analytical Report prepared under the BIGDATA4RIVERS project, financed under the Interreg Europe program. Its elaboration had as general objective to promote a deeper knowledge, among the partners, of the reality of each region with regard to the management of water and water resources, in the context of the community water directive, as well as the identification of good practices in this field.

The specific objectives of this document, which were specified in the application for the Interreg Europe program, include the following:

This document consists of nine chapters in addition to this one. The second chapter, called State of Play, aims to characterize the situation of each region and respective country in the context of water resources management, the role of river basins, respective management plans and policies adopted. It consists of two sub- chapters in which the first addresses the current state of watershed management and in the second the ongoing management policies and plans, in each region and country, as well as its institutional framework, identifying the main bodies involved and their functions.

The third chapter aims to characterize the application of community directives, in the scope of water and its management. Designated as Application of the EU Directives, it was also divided into two sub-chapters. The first (sub - chapter 3. 1 Implementation of The Water Framework Directive) was considered the level of implementation of the WFD in each country, given the prevision programming cycles, and the second sub - chapter the main results obtained, resulting from such implementation. In this case, the analysis was based on aspects such as the classification of types and quality of water bodies, environmental quality standards adopted through legislation in each country and, in some cases, even the framework given to industrial activity.

The fourth chapter describes the areas, in the field of water and water resources management, in which information and communication technologies can play an important role. In the first case, the analysis focused on the technologies directly associated with water management, namely in the treatment systems, and in the second, the monitoring of the quality of rivers and lakes.

The fifth chapter focused on describing the main policy instruments of the various partners that support their activity within the scope of the BIGDATA 4RIVERS project. The sixth chapter corresponds to the description of the good practices identified by each partner, according to a previously defined characterization grid and which provides for a brief assessment of the conditions for replication of these practices in other European regions.

In the seventh chapter, each partner identified the main indicators used, in the regional context, within the scope of WFD and water and water resources management with the aim of allowing a pool of knowledge about the processes for defining the indicators, their meaning and use. In the last chapter, each partner identified their respective stakeholders, describing their role and relationship with the project.

In methodological terms, a rigid guide to be followed by the various partners has not been defined. Depending on the objectives identified for each chapter and sub-chapter, each partner collected the information necessary to ensure those objectives. Although this situation has led to some heterogeneity of information, it does, however, allow for a more diversified and enriching knowledge of the various topics mentioned above. For chapter, a leading partner was defined responsible for the compilation of the respective information. In the end, all the information was grouped in this document by the lead partner, which was then analysed and discussed in the TC.

The analysis of the diverse information collected allows us to conclude that:

- the WFD has already been transposed into the national law of the different countries;
- in all cases, the hydrographic basin corresponds to the base unit in the management of water and water resources, as defined in the WFD;
- the elaboration of river basin plans is a practice already consolidated in all the regions and countries analysed, being complemented or part of other management plans of a regional, intraregional or other level depending on the institutional framework of each country;
- the type, functions and responsibilities involved in the management of water and water resources, namely in the definition of policy instruments, depends on the institutional framework of each country. In some cases, they are entities of a national character that have the predominant role and in others this role is already performed by institutions of an intraregional or regional character;
- in all cases, local entities have responsibilities in this area, varying according to the aforementioned institutional framework;
- in all regions / countries the classification of existing water bodies has already been carried out, as well as the characterization of their quality, according to the guidelines of the WFD;
- still deriving from the WFD in all cases, several legislations related to EQS as well as emerging pollutants was drafted and transpose;
- all partners already use information and communication technologies in activities related to the management of water and water resources, albeit with different levels of technological maturity. Uses ranging from monitoring rivers and lakes, to data transfer via WI-FI and data processing have been described. In some cases, some solutions to support decision making with data mineralization technologies have been reported;
- finally, good practices were identified by all partners with the possibility of replication, at least partially, in other regions.

2. STATE OF PLAY

2.1. River basins management

2.1.1. Spain - Iberian Association of Riverside Municipalities of Duero River

In the case of Spain, the territory is organized in municipalities, provinces, autonomous communities and the central state. All these entities have the right for the management of their own interests. Being a country that privileges the management of the territory through the autonomous regions, the sharing of the competences with the central state are well defined although there are some areas of doubt.

These competencies can be of various types: legislative (power to proclaim laws), regulatory (power to regulate) and executive (to fulfil and enforce the laws). Depending on how competences are shared by the state and autonomous communities, those could be:

- exclusive competences, when only one entity has competence in the subject;
- shared competences, when the different rights belonging to a competence are distributed among the entities. For example, the state proclaims the basic law on a given subject and the autonomous community develop, execute and enforce this law;
- concurrent competences, when the two entities have the same rights on the matter.

In the use of water as a resource since it intervenes in several domains such environmental, agricultures, fishing, health, energy, civil protection sports and also leisure it turns out that each entity has some degree of competences. In a simple way it can be said that the general principles of the public water management are described as follows:

- ensure an integrated management of the resource in its various aspects, while respecting the participation of all entities, according to their competences;
- respect the hydrographic basin and its hydrological cycle;
- ensures the compatibility of the water resources with other management activities like the territorial planning, environment protection and natural resources;
- the hydrographic region is indivisible and is the base unit for watershed planning and management purposes.

Two types of hydrographic basins are distinguished for the purposes of distribution of responsibilities:

- intercommunity basins when its territory extends over more than one autonomous community;
- intracommunity basins, when its territory is fully included within the territory of one autonomous community.

Regarding the competences in relation with the public hydraulic domain they are divided between the central state and the autonomic regions. The central state have the following functions:

- hydrological planning and the implementation of state plans for hydraulic infrastructures;
- the adoption of the necessary measures for compliance with international agreements and conventions on water;
- the granting of concessions related to the public hydraulic domain in intercommunity hydrographic basins as well as its protection, in intercommunity hydrographic basins. However,

the processing of the same may be entrusted to the Autonomous Communities.

Regarding the autonomous community that, by virtue of its statutes of autonomy, exercises powers over the public hydraulic domain in hydrographic basins fully included within its territory, must adjust the legal regime of its hydraulic administration to the following bases:

- the general principles of the public water management;
- the representation of users in the collegiate bodies of the Hydraulic Administration will not be less than a third of the members that make them up.

In the case of acts and agreements made by the autonomous community that violate the central (state) hydraulic legislation or don´t comply the national hydrological planning the dispute will be decide in the administrative courts.

With regard to the water resources the legal regimes are different and their corresponding powers are distributed, exclusively or shared, between the Central State and the Autonomous Communities, in accordance with the provisions of the Constitution and the respective stature's autonomy. The Spanish Constitution establishes the following competence framework:

- Is an exclusive legal responsibility of the central state:
  - make legislation, management and concession of resources and hydraulic uses when the waters flow through more than one Autonomous Community (intercommunity basins) and the authorization of electrical installations when their use affects another Community or the transport of energy leaves its territorial scope.
  - public works of general interest or whose performance affects more than one Autonomous Community.
  - basic legislation on environmental protection, without prejudice to the powers of the Autonomous Communities to establish additional protection standards.

- and the Autonomous Communities have the following competences:
  - the projects, construction and exploitation of hydraulic uses, canals and irrigation of interest of the Autonomous Community;
  - mineral and thermal waters;
  - fishing in inland waters, shellfish and aquaculture, hunting and river fishing;
  - management in matters of environmental protection.

When a basin comprises several Autonomous Communities, the Central State assumes management through entities designated by Hydrographic Confederations. They are public law entities with their own legal personality different from that of the State, attached for administrative purposes to the Ministry of the Environment and Rural and Marine Affairs and with full functional autonomy, in accordance with the provisions of the Water Law. The public administration of water is exercised in the intercommunity basins by the hydrographic Confederations and in the intracommunity basins by the Hydraulic Administrations of the corresponding Autonomous Communities. The hydrographic confederations main functions are:

- elaboration of the Basin Hydrological Plan, its monitoring and review;
- administration and control of the Public Hydraulic Domain;
- project, construction and operation of the works carried out with charge to the Agency's own funds, and those that are entrusted to them by the State;
- those derived from agreements with Autonomous Communities, Local Corporations and other public or private entities, or from those signed with individuals.
- administration and control of exploitations of general interest or that affect more than one

Autonomous Community.

The hydrographic confederations have also the competence associate with the licenses and concessions related to public water domain except for those relating to works and actions of general interest of the State. In this case the competence will correspond to the Ministry of the Environment. On other hand they still responsible for:

- carrying out hydrological studies, information on floods and water quality control.
- study, project, construction, conservation and exploitation and improvement of the hydraulic works included in their own plans, as well as those that could be entrusted to them;
- definition of water quality objectives and programs, in accordance with hydrological planning;
- plans, programs and actions for the proper management of demands, to promote savings and economic and environmental efficiency of the different uses of water.
- provide technical services and advice.

The maps pf the following figure shows the different Spanish hydrographic basins (cuencas) and confederations (confederaciones).

Figure 1 | Delimitation of the Spanish hydrographic basins and confederations

Source – Wise, Eurostat

Spain has 25 river basin districts (RBDs) being that eight of them are part of international river basin districts. Spain shares International RBDs with Portugal (Miño-Sil, Duero, Tajo and Guadiana), with France (Eastern Cantabria, Ebro), with Andorra (Ebro) and Morocco (Ceuta and Melilla). In the next figure the 25 different river basins districts are displayed and in the Table 1 their characteristics are described.

Figure 2 | Delimitation of RBD in Spain

Source – Wise, Eurostat

Table 1 | Overview of Spain´s River Basin Districts

RBD	Name	Size (km^2)*	Countries sharing borders
ES010	Miño-Sil	17619	PT
ES014	Galician Coast	12988	-
ES017	Cantábrico Oriental	6405	FR
ES018	Cantábrico Occidental	19002	-
ES020	Duero	78889	PT
ES030	Tagus	55781	PT
ES040	Guadiana	55528	PT
ES050	Guadalquivir	57228	-
ES060	Andalusia Mediterranean Basins	20010	-
ES063	Guadalete and Barbate	5969	-
ES064	Tinto, Odiel and Piedras	4729	-
ES070	Segura	19025	-
ES080	Jucar	42735	-
ES091	Ebro	85570	AD, FR
ES100	Internal Basins of Catalonia	16438	FR
ES110	Balearic Islands	4968	-
ES120	Gran Canaria	1558	-
ES122	Fuerteventura	1660	-
ES123	Lanzarote	836	-
ES124	Tenerife	2033	-
ES125	La Palma	706	-
ES126	La Gomera	370	-
ES127	El Hierro	269	-
ES150	Ceuta	20	MA
ES160	Melilla	24	MA

Source – Wise, Eurostat

The intervention area of the Iberian Association of Riverside Municipalities of Duero River corresponds to the hydrographic basin of Duero river. This hydrographic basin has a total area of 97 477,66 km^2 of which 18 587,85 km^2 are in Portugal, corresponding to 19,07% of the total area. The 78 889,0 km^2 in Spain, correspond to the others 80,93%. This is the major river basins between the two countries.

From the Portuguese side this hydrographic region includes totally or partially, 74 municipalities. In Spain the hydrographic region of the Duero extends partially to eight Autonomous Communities being 98% of this region corresponding to Castilla y León.

At Portugal the responsibility of the management of water resources, including the respective planning, licensing, monitoring and inspection is from the Portuguese Environment Agency, through its territorially service of Hydrographic Region Administration. In the case of the Duero river will be the Northern Region Administration. In Spain this responsibility is from the Confederación Hidrográfica del Duero, which depends on the Ministry of Agriculture and Fisheries, Food and Environment.

A cooperation agreement (convention) between the two countries is in force, resulting from the review of a first one carried out in 1964. The Convention applies to activities with the objective of promoting and protecting the good condition of the waters of hydrographic basins common to both countries (Minho, Lima, Douro, Tajo and Guadiana) and to the uses of water resources, in progress or projected, especially those that cause or are likely to cause transboundary impacts. For this purpose the two countries commit to coordinate actions that promote and protect the good condition of surface and groundwater in Portuguese-Spanish hydrographic basins, actions for the sustainable use of these waters, as well as actions that contribute to mitigate the effects of floods and drought or scarcity. In this context the two parties establish the following cooperation mechanism:

- exchange of regular and systematic information on matters covered by the Convention, as well as international initiatives related to them;
- consultations and activities within the bodies established by the Convention;
- adoption, individually or jointly, of the technical, legal, administrative or other measures necessary for the application and development of the Convention.

In order to assure a good articulation of the agreements between the two countries Cooperation Bodies were defined which are the "Conference of the Parties" and the "Commission for the Application and Development of the Convention".

The first consists of representatives appointed by the Governments of the Parties under the chairmanship of a Minister from each of the States or to whom he delegates. The meets of the “Conference of the Parties” will occurred when the two countries decide or at the request of one of them to assess and resolve those issues on which an agreement has not been reached within the “Commission”.

The Commission is composed of delegations appointed by each country, subject to prior agreement on the number of delegates, and may create subcommittees and working groups as deemed necessary. Is responsibilities are those predict at the Convention as well those conferred by the two countries for the pursuit of the objectives and provisions of this Convention. The objective of the Commission is to propose to both parts measures to develop the bilateral relationship regime. The Commission is the privileged body for resolving issues relating to the interpretation and application of the Convention also being the institutional organ that succeeds in the duties and powers of the International Rivers Commission. It will gather in ordinary session, once a year, and in extraordinary session, whenever one of the parties so requests, on the date, place and with the agenda to be determined through diplomatic channels. Unless there is a special agreement between the parties, the meetings are held alternately in Portugal and in Spain and are chaired by the head of the delegation of the Party in whose territory it is held. The working languages are Portuguese and Spanish. The Commission's deliberations are adopted by agreement of the two delegations. The deliberations are considered perfect and take effect if, after two months after the

date of its adoption, neither Party formally requests its revision or its submission to the Conference. The functioning of the Commission is governed by regulations drawn up by it and approved by the Parties.

The cooperation agreement covers several aspects related to the management of river basins such as the assessment of transboundary impacts, water quality, pollution prevention and control and the flow regime.

In Spain, water management is carried out by different agencies/administrations: The National Water Council, in force since the 1985 Law, is the highest advisory body whose functions are to report on the draft National Hydrological Plan and the Basin Hydrological Plans. The regional, local and central administrations are in charge of managing water quality. The Basin Organizations, or Hydrographic Confederations, created in 1926, are the highest authority in the management of water resources at the basin level. Its main role is the protection and sustainable use of water. The town councils provide final services to users, such as the supply of drinking water, sanitation and purification.

The water management in Spain was not considered as an important aspect to take into account until the 19th century, when water was questioned as a fundamental good for the development and prosperity of the towns, although it was still not granted the economic value that it currently has. At that time, they began to demand actions from the political power to find solutions for the future and to talk about planning. The first steps were taken for the incorporation of hydraulic issues within the administrative problems of the State.

In 1864 the Consulting Board of Roads, Canals and Ports was commissioned to draft the program for the hydrological study of river basins through their water section.

In 1865 a Royal Order of July 29 created the Ten Hydrological Divisions in force, which underwent a series of suppressions and reappearances to be definitively transferred in 1899 to the Provincial Headquarters where a special section of water would be created for them. It is the time of the enactment of the Water Law (1879) that did not take into account, with the perspective that we can apply today, issues such as water quality, regulation of flows through reservoirs, the close relationship between surface and groundwater, associated river ecosystems etc. Changes in mentality and the consideration of water as a source of life and development of a territory, make it possible that in the 20s of the 20th century the then Minister of Development, Rafael Benjumea, created in 1926 the Trade Union Confederations, the germ of the future Hydrological Confederations. In fact, the year 1926 represents a before and after in the Spanish hydrological structure when the first Hydrographic Confederation was created around the Ebro river.

Regarding the Duero, by Royal Decree of June 22, 1927, the Duero Hydrographic Trade Union Confederation was created, having as its fundamental mission the management of water in the Spanish part of the Duero basin, guaranteeing the availability and quality of the waters for the different uses demanded.

2.1.2. Greece - Regional Development Fund on Behalf of the Region of Attica

Greece has a population of 11 million with a high concentration in the Athens metropolitan area, and a total surface area of 131,957 km^2 it is located in the southern extremity of the Balkan peninsula in south-east Europe. Its territory includes more than 2 000 islands in the Aegean and Ionian seas. Mount Olympus is the highest point in the country.

Greece has 14 River Basin Districts (RBDs) whose characteristics are described in the Table 2. The two largest ones are the Western Macedonia RBD (GR09) covering 15 218 km^2 and the Central Macedonia (GR10) covering 14 264 km^2. Two of RBDs, Aegean Islands (GR14) and Crete (GR13) cover islands, while six of them (Northern Peloponese-GR02, Western Sterea Ellada-GR04, Epirus-GR05, Attica-GR06,

Eastern Sterea Ellada (GR07 and Thrace-GR12) cover both mainland and island areas.

Figure 3 | Map of River Basin Districts of Greece

Source: WISE, Eurostat (country borders)

The following overview is provided regarding the shared transboundary catchment with EU Member States/third countries (Table 2):

- with Albania (AL) the Lake Prespa Basin (Part of Drin/Drim sub-basin) (GR09), Aoos/Vjosa River Basin (GR05);
- with Bulgaria (BL) the Mesta-Nestos River Basin (GR12), Struma-Strymonas River Basin (GR11), Maritsa-Evros-Meric River Basin (GR12), Axios/Vardar River Basin (GR10);
- with Republic of North Macedonia (NMK) the Lake Prespa Basin (Part of Drin/Drim sub-basin) (GR09), Axios/Vardar River Basin including the Doirani Lake Basin (GR10), Struma-Strymonas River Basin (GR11);
- With Turkey (TR) the Maritsa-Evros-Meric River Basin (GR12).

The National Monitoring Network of the quantitative and qualitative status of surface water and groundwater in Greece was formed through a Joint Ministerial Decision (JMD) 140384/2011 “Designation of the National Monitoring Network of the quality and the quantity of waters with definition of the measurement points (stations) and the bodies liable for their operation, according to article 4, paragraph 4 of Law3199/2003 (A’ 280)”.

The National Monitoring Network includes 449 monitor stations in rivers, 53 stations in lakes, 34 in transitional waters, 80 in coastal waters and 1392 stations in groundwater bodies that totalized 2008 station (from which 616 are in surface water bodies and 1392 in groundwater bodies). Stations are divided into two types: surveillance and operational. Surveillance stations operate in water bodies of good

status for a certain period of time (one year), while operational stations run continuously on water bodies which fail to achieve good status (i.e. an operational station may be characterized a surveillance station if the status of the system is improved and has reached a good status).

Table 2 | Overview of Greece's River Basin Districts

GREEK RIVER BASIN DISTRICTS			
RDB	Name	Size* (km2)	Countries sharing borders
GR01	Western Peloponnese	7,235	-
GR02	Northern Peloponnese	7,418	-
GR03	Eastern Peloponnese	8,442	-
GR04	Western Sterea Ellada	10,432	-
GR05	Epirus	10,007	AL
GR06	Attica	3,139	-
GR07	Eastern Sterea Ellada	12,268	-
GR08	Thessalia	13,153	-
GR09	Western Macedonia	15,218	AL,NMK
GR10	Central Macedonia	14,264	BG, NMK
GR11	Eastern Macedonia	7,320	BG, NMK
GR12	Thrace	11,242	BG,TR
GR13	Crete	8,301	-
GR14	Aegean Islands	9,118	-

* Area in Greek territory.

Source: River Basin Management Plans reported to WISE3 (http://cdr.eionet.europa.eu/be/eu/wfdart13)

The reformed National Monitoring Network meets fully the requirements of the Water Framework Directive (2000/60/EC) (Article 8 and Annex V), as well as the Directives on nitrate pollution from agricultural sources (91/676/EEC), for groundwater (2006/118/EC) and for priority substances (2008/105/EC).

The following entities undertake the operation of the Network under the supervision of the Special Secretariat for Water according to the aforementioned JMD 140384/2011:

- General Chemical State Laboratory (GCSL)
- Hellenic Centre for Marine Research (HCMR)
- Institute of Geology & Mineral Exploration (IGME)
- Greek Biotope/Wetland Centre (EKBY)
- Municipal Water and Sewerage Company of Larissa (DEYAL)
- Land Reclamation Institute (LRI)

The roles and responsibilities of the each are as described above:

- Hellenic Centre for Marine Research (HCMR): Monitoring (sampling and analysis) of the biological, hydro morphological and general physical-chemical parameters (transparency, temperature, dissolved oxygen, BOD, conductivity, pH value, alkalinity, nutrients) in

rivers, transitional and coastal waters, as well as sampling for chemical parameters (priority substances and specific pollutants) in transitional and coastal waters (and shipping samples to the General Chemical State Laboratory for analysis).

- Greek Biotope/Wetland Centre (EKBY): Monitoring (sampling and analysis) of the biological, hydro morphological and general physical-chemical parameters in lakes, as well as sampling for chemical parameters in lakes (and shipping samples to the General Chemical State Laboratory for analysis).
- General Chemical State Laboratory (GCSL): Analysis of chemical parameters (priority substances and specific pollutants) in all surface waters (rivers, lakes, transitional and coastal). The chemical parameters to be monitored and their monitoring frequency depend on the type of pressures that the system is subject to and have been defined for each station separately.
- Land Reclamation Institute (LRI): Sampling of chemical parameters in rivers (and shipping samples to the General Chemical State Laboratory for analysis) and systematic monitoring of the discharge in approximately 50 river stations.
- Municipal Water and Sewerage Company of Larissa (DEYAL): Sampling chemical parameters in rivers and lakes (and shipping samples to the General Chemical State Laboratory for analysis) only for the Water District of Thessaly.
- Institute of Geology and Mineral Exploration and Studies (NCSD-EKBAA/IGMEM): Monitoring (sampling and analysis)) of all parameters (quality, pesticides and level) in groundwater (the parameters to be monitored have been identified in detail for each station).

Generally, while there is only one entity responsible for monitoring groundwater (IGMEM), there are five involved in monitoring surface water and close co-operation between them is of course required.

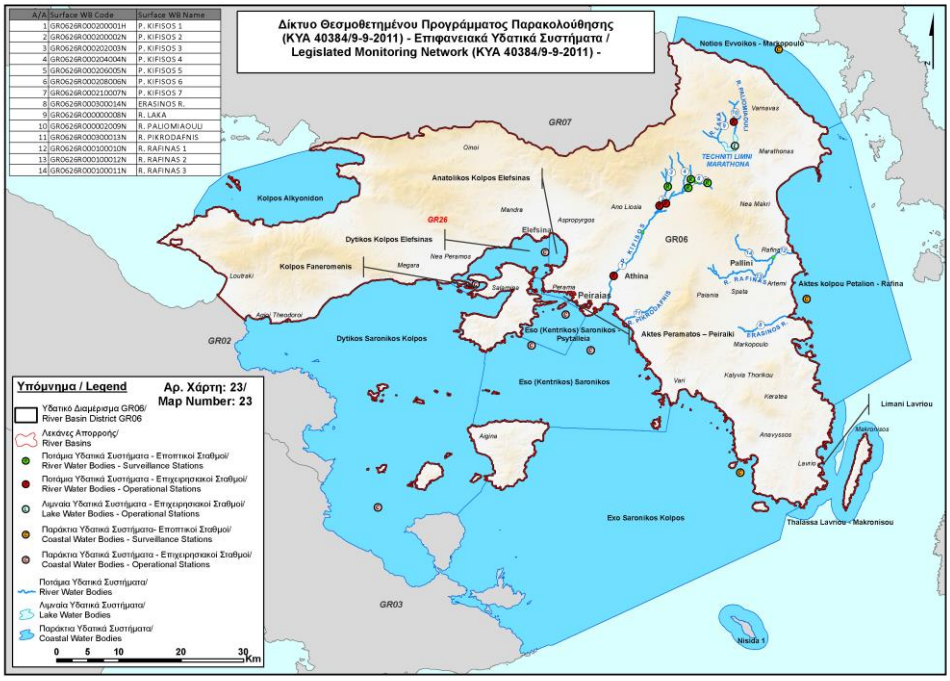
Attica River Basin District (GR06) includes almost the entire Prefecture of Attiki (74,9%), the islands of Aigina, Salamina and Makronisos and small parts of the Prefectures of Voiotia (1.4%) and Korinthia (12.9%). Its population, according to 1991 census was 3.502.724 inhabitants and according to the 2001 census was 3.859.805, indicating an increase of 10.0%. According to the census of 2011, the population of the River Basin District is 3.769.598 inhabitants indicating a decrease of 2.3% compared with the 2001 census.

Although the Attica River Basin District is heavily forested (46% of total area), the percentage of the basin covered by crops represents 24% of total area, the urban areas 17% of total. Pasture account by 4% and the other uses cover 9% of the total area.

Water uses are distinguished in drinking water, irrigation, livestock and industry. The total annual demand for all uses is about 506 106 m^3. Drinking water is the main use and totalize 414.746.506 m^3 (82,03%). The demand for irrigation amounts to 68.463.081 m^3 (13,54%), the industry uses 20.832.567 m^3 (4,12%) and livestock 1.587.992 m^3 (0,31%) per year. Approximately 80% of the total annual demand (about 406 106 m^3) of Athens Metropolitan area derives from surface water bodies (Mornos, Evinos and Yliki) that do not belong to Attica RBD. Raw water is classified in A2 category, in accordance with the European Directive 75/440/EEC on the quality required for surface water, intended for production of drinking water. Approximately 100 106 m^3/year (about 20% of needs) are supplied through boreholes and springs exploitation, covering mainly the water demand for irrigation.

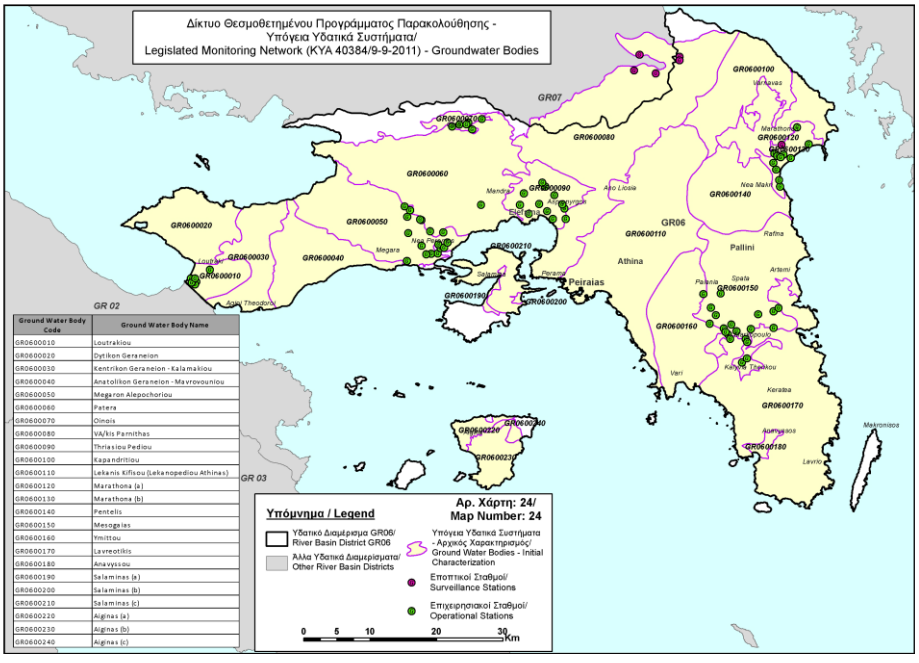
The maps of the following figures show the monitoring network for the surface water bodies and grounded water bodies for the Attica RBD.

Figure 4 | Map of Legislative Monitoring Network Surface Water Bodies Attica RBD



Source: MANAGEMENT PLAN for the River Basins of Attica River Basin District, Summary

Figure 5 | Map of Legislative Monitoring Network Ground Water Bodies of Attica RBD



Source: MANAGEMENT PLAN for the River Basins of Attica River Basin District, Summary

The surface water bodies within the river basin district of Attica were identified as falling within either one of the following surface water categories: rivers, lakes or coastal waters. In the River Basin District of Attica fourteen (14) rivers are identified, all with the same typology (SsL1: Small lowland and semi-mountainous rivers with relatively steep slope (> 1.2 ‰), which flow in the region of the Southern Aegean

Sea). Only one water body in the category of lakes exist, the Artificial Marathona Lake (Techniti limni Marathona), that is identified as an L-M8 type (Reservoir, deep, large, limestone). All fourteen (14) coastal waters identified in the River Basin District of Attica belong to the IIIE type. The spatial characteristics of surface water bodies of RBD of Attica (06), are presented in the table below.

Table 3 | Spatial characteristics of surface water bodies of RBD of Attica

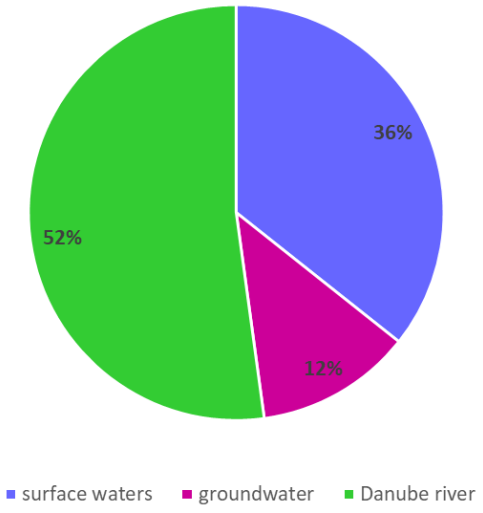
Type of WB	Number	Characteristic size	Minimum	Mean	Maximum	Total
Rivers	14	Length (km)	1.35	8.97	21.21	125.64
Lakes	1	Surface (km²)	2.98	2.98	2.98	2.98
Coastal waters	14	Surface (km²)	0.44	287.83	1,295.20	4,029.55

2.1.3. Romania - The National Union of Romanian Entrepreneurs

Romania has on paper water resource totalling 134.6 billion m^3, of which the usable resource is roughly 38.346 billion m^3, which comes from inland rivers (13.679 billion m^3), the Danube River (20 billion m^3) and groundwater (4.677 billion m^3).

At the national scale, Romania's water resources are unevenly distributed in space - they differ from one region to another - and time, since they undergo large seasonal variations. There are the inland waters that are more accessible, better distributed within the Romanian territory and with a high share in terms of economic recovery.

Figure 6 | Romania's water resources



Source: National Institute of Statistics of Romania

Romania's hydro-meteorological network includes 882 monitoring stations, of which approximately 600 are automated.

It is worth mentioning out that the total surface of the country, 232,193 km^2 are located within the Danube basin (i.e. 97.4% of the total surface of the country); thus, according to the figuresmentioned above, Romania alone has 29% of the surface and 21.7% of the population of the Danube river basin.

Due to the influence of the Danube river on the morphology of the shore and the condition of the waters, within the Danube river basin there were included the Romanian coastal waters as well as the tributary

basins flowing into the Black Sea (with an area of about 5,198 km^2) forming, this way, the Danube River Basin District, in accordance with the provisions of the Water Framework Directive (the entire territory of Romania is included in the Danube River Basin District).

In Romania, the total length of the hydrographic network is 78,905 km and is evenly distributed, with a radial configuration, 98% of its rivers springing are from the Carpathian Mountains. On Romania territory there are the upper and middle courses of an important number of rivers that cross the state border, being Tisza, Prut and Danube rivers, among others, part of the Romanian border.

The main rivers are Mureş (761 km), Prut (742 km), Olt (615 km), Siret (559 km), Ialomiţa (417 km), Someş (376 km) and Argeş (350 km). The most important lakes are those formed from the former lagoons on the Black Sea coast (Razim - 425 km^2, and Sinoe - 171 km^2), and the lakes formed along the Danube riverbanks (e.g., Brateş - 21 km^2) (Source: www.rowater.ro)

The water resources in the inland rivers are totalling 40 billion m^3, which represents 50% of the water resources of the Danube River. (Source: www.rowater.ro / Danube River Flood Risk Management Plan)

The largest water supply is brought by the Siret basin with an average flow of 224 m^3/s, and a volume of 7,083 million m^3 representing 17% of the total volume of water resources of the country. It is followed by Mureş (186 m^3/s, 5,870 million m^3) with 14% and Olt (174 m^3/s, 5,490 million m^3) with 13%. These three water basins provide almost half of the volume of water resources of Romania. However, there are also water basins that, although they have almost identical surfaces, they have very different characteristics because, of their different altitude, relief, and climate conditions (Source: Romanian Water Association, Strategy for Sustainable Development of Public Water Supply and Sewerage Services "Romania 2025")

Although water is a renewable natural resource, it faces limitations in terms of the annual volume available, even showing declining trends in some river basins or even the impossibility itself in case of increased pollution. Limitations of the use of water resources are generated by other reasons, among which deserve to be mentioned these:

- transport of water resources at a distance faces many technical and economic difficulties, a shortcoming which makes water be considered as a regional resource, since we are not able to achieve an interconnected national system;
- the water resources available on the Romanian territory are strongly influenced, both quantitatively and qualitatively, by the human factor, by an intensive and unsustainable use on the brink of the socio-economic resources on the one hand and by a heavy pollution on the other hand (Source: Romanian Waters National Administration, National River Basin Development Plan of Romania - Synthesis).

The following hydrographic basins areas, as show in the next figure and table, for which Management Plans are developed were set at national level by Law 310/2004 on the amendment and completion of the Water Law, namely: Someş - Tisa; Criș; Mureș; Banat; Jiu; Olt; Argeş - Vedea; Buzău – Ialomița; Siret; Prut - Bârlad; Danube, Danube Delta, Dobrogea (including coastal waters).

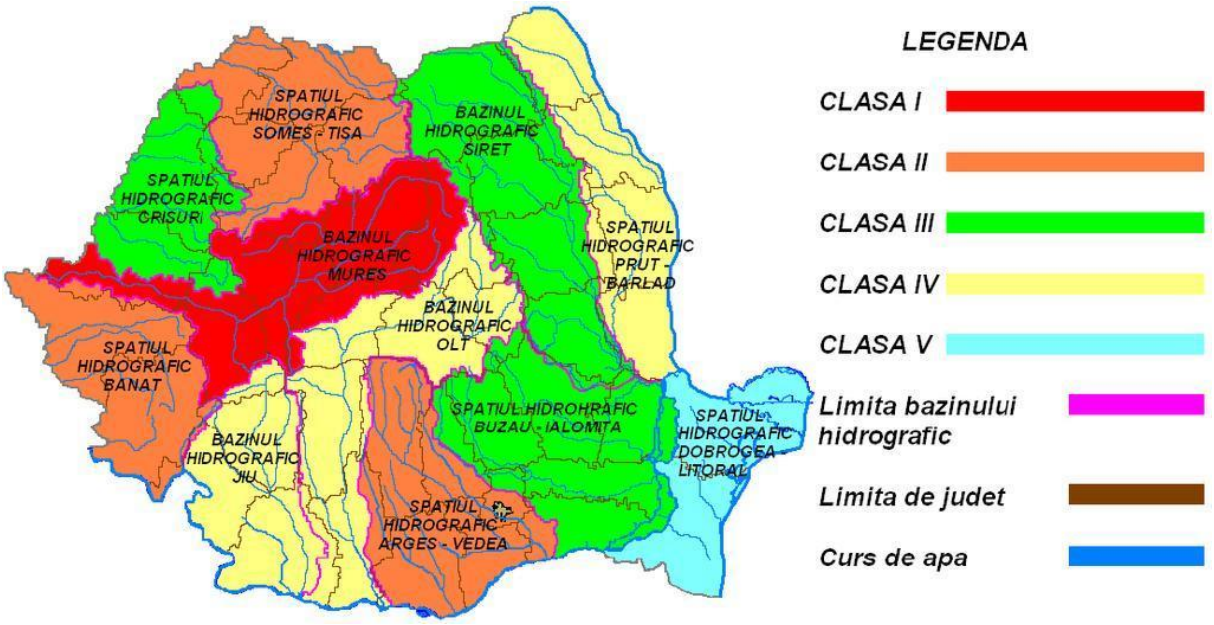
Through their specificity, the Management Plans describe the main categories and surface bodies of water of a total of 3,027 as well as the significant and potentially significant pressures found, hydro-morphological pressures (dams, reservoirs, etc.), and other types of anthropogenic pressures (i.e. aquaculture, sources of accidental pollution).

Within the updated National Management Plan, a total number of 8,880 potentially significant pressures were identified, the largest share of pressures consisting of diffuse pressures from human agglomerations lacking water collection and treatment systems and from agriculture.

Table 4 | Hydrographic Basins areas for which the Management Plans are developed

Management Plans (no)	Water Basin/ Hydrographic area	Total area (km²)	% of the total surface of the country	Total length of the hydrographic network (km)
1.	Banat	18,312.20	7.68	6,705
2.	Jiu	16,758.59	7.03	4,954
3.	Olt	25,387.89	10.65	9.872
4.	Argeş - Vedea	21,543.20	9.04	7,039
5.	Buzău - Ialomiţa	26.470.64	11.11	5,373
6.	Danube, Danube Delta, Dobrogea HA and coastal waters	15,469.65*	6.49	542
7.	Mureş	28,539.58	11.97	10,861
8.	Crişuri	14,939.00	6.27	5,785
9.	Someş - Tisa	22,451.86	9.42	8,423
10.	Siret	27,949.01	11.73	10,280
11.	Prut - Bârlad	20,569.04	8.63	7,679

Figure 7 | Hydrographic basins for which the Management Plans are developed



Legend: Class I, Class II, Class III, Class IV, Class V, River basin boundary, Country boundary, Stream

Source: www.rowater.ro

Referring to the bodies of groundwater, 143 groundwater bodies were found and delimited, out of which 115 are of groundwater type and 28 are deep groundwater bodies. On these waters, the main pressures are the diffuse ones due to human agglomerations without wastewater collection and treatment systems, and those caused by agricultural activities.

Protection zones have been identified as follows: protection zones for drinking water intakes, areas for the protection of economically important aquatic species, protected areas for habitats and species where water is an important element, areas vulnerable to nitrates and sensitive areas to nutrients, as well as

bathing areas.

At the national level, the monitoring network and monitoring programmes for surface and groundwater have been updated, including a number of 194 new monitoring sections for 184 surface bodies of water. As far as the groundwater bodies are concerned, the quantitative monitoring network was extended with 95 boreholes, and for the chemical monitoring, with 115 boreholes.

An important issue for consideration at national level has been the environmental objectives for surface water bodies, groundwater bodies and protected areas, as well as the exceptions to the environmental objectives. The main causes of non-achievement of environmental objectives are related to technical feasibility, followed by disproportionate costs.

Economic and financial policy in the field of water includes two main components: water services, respectively water supply services, sewerage and wastewater treatment and water resources management activities.

An important aspect considered was the link between quantitative characteristics and climate change, which allowed for a better coordination between basin management plans and flood risk management. Thus, the measures resulting from various medium- and long-term plans (e.g. the National Climate Change Action Plan) include in their evaluation climate change issues and the actions required for climate change mitigation and adaptation measures (as specified in the programming measures of the Water Basin / Hydrographic Areas Management Plans). For most of the measures for the development of water supply infrastructure and wastewater collection and treatment infrastructure, the projects design and planning phases took into account the paramount aspects of climate change.

Romania is one of the few countries that has many decades of experience in water resources management using an integrated water basin-level approach. Each of the 11 inland catchment areas has a Water Basin Administration (abbreviated ABA) which is responsible for planning and implementing water resources management and operation of large water plants and facilities.

Water resources management requires an integrated approach of the provisions of the EU Water Framework Directive 2000/60/EC with those of other EU water directives, as well as with other relevant policies and strategies in certain fields, namely Directive 2007/60/EC on the assessment and management of flood risk, Marine Strategy Framework Directive 2008/56/EC, Directive 92/43 / EEC on the conservation of natural habitats and of wild fauna and flora, other legal acts on nature protection, combating drought and climate change, promoting hydropower, regulating navigation, agriculture etc. Another important issue is the integration, and quantitative and qualitative planning of water resources.

The International Commission for the Protection of the Danube River (ICPDR) Climate Change Adaptation Strategy is a landmark document for national strategies and activities in the field of adaptation to climate change and more specifically, it presents appropriate adaptation measures as a component of the River Basin Management Plans and Flood Risk Management Plans nationwide. (Source: http://www.rowater.ro/Documente)

An integrative water resources management system should take into account all the defining components involved in this system, namely:

- water resources;
- water supply systems;
- sewage - wastewater collection and wastewater treatment systems in order to reduce the impact on the environment.

The implementation of a circular economy in water management should take into account all three

components presented above.

At national level, the management of water resources (surface water and groundwater) is provided by the National Water Administration while the public water supply and sewerage service fall within the scope of public utility services.

The public water supply and sewerage service includes water supply, sewerage and wastewater treatment, as well as the collection, sewerage and drainage of rainwater, activities that meet the needs for public utilities and general public interest of local communities.

Therefore, an important issue that it is worth mentioning and follow is the interconnection between the availability of water resources and the management of the supply and evacuation/ treatment of wastewater (integrated technological and functional assemblies/facilities that cover the entire technological circuit, from raw water capture to discharge of treated wastewater into emissaries).

Romania has decided to return to the principle of local autonomy (devolution of powers) by achieving decentralization, thus transferring the main and specific responsibilities to local public governments (Local public administrations have the right to join into associations in order to efficiently develop public services of common / regional interest).

In Romania, 12,853,110 people benefit from drinking water from the public network, i.e. 65.2% of Romania's resident population. In urban areas, 10,040,392 people are connected to the public water supply system, i.e. 94.9% of the urban resident population, while in rural areas only 2,812,718 people benefit from drinking water from the public network, representing 30.8% of the country's rural resident population. (Source: http://insse.ro/cms/sites/default/files/field/publicatii/distributia_apei_si_evacuarea_apelor_uzate_in_anul_2016_1.pdf)

At national scale, a number of 313 municipalities and cities benefit from sewerage services, representing 97.81% of the total urban localities and 871 rural localities, representing 30.44% of the total rural localities) (Source: ARA, State of play report on water supply and sewerage services in 2016).

According to data published by the National Institute of Statistics, the population of Romania connected to sewerage systems represents less than half of the total population of the country, while only about 47% of Romanians have access to wastewater treatment networks.

Official statistics show large gaps between regions of the country in terms of sewerage infrastructure. The lowest percentage - 34.00% - of the population that has access to sewerage services is in the North-East Region (1,108,436 inhabitants). Also, in the South-Muntenia Region, 1,054,004 inhabitants, i.e. 34.8% of the region’s population, live in houses connected to the sewerage system, and in the South-West Oltenia Region, the share is slightly higher i.e. 36.4% (i.e. 726,229 inhabitants).

By the end of 2018, there were a number of 1,927 human settlements larger than 2,000 inhabitants of which 809 were equipped with water collection systems and 807 with treatment plants. There were also 606 human agglomerations smaller than 2,000-population equivalent (PE) equipped with centralized water collection systems and 350 with treatment plants. The total degree of connection to the sewerage of the equivalent inhabitants from the agglomerations larger than 2,000 PE was approx. 63%, and the degree of connection to water treatment plants was 58.4%.

In order to reduce pollution with organic substances from human settlements, basic and additional measures have been established in the Management Plans of River Basins/ Hydrographic Areas, which are currently in various stages of implementation.

2.1.4. Sweden - The County Administrative Board of Östergötland

Sweden is a long-stretched country with a total area of 407 300 km2 with a registered population of 10,3 million inhabitants (Statistics Sweden, 2020). For efficient governmental purposes Sweden have been divided into 21 regions with their own regional governmental authority called the County Administrative Board (CAB). Further the regions are divided into a total of 290 municipalities. The region Östergötland is governed by the County Administrative Board of Östergötland and the region encompasses an area of approximately 10 550 km2, a population of 465 000 residents (Statistics Sweden, 2020).

In Sweden there are over 26,000 lakes and rivers, streams and ponds. That's one-fifth of all water bodies in Europe. (HaV, 2019). This relation is however in constant change due to hydrological events (such as land elevation, erosion or creation of embankments) (SMHI, 2008).

In the district of Östergötland all water types are represented as there are rivers, lakes, groundwater aquifers and coastal waters (brackish water (SMHI, 2008). Collectively coast and shores constitutes 12 778 km in total, where 734 km is mainland coast of the Baltic sea also including 159 km shoreline of the second largest lake, Vättern (Statistics Sweden, 2013). The total count of inland lakes in 2002 were 2 063, with sizes ranging from > 100 to 0,01 km2 (SMHI, 2002).

Table 5 | Waterbody types and number of each category in Östergötland

Waterbodies	
Water type	**Number of the water type**
Coastal waters	45
Watercourses	116
Lakes	235
Groundwater aquifers	174

Next a brief description of the different entities involved in the management of water resources and water is made.

Swedish Agency for Marine and Water Authority (HaV)

The Swedish Agency for Marine and Water Authority has a guiding and regulatory function in the implementation of the WFD in Sweden. The agency oversees the work of county administrative boards through the water authorities appointed in each of the five water districts in Sweden. They also take part in reporting Sweden's progress to the EU. (HaV, 2019).

Geological survey of Sweden (SGU)

For groundwater, the geological survey of Sweden has the right to issue instructions for how water management should be carried out through regulations under the Water Management Ordinance (SGU, 2019).

Figure 8 | Water districts of Sweden (Water Authorities)

Source: (HaV, 2019)

Water Authorities

Implementation of the water framework directive have been assigned to five water authorities, appointed by the government to represent each of the five water districts. These five districts are from south to north; South Baltic sea district, Skagerrak and Kattegat, North Baltic sea, Bothnian Sea and Bothnian Bay district where Östergötland belong to the South Baltic sea district. Five of the 21 county administrative boards have been appointed as the water authority of their district. The responsibility of the authorities is to:

- prepare cases for the water delegation
- coordinate all CAB-offices and municipalities in their district
- collaboration with affected parties (local to international level)
- prepare management plans (RBMP) and programme of measures (PoM) for their district
- decide on EQS
- exchange knowledge and experiences with other European countries on different issues regarding the WFD
- submit information for reporting to European Commission to the Swedish Agency for Marine and Water Authority.

County administrative board

At all county administrative boards, a preparation secretariat can be found which is assigned to assist the water authorities with water management in their region. This includes close collaboration with stakeholders in the region such as municipalities, water management associations, water councils and other local water stakeholders. A preparation secretariat undertakes several tasks regarding water management such as:

- Assessing the status and which type of impact that exist for waterbodies;

- With guidance of the water authorities.
- Develop and perform surveillance of conditions in waterbodies;
- Propose measures, where deemed necessary;
- Support water councils and measurement fulfilment;
- Upload data for possible impacts, current status, possible and performed measures, monitoring programmes and EQS in national database (VISS).

The County Administrative Board of Östergötland belongs to the water district Southern Baltic sea where the head of the district is the County Administrative Board in the Kalmar region.

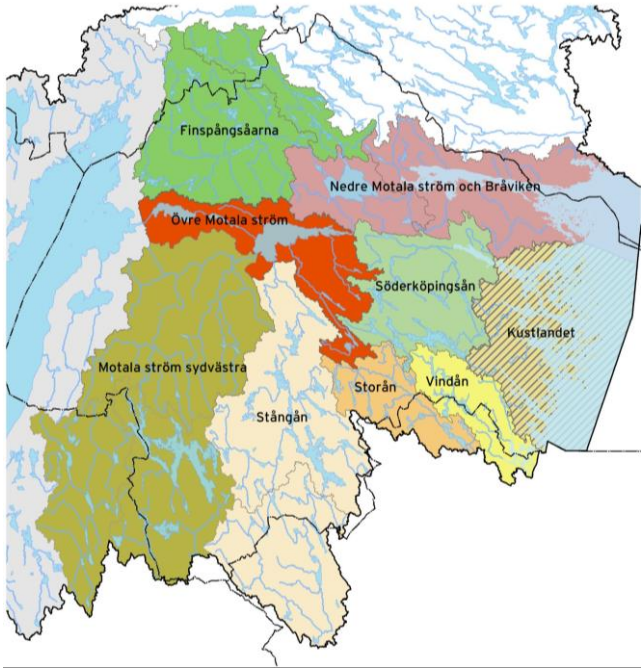
Municipalities

The municipalities have a wide range of responsibilities related to water management such as providing clean drinking water, purification of wastewater and supervision. They are responsible for implementation of several measures in the PoM documents presented by the water authorities. Additionally, the presented EQS are strict meaning municipalities cannot give permission for development of i.e. industries that risk lowering of surface water status (Vattenmyndigheterna, 2020).

Water organisations

Water management is not only performed by official governmental offices but also by organisations such as water councils and water management associations. Water management associations are municipalities, industries, landowners and power producing companies. In Östergötland the Motala Ström water organisation (MSV) is a coordinated recipient control association, its members are various operators who impact the aquatic environment. The association develop control programs to monitor the environment in the catchment area of Motala Ström, CAB is a consultant party in the development of the program.

Figure 9 | Sub catchment Area and Water councils



Source: CAB-Östergötland 2012

For each sub catchment area there are water councils, organizations that gather communities surrounding the catchment area such as municipalities, NGO's, local inhabitants and landowners as well as other interested parties in the area (Table 6). A water council have no decision-making rights but can impel the work with management plans, measures, apply for financial grant for measures or monitoring and serve as a valuable source of local knowledge about the conditions in the sub catchment areas.

Table 6 | Sub catchment Area and Water councils

Water councils	
Catchment area	**Sub catchment area**
Motala Ström	Finspångsåarna
Motala Ström	Övre Motala Ström
Motala Ström	Nedre Motala Ström
Motala Ström	Motala Ström sydvästra (Svartån)
Motala Ström	Stångån
Storån	Storån
Söderköpingsån	Söderköpingsån och Slätbaken
Vindån	Vindån
The coast	Östergötlands skärgård

2.1.5. Portugal - CIM Alto Minho

In the Portuguese case, the current institutional framework for river management and in the broader scope of water, originates in the approval, in December 2005, of the so-called Water Law (Law No.

58/2005 of 29 December). Having established the basic principles that should assist water management in Portugal. It is also with the approval of this law that the Water Framework Directive of the European Parliament and of the Council, of 23 October 2000 (Directive 2000/60 / EC) is transposed, thus ensuring the adoption of the Community action framework concerning the protection of inland surface waters, transitional waters, coastal waters and groundwater. The definition of the Portuguese institutional framework was based on three “pillars”:

- the representativeness of the state;
- the representativeness of the sectors of activity and users of water resources;
- the articulation of the different spatial planning and management instruments.

It is also with the publication of the Water Law that it is established that the hydrographic region is the main unit of water management based on the hydrographic basins existing in the country. This principle still remains today.

The institutions of the Public Administration that were responsible for exercising the powers provided for in the Water Law were:

- at the national level, the Water Institute, which, as national water authority, was the state as guarantor of national policy of water;
- at regional area, the administrations of the hydrographic regions (ARH), which continue water management tasks including the respective planning, licensing and monitoring.

The representation of the sectors of private companies and users of water resources was ensured by the bodies’ advisor:

- the National Water Council (CNA), as the Government's consultative body in matters of water resources;
- the advice the river region (CRH), while bodies advisory administrations of the hydrographic region is for respective watersheds hydrographical integrated therein.

Finally, the articulation of spatial planning instruments with the rules and principles of the water law and the water plans as well as the integration of water policy in transversal environmental policies should be ensured by the Regional Development and Coordination Commissions (CCDR).

Continental Portugal was then divided into eight hydrographic regions, which are still maintained today, under the responsibility of five Hydrographic Region Administrations.

Figure 10 | Intervention area of Portuguese hydrographic regions (INAG)

Source: Wise, Eurostat

In view of the territorial intervention area of the project, the following should be highlighted:

- Hydrographic Region of Minho and Lima (RH1) comprising the hydrographic basins of the rivers Minho and Lima and the riverside of the coast between the respective estuaries and other small adjacent rivers;
- Douro Hydrographic Region (RH 3), which comprises the hydrographic basin of the Douro River and other small adjacent streams.

As mentioned, the national authority in the water domain was the National Water Institute (INAG). Its competences were diverse in order to ensure water management at national level and to guarantee the achievement of the objectives of the water law and to guarantee the international representation of the State in this field. Among its specific competences, the following stand out:

- promote water protection and planning, by drawing up the national water plan, approving specific water management plans and river basin management plans;
- promote the planning of appropriate uses of water through the preparation of development plans of public water reservoirs, the development plans of the estuaries and the development plans of the coastline;
- ensure national monitoring of water, technically coordinating the procedures and methodologies to be followed;
- the coordination between the programs of measures specified in the river basin management plans and the achievement of environmental objectives;
- setting the methodology and ensure the realization of economic analysis of water use, ensure the regular review and ensure its observance in the river basin management plans;

- declare the alert situation in case of drought and initiate, in conjunction with the competent authorities and the main users, the recommended information and action measures;
- promote the efficient use of water through the implementation of a program of preventive measures applicable under normal conditions and imperative measures applicable under drought conditions;
- apply measures to reduce flood flows and create warning systems to safeguard people and goods.

The Administrations of the Hydrographic Regions had the general objective of ensuring, in their respective territorial area, the protection and enhancement of the environmental components of the waters. Among its various competences, the following stand out:

- develop and execute river basin management plans and specific water management plans;
- decide on the issuance and issue the titles for the use of water resources and supervise that use;
- carry out the analysis of the characteristics of the hydrographic region and the impact of human activities on the state of the waters;
- carry out an economic analysis of the uses of water in the respective regions;
- set and apply the measures provided for programs in the river basin management plans, identifying the territorial measures of protection and enhancement of water resources and monitoring their effects;
- elaborate or collaborate in the elaboration, as defined by the national water authority, of the plans for the ordering of public water reservoirs, in the coastal land management plans and in the estuary management plans in the area within its jurisdiction;
- prepare the register of protected areas;
- promote the requalification of water resources and river systematization;
- identify catchment areas for water intended for human consumption.

The ARH could delegate some of its powers, through its governing body, to some entities described in the Law, through the signing of protocols or partnership contracts. Thus, the ARH could delegate:

- in municipalities, powers of licensing and supervision of water use and powers for the elaboration and execution of specific water management plans or measures programs provided for in the Law;
- at the Institute for the Conservation of Nature (ICN), powers to license and supervise the use of water in a classified area under its jurisdiction or powers to prepare and execute specific water plans or measure programs provided for in the Law;
- in user associations and concessionaires for the use of water resources, powers to draw up and carry out specific water plans or to draw up and carry out measures programs provided for by law.

The ARH were subject to the supervision and supervision of the Minister for the Environment, Spatial Planning and Regional Development, with the inherent powers being delegated to the president of INAG.

The Regional Development and Coordination Commissions (CCDR) are, according to decree-law 104/2003, decentralized services of the central administration with administrative and financial

autonomy, charged with implementing measures for the development of the respective regions. CCDRs only exist in the territory of mainland Portugal, with a total of five distributed as follows:

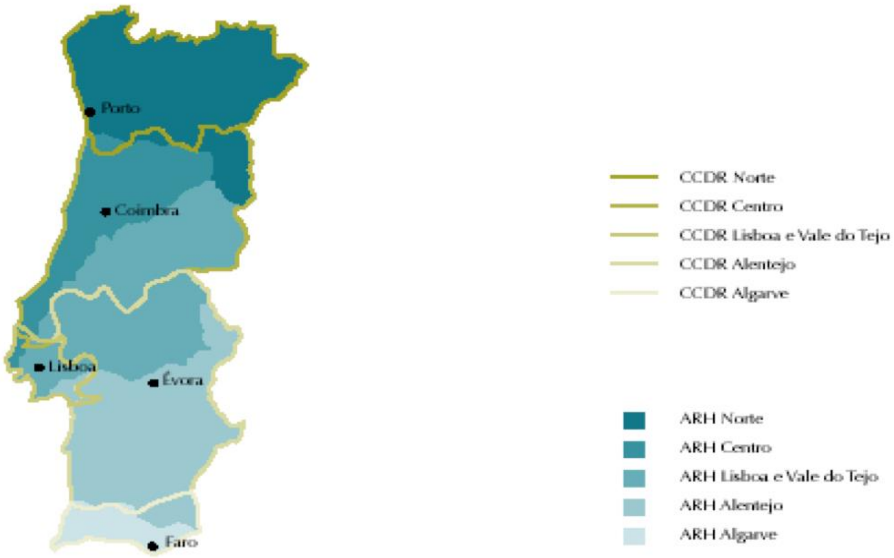
- CCDR Norte - based in Porto;
- CCDR Centro - based in Coimbra;
- CCDR Lisbon and Tagus Valley - based in Lisbon;
- CCDR Alentejo - based in Évora;
- CCDR Algarve - based in Faro.

It is in this context that, within the scope of the Water Law, powers have been attributed in the field of water management, namely:

- the protection and enhancement of the environmental components of waters integrated in the global weighting of such components through territorial management instruments;
- the exercise of the coordinating powers attributed to it by law in the field of integrated pollution prevention and control.

For the performance of these competencies, CCDR wings had the necessary technical collaboration from the territorially equivalent ARH.

Figure 11 | Delimitation of CCDR and HRA in Portugal



Source: WISE, Eurostat

Although they have an advisory role, it is considered of interest to describe, not the competences of the National Water Council and the Councils of the Hydrographic Regions, but also its composition, namely the different type of institutions and bodies represented. Its main functions were to appreciate and monitor the preparation of the National Water Plan, river basin management plans, as well as other plans and projects that may be relevant in the field of water management at national level. Is function is also to formulate or appreciate strategic options in the scope of national water management in a sustainable manner and to propose measures that it considers relevant in the best articulation of the actions resulting from them.

It was up also the CNA contribute to the harmonization of methodological procedures and appreciate the

factors determines the effort in the planning process of the National Plan for Water and the hydrographic basin plans to, in particular relating to international rivers Minho, Lima, Douro, Tagus and Guadiana.

The CNA was chaired by the Minister of the Environment, comprising a general secretary and 30 members. Among the members are represented several general directions (of the environment, Spatial planning and urban development, energy, industry, among others) representatives of the National Association of Municipalities. Portuguese, representatives of non-governmental organizations in the area of the environment and natural resources, representatives of scientific and research entities and also of companies or economic associations related to water uses.

In 2013, and after the creation of the Portuguese Environment Agency (APA), INAG is integrated into the APA and is later extinguished, this national agency assuming its competences as well as those attributed to the Hydrographic Basin Administrations that become its own regional delegations.

Also with the creation of APA occurs some changes at the level of advice emphasizing that Region Councils Hydrographic become advisory bodies of the APA and not of HRD (Ordinance no. 37/2015, of February 17) having the following skills:

- to accompany and participate in the preparation of river basin management plans and specific water management plans, issuing an opinion prior to their approval;
- participate in the preparation of the programs of measures, with a view to their operationalization and future implementation;
- promote and monitor the definition of procedures and the production of information regarding the evaluation of the execution of the programs of measures for water resources, constituting themselves as dynamiting forums for the articulation between the entities promoting these measures;
- to accompany, participate and share programs and results of monitoring and evaluation of the status of water bodies, in order to ensure solid information bases for the planning process that allow decision making based on proven values;
- the planning and water management constitute an important contribution to the sustainable development of the river basin, the environmental, economic and social aspects, based on an optimization model and efficient use of water resources;
- give an opinion on questions concerning the goals and procedures for the efficient use of water resources;
- contribute for issues related to adaptation to climate change are considered and considered in the planning process and decision on water resources;
- promote, within the scope of the entities that compose it, the training and public dissemination of relevant information so that the objectives of the river basin management plans are achieved;
- follow and participate in programs and measures that the APA submit for its consideration;
- issue an opinion when request of the APA, on matters considered relevant to the management of water resources in the context of river basin.

The same document establishes the composition of the CRH, stressing that it must reflect the specificity of each hydrographic region, the transversely of water vis-à-vis the various sectors of the economy and the environment, the essential interaction of Public Administration and civil society in the design and management of water, and the importance of applying technical scientific knowledge and the best available practices. In order to ensure this objective, the composition of CHA should be as follows:

- the president, appointed by the member of the Government responsible for the area of the environment, on a proposal from the APA;
- the secretary, appointed by the president of the APA;
- the members representing the entities of the central Public Administration, the municipalities, the management entities of municipal or multi- municipal water services , the main users related to the consumptive and non-consumptive use of water and the sectors of economic activity and, still , individuals of recognized merit, academic or professional prestige with particular focus on the territorial area of the CRH, under the terms set out in the annex to this ordinance, which is an integral part of it.

The municipalities, in addition to the competences associated with their participation, directly or indirectly, in the National Water Council and in the different river basin councils, they assume an important role in the direct supply of water to the populations and in drainage and water treatment residuals.

Public water supply systems aim to provide an essential public service for the health and well-being of the population, which consists of meeting the needs of communities in terms of water supply.

In Portugal and with regard to the collection, treatment and distribution of water for public consumption, the systems are divided into two types: management systems responsible for “low” water supply (Municipal systems) and management systems responsible for the “high” water supply, usually multi-municipal systems since they serve at least two municipalities or required an investment predominantly made by the State due to reasons of national interest and can be managed through the associations of municipalities.

The “low” water supply systems include the supply components that have to do with the distribution, with the respective connecting branches, including the delivery reservoirs in cases where these are not part of the “high”. The “high” water supply systems therefore carry out a wholesale water distribution activity in relation to the municipalities they serve, assuming the role of retailers. The law allows, when advantageous, multi-municipal systems to supply water at “high” and “low” levels.

The management and operation of water supply systems, whether municipal or multi-municipal, must respect the four basic principles, legally established: principle of the pursuit of public interest, principle of the integrated character of systems, principle of efficiency and the principle of prevalence business management. The systems, whether multi-municipal, intermunicipal or simply municipal, must assume the existence of management entities that ensure, under appropriate conditions, the respective design, construction, operation and management of public water distribution systems for public consumption. In the Portuguese case, the management of water supply systems may take the following forms: municipal systems for water supply in “low” and municipal services, public companies and concessions for multi-municipal water supply systems in “high”.

2.1.6. France - Cluster DREAM

Water resources are significant in France and can describe as follows:

- 480 billion m^3 of precipitation for the French territory each year.
- 270,000 kilometres of permanent rivers and groundwater estimated at 2,000 billion m^3. On the basis of these figures, we can consider that France has considerable water resources.
- there is no risk of shortage, but good resource management is necessary: estimated country needs (32 billion m^3/year) about 17% of available resources. The country has an available water resource of 193 billion m3 per year, while the country's water needs

amount to 32 billion m3 per year. The challenge is to anticipate the shortages and manage the water resources in order to replenish the aquifers when their level becomes too low, using surface water or sanitized wastewater (le centre d'information sur l'eau [2020]).

- France is divided into 12 major river basin, 7 of them are located in the metropolis iand 5 other in ultra-marine areas (Lesage 2013).

Figure 12 | 6 Major river basins

Source: (Bassin hydrographique 2020)

Table 7 | Description of large river basin in France

River Basin	Surface	Total linear of the watercourse
Rhin-Meuse	31 437 km²	30 053 km
Artois-Picardie	19 920 km²	12 265 km
Seine -Normandie	94 881km²	55 083 km
Loire-Bretagne	15 870 km²	135 493 km
Adour-Garonne	118 040 km²	119 966 km
Rhône-Méditerranée-Corse	130 660 km²	152 427 km
Total	551 808 km2	515 785 km

Source: (Pella, Sauquet, Chandesris 2006)

Table 8 | Description of Loire-Bretagne large basin river

Uses	Weight of the basin on the national territory	Stakes on the basin	Developments between the two inventories	Main pressures on the resource
Population and land use	20% of national population	-13 million of inhabitants -70% of agricultural land - 8% of aquatic environments - 4% artificial lands	More 7% of inhabitants between 2006-2015	Increasing pressure on the coastland in large urban areas
Drinking water supply	20% of the turnover	-2100 AEP services -4500 sanitations services -About 1 billion m^3/year	-Increase in the price of water -4,11euros TTC/m^3 in 2014	-
Agriculture	32% of total gross output	-216 000 full time job -111 000 exploitation -580 million of m^3 samples in 2015	Decrease in the number of exploitations and increase in the average of SAU	- Concentration of production - Pollution and pressure on the resource - Share resource
Industry	20% of turnover	-More than 850 000 jobs - 180 million m^3	Increase of activities	Pollution and pressure on the resource
Energy	15% national installed capacity	-28 000 jobs -5 nuclear centre -17 hydraulic power stations Tidal wave -1,5 billion m^3 deduct	Stable production	Physical pressure on the environment
Recreational uses	14% of national tourism	-	Tourism	Physical pressure on the environments
Aggregates	25% of national production	- 18 000 jobs -1000 industry - 336 million of euros	-	-

Source: (Comité de bassin 2019)

The Centre Val de Loire region, fourth region in size, covers 39 151 km². With 2.56 million inhabitants, or 4.1% of the metropolitan population, the region ranks 10th nationally. As on January 1, 2019, the Centre-Val de Loire region had 1 758 municipalities, 80 public establishments for inter-municipal cooperation, 6 departments. The Centre Val de Loire region is crossed from east to west by the Loire River. The Centre-Val de Loire region is largely located within the Loire-Bretagne river basin and a small part is located in the Seine-Normandie river basin (Agence de l'eau Loire-Bretagne 2018a).

Figure 13 | Centre Val de Loire region

Source: Centre Val de Loire

In a brief description of the French legislative framework can be the following:

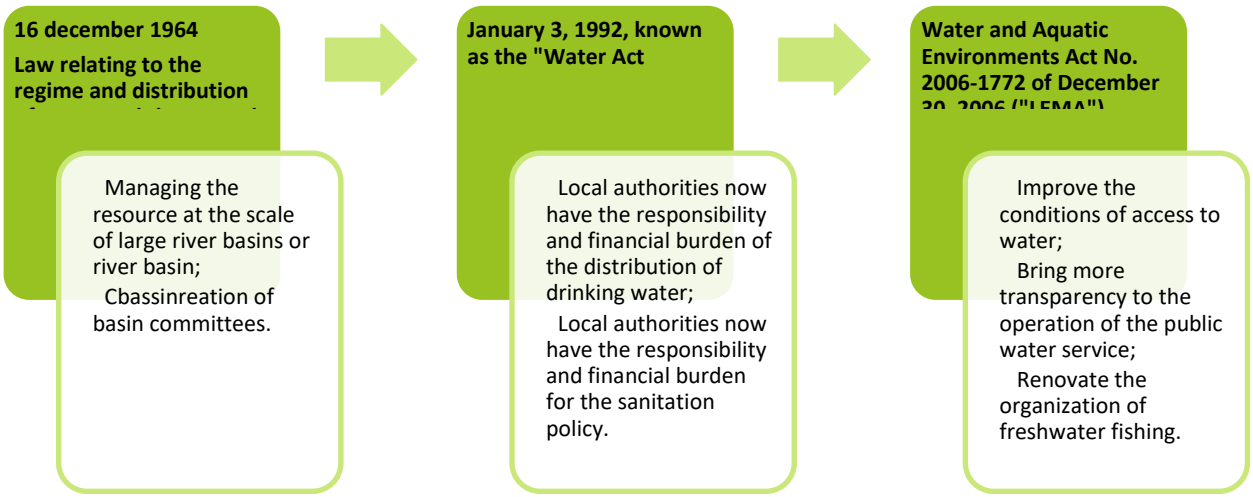
- **Act 64-1245 of 16 December 1964 relating to the regime and distribution of water and the control of its pollution**. In this law lays the foundations for what has become the "French school of water management". Its goal is to manage the resource at the scale of large river basins or river basins with the creation of basin committees, which are like real "water parliaments." This law will inspire the water framework directive. This law implemented an advisory body to the Minister for the Environment called the National Water Committee (CNE) (Lesage 2013);
- **Water Act 92-3 of January 3, 1992, known as the "Water Act": The law says that "water is part of the nation's common heritage".** It provides for the establishment in each basin, of the river basin management plan (RBMP), supplemented in each sub-basin by a plan of water management (RBMP see definition above). Local authorities now have the responsibility and financial burden of the distribution of drinking water and sanitation policy through this law (Lesage 2013);
- **Water and Aquatic Environments Act No. 2006-1772 of December 30, 2006 ("LEMA")** transposes the Water Framework Directive (WFD) to achieve the goals set. The aim of this law is to give itself the means to achieve the objectives of the WFD, improve the conditions of access to water, bring more transparency to the operation of the public water service, and renovate the organization of freshwater fishery. Moreover, this law strengthens the river basin as the area for implementing sustainable water management. It gives more power to organizations of water users and their representatives to water policy definition. At last, it reinforces the water policy funding based on the following aims:

- “water pay water”: the costs of drinking water and sanitation are paid by the users of drinking water;
- “Polluter pays”: the users of water and aquatic environments participate financially in actions to preserve and improve the state of aquatic environments, in particular through taxes.

This law created new tools against water and wetland habitats pollution with, for instance, only one” “water police” and strengthens the role of local authorities in the management of water public services and sanitation (Noêl 2009).

Through this law, a decision has been taken on substances classified as "dangerous priority" with the aim of eliminating substances classified as "dangerous priority" by 2020. An initial list of 33 substances was adopted including metals, pesticides and hydrocarbons (Noêl 2009).

Figure 14 | The French legislative scheme



Source: (Bassin hydrographique 2020)

Two other major national texts deserves to be mention:

- Law n ° 2016-1087 of August 8, 2016 for the recovery of biodiversity, nature, and landscapes. This law aims to protect, restore, and enhance biodiversity and the French natural heritage by avoiding, reducing, or compensating for the negative effects of human activities on the environment. This law created the French Agency for Biodiversity.
- Law No. 2017-1838 of December 30, 2017 relating to the exercise of the jurisdiction of local authorities in the field of aquatic environment management and flood prevention establishes the jurisdiction of aquatic environment management and flood prevention.

The water management is based on six key principles:

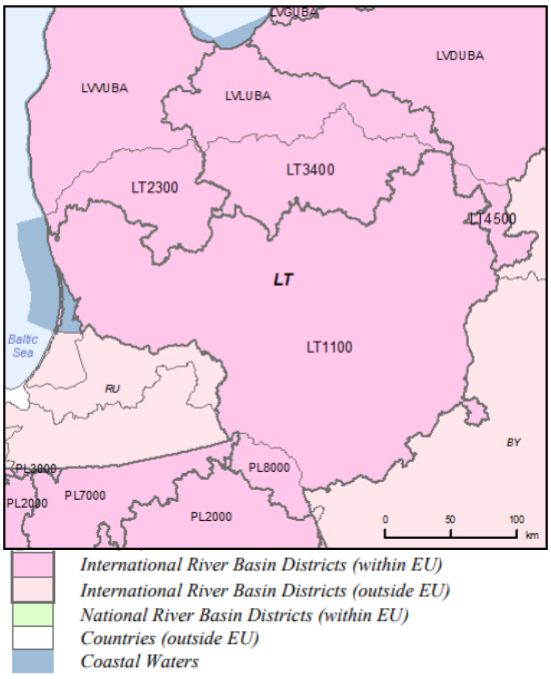
- decentralised management at the river basin level: The French water policy is defined and coordinated at the national level, but it is decentralised at the level of large river basin. It takes into account the geographical reality of resources because "water does not know administrative boundaries"(Noêl 2009);
- an integrated approach: This integrated approach takes into account all water uses, the needs of aquatic ecosystems, pollution prevention and control of natural and accidental hazards (Noêl 2009).

- the organization of consultation and coordination of actions: this is the role of the Basin Committees and the Prefects of Basin Coordinators (Noêl 2009).
- the mobilization of specific financial resources: "water pays for water" in accordance with the polluter-pay and user-pays principle. It is the vocation of the Water Agencies to collect specific royalties (Noêl 2009).
- multi-year planning and programming: planning that defines the objectives and priorities of action in the River Basin Management Plans (RBMP) across river basins and a plan of water management (local RBMP) at the sub-watershed level (Noêl 2009).

2.1.7. Lithuania - Kaunas University of Technology (KTU)

Lithuania's area equals 65 000 km². The population of Lithuania was 2.8 million as of the beginning of 2020. Lithuania has 758 rivers, more than 2 800 lakes and 99 km of the Baltic Sea coastline, which are mostly devoted to recreation and nature preservation. Forests cover just over 30% of the country. All four RBDs in Lithuania are international, shared with Latvia, Poland, Belarus and the Russia (EC, 2012).

Figure 15 | Map of River Basin District of Lithuania



Source: WISE, Eurostat (country borders)

Table 9 | River Basin Districts

LITHUANIA'S RIVER BASIN DISTRICTS			
RBD	**Name**	**Size (km2)**	**Countries sharing RBD**
LT1100	Nemunas	48385 (including coastal and transnational waters)	BY, LV, PL (relatively small part), RU
LT3400	Lielupė	8948	LV
LT2300	Venta	6276	LV
LT4500	Dauguva	1875	BY, LV

Source: River Basin Management Plans reported to WISE2 (http://cdr.eionet.europa.eu/lt/eu/wfdart13)

Table 10 \ Transboundary River Basins by category and share in Lithuania

TRANSBOUNDARY RIVER BASINS BY CATEGORY AND % SHARE IN LITHUANIA				
Name international river basin	National RBD	Countries sharing RBD	Co-ordination category	
			3	
			km²	%
Daugava/Sapadnaja Dwina	LT4500	BY, LV	1682	2.2
Lielupe	LT3400	LV	8951	50.3
Nemunas/Nieman/Neman/Nyoman	LT1100	BY, LV, PL, RU	50048	51.1
Pregolya	LT1100	PL	83	0.6
Venta	LT2300	LV	5185	44.3

Category 1: Co-operation agreement, co-operation body, RBMP in place. Category 2: Co-operation agreement, co-operation body in place. Category 3: Co-operation agreement in place. Category 4: No co-operation formalised.

Source: EC Comparative study of pressures and measures in the major river basin management plans in the EU.

The Environmental Protection Agency (EPA), under the Ministry of Environment, has overall responsibility for the administration of all the four RBDs. The EPA is responsible for:

- delineation of RBDs;
- delineation of water bodies (including heavily modified and artificial water bodies);
- collection of information for the Register of Protected Areas and management of the Register;
- assessment of human pressures on lakes and rivers;
- assessment of the status, establishment of a system for the classification and definition of objectives for surface water bodies;
- monitoring of surface waters (the EPA is responsible for the preparation of a monitoring programme, co-ordination of monitoring and complex chemical analysis);
- public consultation and reporting to the European Commission. Responsibilities for the implementation of the water policy are shared between the Ministry of Environment (MoE) and institutions subordinated to the MoE.

The main responsibilities of the institutions are outlined below:

- the Ministry of Environment is responsible for organising economic analysis, economic assessment of proposed measures and development of measures related to cost recovery for water services. The MoE coordinates the activities of subordinated institutions to ensure the implementation of river basin management. The MoE is also responsible for drafting and coordinating international agreements in the field of management of international river basin districts;
- the Lithuanian Geological Survey (LGS) has overall responsibility for the implementation of WFD tasks related to groundwater. The LGS is responsible for monitoring, characterisation, pressure analysis, classification of the status of groundwater bodies, delineation of water bodies at risk of not reaching good status, and establishing

objectives for groundwater bodies;

- the State Service for Protected Areas (SSPA) is responsible for the collection of data on protected areas (including areas designated for protection of birds and habitats), assessment of the status of protected areas, development of measures in protected areas and submission of the abovementioned information to the EPA;
- the Lithuanian Hydro meteorological Service (LHS) is responsible for hydrological monitoring of rivers and lakes, assessment of the quantitative status and human pressure on surface water bodies, development of proposals for objectives of water bodies and delineation of water bodies at risk with regard to the quantitative status. 6. The Regional Environmental Protection Departments (REPDs) are responsible for the collection of monitoring data for surface waters, issue of permits and control of water abstractions and wastewater discharges (including priority substances), collection of information for RBD analysis at local level, identification of problems and enforcement of RBMPs and PoMs.

Other state institutions have the responsibility to provide information needed for the development of RBMPs and PoMs.

Figure 16 | Major institutions involved in the implementation of the Water Framework Directive

Authorities, responsible for preparation and implementation of RBMPs in Lithuania

	Authority	Control through permitting	Preparation of the RBMPs	Implementation of the RBMPs. Measures for: monitoring of surface waters	monitoring of groundwater	point pollution control	agriculture	hydromorphology	coastal waters	public awareness raising
Ministry of Environment	Environmental Protection Agency	●	●	●		●	●	●	●	●
	Geological Survey	●	●		●					
Regional Environmental Protection Departments		●		●						
Municipalities		●				●			●	
Ministry of Agriculture / its Fisheries Department							●	●		●
Ministry of Energy								●		
Ministry of Transport and Communications									●	
Economic entities					●					

RBDs' Coordination Councils. Stakeholders, experts, NGOs

● This flowchart connector means that the relevant institution is responsible for implementation of indicated functions/measures, approved in the four RBD Management Plans in Lithuania.

Source: RBMP

2.2 Plans and policies

2.2.1. Spain - Iberian Association of Riverside Municipalities of Duero River

The main instruments in the field are the water law, the national hydrological and basins plans being that the last ones have a preponderant role in the management of waters resources. Other types of instruments complementary must be referenced:

- coordination of the basins plans with the sectoral;

- water resources information systems;
- hydraulic infrastructures plan, maintenance, inspection and security control;
- promotion quality throughout the water cycle;
- evaluation of agrarian, urban, industrial and energy exploitation projects that substantially affect hydrological planning or the uses of the Water.

The ministerial order for hydrological planning is an intra-ministerial regulation tool that defines precisely the procedures for the planning process and other substantial obligations such as the conditions for granting exceptions and the monitoring and classification of the ecological and chemical status of surface waters. However, only applies to rivers that flow through different regions and not to rivers that are completely within the territory of one region. This is due to the distribution of competences between central state and regions established by the Spanish constitution where catchments shared by more than one region are the exclusive competence of the State, and intracommunity catchments are the exclusive competence of the regions. National laws and decrees are considered (in full or in part) as basic rules that apply across the country, but ministerial orders do not bind regions. Additional legislation at regional level is therefore needed to ensure that Spanish legislation fully complies with the directive. Nevertheless, the hydrological planning has been used as a "guidance document" in the development of intra-community river basins planes. Further guidance documents have been developed and are either available as draft or final versions, both at National or Regional levels.

Since Spain transposed the Community water directive, the work carried out has been to ensure that those instruments and the definition of national policies respect the principles of the directive.

2.2.2. *Greece - Regional Development Fund on Behalf of the Region of Attica*

The 2000/60/EC Directive for the establishment of a framework for Community action in the field of water policy or Water Framework Directive, after a long period of discussion and negotiation between the Member States of the European Union came into force on 22 December 2000.

It is a comprehensive and innovative effort to protect and manage water resources and it constitutes the basic institutional tool introduced in the water sector in the European Union, reflecting the trend towards integrated environmental planning and sustainable management for long-term protection of waters (surface and groundwater) and ecosystems.

To achieve this goal, River Basin Management Plans have to be established, the content of which is described in Article 13 and Annex VII of 2000/60/EC Directive. Each River Basin Management Plan is a strategic document for the River Basin District to which it refers to and provides the necessary information and instructions for the integrated management of water and ecosystems.

The legislative and institutional framework of the country has been harmonized with 2000/60/EC Directive with various legislative provisions (Law 3199/9-12-2003 and its amendments, Presidential Decree 51/2007, Joint Ministerial Decision 39626/2208/E130, Decision 706/2010 of the National Water Committee, Ministerial Decision 51354/2641/E103/2010, Joint Ministerial Decision 140384/2011, Ministerial Decision 1811 of the Minister of Environment, Energy and Climate Change etc.).

For each River Basin Management Plan an environmental report should be carried out. The environmental report determines whether the Plan and the suggested measures are likely to have a significant environmental effect. The environmental report is called Strategic Environmental Impact Assessment (SEIA) and is applied under the SEA Directive (2001/42/EC). The SEIA results can be summarized as follows:

- the implementation of the RBMP as well as the suggested Program of Measures show

optimum performance and promote the environmental objectives concerning water, while at the same time have strong relationship with the environmental objectives related to biodiversity, ground and public health.

- the suggested measures have positive effect in the water environment as well as in other environmental aspects, such as ground and biodiversity. On the other hand, the zero option will have a negative impact in the water environment.
- the expected negative effects derive from the construction of infrastructure and are considered to be reversible to a great extent, through the implementation of appropriate environmental restrictions (arise from specific Environmental Impact Assessments).
- the alternative additional measures don't seem to change the environmental performance of the Plan and therefore are not suggested to be adopted.

In the framework of the River Basin Management Plan, a dedicated Drought and Water Scarcity Management Plan (DWSMP) has been developed, based on the principles of proactive management and planning. The main purpose of the DWSMP was to quantify the drought and water scarcity phenomena in the River Basin District, to assess possible methodologies for the prediction of future events, and to propose adequate response measures for the various risk levels.

All data developed and used for the first cycle implementation of the WFD was available and used for Flood Risk Assessment (FRA) and for Flood Mapping elaboration. Also, more detailed information derived from the FRA and from the FD-flood mapping on water bodies' hydro morphological alterations and on environmental pressures due to flooding used in the second cycle of the WFD (for a better analysis of hydro morphological pressures and for the elaboration of Plan of Measures - PoMs). The information and programme of measures contained in each future management plan (WFD or FD), will consider all the information and measures produced in previous cycles.

Climate change has not been taken into consideration in any of the RBMPs, PoMs or DMPs, (no specific chapter or discussion), e.g. regarding expected changes in water availability. The only exceptions to this are some RBD, in the DMP of which a two-page chapter is dedicated to the issue of climate change. It summarises two studies dealing with the “Effects of climate change on rainfall, temperature and evaporation”, which develops different relevant scenarios, and another on the “Effects of climate change on agriculture and irrigation”, which describes changes in irrigation needs and proposes some measures for increasing irrigation water productivity in order to reduce irrigation water needs and to conserve water. The information and program of measures from the WFDs are used in the Regional Plans for Adaptation to Climate Change that are currently in progress.

2.2.3. Romania - The National Union of Romanian Entrepreneurs

In accordance with Art. 2 (38) of Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (hereinafter referred to as the Water Directive), services relating to the use of water covers, in the case of individual households, public institutions or any economic activity, the following:

- capture, damming, storage, treatment and distribution of surface water or groundwater;
- wastewater collection and treatment facilities to be discharged into surface waters.

Strategic planning, defined as a systematic way of anticipating and responding to the challenges created by change, is the normal approach in terms of improving the administrative, institutional, economic and social framework in which Romania's water resources management is carried out.

At national level, WFD was transposed into national legislation by the Water Law no 107/1996 with subsequent amendments and completions. According to the Water Law, the Master Plan for Planning and

Management is the main tool for planning, development and management of water resources at the level of the river basin district and consists of the River Basin Arrangement Plan (PABH) – i.e. component of quantitative management and the River Basin Management Plan (PMBH) – i.e. component of qualitative management.

From a legal perspective, the Order of the Minister of Environment and Water Management no 1,258/2006 approved the Methodology and the Technical Instructions for the elaboration of the Master Plans for the Arrangement and Management of the River Basins.

Directive 2007/60/EC on the assessment and management of flood risks is the second basic pillar of EU water legislation and aims to mitigate the risks and negative consequences of floods across the EU Member States.

The implementing tool of the Flood Directive, regulated by Article 7, is the Flood Risk Management Plan and is one of the components of quantitative management of water resources. Flood Risk Management Plans will be developed and approved as separate documents, and correlations will be made between the three types of plans (PMBH, PABH, PMRI) at the level of the River Basin Management Plan, respectively the Arrangement and Management Master Plan.

The main specific objectives considered for the purpose of an integrative management of water resources are:

- implementation of the River Basin Management Plan, as a component of the Danube River Basin in accordance with the provisions of the EU's Water Framework Directive;
- development of the Flood Risk Management Strategy, of the related plans and programmes necessary for the implementation of the strategy, implementation of the measures deriving from the above, and strategy's implementation in accordance with the provisions of the European legislation in the matter;
- an important issue for mitigating the negative impacts of natural phenomena on life was the Development of the Master Plans for the Arrangement of River Basins for water uses.
- elaboration and implementation of the Plan for protection and rehabilitation of the Romanian Black Sea coast against erosion and promotion of an integrated management of the coastal area" (Source: www.rowater.ro)

From the point of view of water resources protection, under the "Romania's National Strategy on Climate Change (2013-2020)", the following adaptation actions were established for the water chapter at national, regional and local level, concerning the following:

- development of integrated programmes in order to reduce the alteration and anthropogenic influence on the geomorphology of river basins, conservation of the natural water flow regime and conservation of biodiversity, conservation and restoration of natural areas on sectors at risk of floods;
- measures to increase the capacity for multi-annual flow regulation;
- fostering investments in river basin infrastructure;
- supporting action to increase the efficiency of water use in the agricultural sector and technological measures to adapt crops to become more drought-resistant and water-resistant;
- resizing the sewers in urban agglomerations;
- cutting the losses in water distribution networks (from 50% currently to 20% by 2025);

- re-evaluation of water resources at the level of river basins and sub-basins amid climate change conditions;
- planning actions at local and regional level in order to cope with periods of heat waves (Source: www.rowater.ro)

The public water supply and sewerage service is part of the public services scope, being subject to the following normative acts:

- Law no 51/2006 on the public utilities and community services
- Law no 241/2016 of the water supply and sewerage service (hereinafter referred to as the Law on water supply and sewerage service) published in the Official Journal of Romania, no 563 of 29.06.2006, republished in the Official Journal of Romania, no 85 of 08.02.2013, with subsequent amendments and completions.

According to the law of the water supply and sewerage service no 241/2006 as subsequently amended and completed by the Law no 215/2018 on the establishment, organizing, coordinating, managing, monitoring and controlling the regulated supply/ provision of water supply and sewerage service at the level of communes, cities, municipalities, counties, as well as on the related administration, operation and functioning of public water supply systems water and sewerage are the exclusive competences of the local public administration authorities.

In order to fulfil the obligations assumed by the Accession Treaty to EU and to comply with requirements for human agglomerations larger than 2,000 PE, and considering the fact that the Implementation Plan of Directive 91/271/EEC concerning urban waste-water treatment, developed in 2004, no longer reflects the current state of play, the Romanian authorities are implementing a national project to update and speed-up compliance, which will provide the compliance for human agglomerations with more than 2,000 PE, especially in terms of compliance measures, financing thereof, and the conformation time frame. Thus, the Ministry of Environment, Waters and Forests, as project leader, and the National Administration of Romanian Waters, as partner, implement a project funded by the Administrative Capacity Operational Programme 2014-2020, on “Improving the capacity of the central public authority in the field of water management in terms of planning, implementation and reporting of European water requirements” (Source: http://www.rowater.ro/Proiect%20SIPOCA%20588/Pagină%20de%20pornire.aspx).

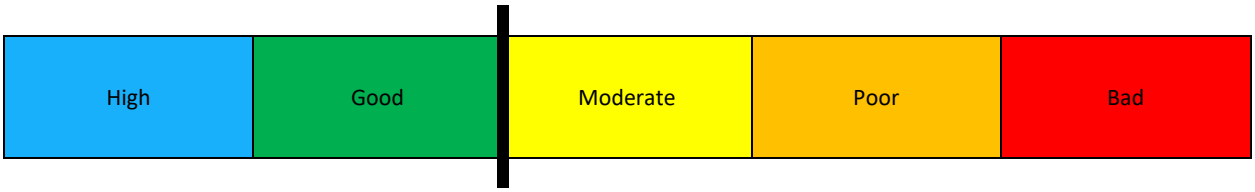
Law no 107/1996 i.e. the Water Law transposes into national law the Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy and the Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.

The Emergency Ordinance no 195/2005 on environmental protection published in the Official Journal of Romania, no 1196 of 30.12.2005 was approved by Law no 265/2006, with subsequent amendments and completions.

2.2.4. Sweden - The County Administrative Board of Östergötland

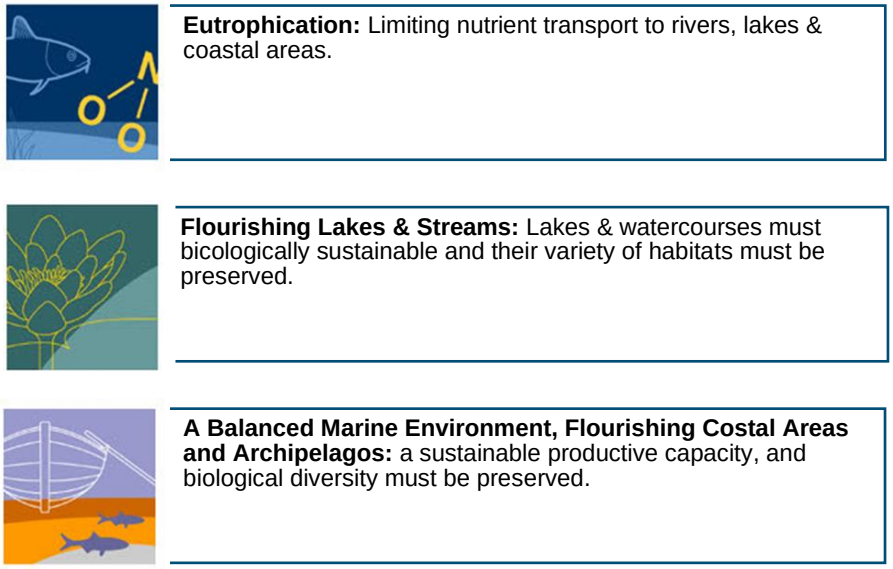
In the environmental context the overall status of lakes and rivers in Östergötland is that only 10% of rivers and lakes reach the goal of good status or better (high status). Main reasons for the less than good status was eutrophication, toxic substances and physical impacts (hydro morphological activities). Eutrophication is a problem in 1 of 10 rivers and 1 of 3 lakes and the entire coastal area of the region.

Figure 17 | Status of water body's



The sixteen environmental objectives of Sweden include 5 objectives related to water quality, supply and biodiversity. At a regional level CAB is responsible for development of the national objectives and adaptation to the specific conditions of the region. Three of these objectives were selected for targeting in BIGDATA4RIVERS as their targets have not been reached and new approaches are needed that presented in the next figure.

Figure 18 | Regional objectives related to water bodies



Source: Figure adapted by Sara Lönnerud CAB Östergötland 2020 from https://www.sverigesmiljomal.se/miljomalen

There are also interesting connections between the environmental objectives and the environmental quality standards; if Sweden does not reach EQS for water bodies we cannot reach the environmental objectives and vice versa.

The river basin management plan of each water district is decided by the water authorities with the object to describe how to manage the problems in the aquatic environments. A management plan is divided in five parts. The first part is a short introduction of networks and cooperation levels, there is also a brief summary of the programme of measures. In the second part the results of the analysis work is presented as well as preparation of EQS and cooperation during the previous cycle. How the monitoring has been performed and which data the status of water bodies has been based on is presented in part three while the programme of measures is presented in part four where authorities are designated as responsible for certain measures. In part five focus lies in which challenges and special issues to consider during the next cycle.

Figure 19 | Disposition of the RBMP of Southern Baltic Sea water district for the period 2016-2021

In the latest PoM for the period 2016-2021, CAB had been appointed as responsible for achieving twelve of the measures in the RBMP for the South Bothnian Bay water district. While other authorities such as national agencies and municipalities are appointed responsible for other measures (Water Authorities, 2016). In the program the measures designated to CAB were:

- the County Administrative Board shall expand and prioritize their monitoring of environmentally hazardous activities and water activities in accordance with chapter 9 and 11 of the environmental code. Supervision should consider catchment area and focus on activities that contribute to EQS not being complied with or risk not being complied with;
- CAB shall perform inspections to identify opportunities and needs to set requirements for hydropower plants and dams to fulfil environmental considerations so that compliance of EQS are reached;
- through inspections or guidance, CAB shall ensure that operators that affect the aquatic environment (by operation or measures in the environment) perform self-monitoring and have necessary control programmes to enable assessment of the impact in status of water bodies;
- prioritise the work with long term protection of drinking water;
    - strengthen the work with protected areas and shorten the time to establish new water conservation areas
    - perform inspections of water conservation areas
    - advice municipalities in how to establish and inspect water conservation areas
    - develop plans for water supply management
    - control of permits for water extraction through supervision
- the County Administrative Board shall have action plans for each catchment area which should be updated annually for implementation and follow-up purposes. Focus of these

action plans must be to ensure that environmental quality standards are complied with and focus on water bodies where measures are needed;

- in collaboration with the Swedish Board of Agriculture the County Administrative Board shall prioritize and develop advisory activities to prevent loss of both nutrients and plant protection products to waterbodies where risk of not complying with EQS is impending;
- the County Administrative Board shall develop their supervisory guidance to ensure municipalities can set requirements necessary to reduce loss of both nutrients and plant protection products to waterbodies where risk of not complying with EQS is impending. This measure is to be implemented in collaboration with the Swedish Board of Agriculture;
- the County Administrative Board shall develop their guidance of municipalities in matter of supervising and revision of individual sewers;
- to ensure that EQS in water are followed in general- and detailed planning in exploitation the County Administrative Board shall guide municipalities. Especially focusing on:
    - that the detailed plan describes how the EQS for water are fulfilled;
    - Prioritizing of measures in municipal level;
    - That information from Water Information Systems of Sweden (VISS) has been considered;
- continue prioritizing grant applications for supervision of contaminated areas that are affecting water bodies where enhancing or preventive measures are needed to comply with EQS;
- the County Administrative Board shall ensure that limestone treatment of acidified lakes and rivers continues as stated in the national guidelines and plans. If necessary, also relocate or broaden selected areas for limestone treatment;
- within the scope of their supervising function, CAB shall control and follow up that the Swedish Transport Administration perform necessary measures in the public road and railway network necessary to comply with the EQS.

The Key strengths that should be stressed are:

- the river basin management plans are updated in intervals of six years as the knowledge about what affects our water bodies are in constant change. There are new environmental issues discovered requiring new approaches which can be met by adaptation and revision of the RBMP in set intervals;
- before issuing the RBMP there are consultations with national agencies, municipalities, water agencies and other affected parties in the basin district. There are open meetings where the public can participate, which facilitates the inclusion of all parties concerned with the status of water bodies in their region. This is a strength as all levels of stakeholders can get involved in the management of water quality in their region.
- The program of measures under the RBMP ensures the distribution of responsibility and provides a limitation of time for implementation, within three years, of the acceptance of the program. It is also clearly stating that authorities are responsible for compliance with the EQS.

Regarding the key weaknesses the points to stress out are:

- in Sweden the great amount of water bodies poses a challenge as status classification, monitoring and establishing EQS as well as the need of measures needs to be assessed

and then performed for each waterbody require a great administrative effort;

- the organization of water management in Sweden has been criticized for its structure, where actors in the field find it difficult to understand. This confusion seems to be based in that there are difficulties in distinguishing which authority is responsible for the different tasks and what the difference is between the authorities. Absence and delays in delivering national guidance documents for the county administrative boards in status assessments has caused issues in the work with the river basin management;
- in terms of resources for performing the tasks in water management such as the river basin management plan and program of measures there can be mismatches. The funding for water management within the water authorities and the county administrative boards has not increased since 2012. In performing measures, a great responsibility lies in the county administrative boards and municipalities to apply for national grants to fund measures. Discrepancies are also present in the funding for monitoring, resulting in difficulties in classification of status as there simply were no data to draw conclusions from.

2.2.5. Portugal - CIM Alto Minho

As previously mentioned, the actual Water Law (Law No. 58/2005 of 29 December) determines the basic principles for the water management in Portugal from which different plans and policies and river management are established being the river basin is one of the examples.

As determined by the water law, the National Water Plan established in Portugal. Is a national policy instrument that aims to be comprehensive but pragmatic, framing the policies of national water resources management, endowed with a strategic vision of water resources management and based on a logic of resource protection and sustainability of national socio-economic development?

In Portugal the hydrographic region is the base unit in the management of rivers and waters. Thus, the other significant instrument in this area is the river basin management plan. The river basin region consists of one or more river basins and their coastal waters. The competence for the preparation of river basin management plans, as water planning instruments aimed at the management, protection and environmental, social and economic enhancement of waters at the level of river basins integrated in a hydrographic region, is committed to the Portuguese Environment Agency.

In general terms, the objectives that river basin management plans should ensure can be divided into three areas: surface water, groundwater and protected areas. The main objectives in relation to surface waters are:

- prevent deterioration of the state of the water bodies;
- protect, improve and recover all bodies of water in order to achieve good water status – good chemical status and good ecological status;
- protect and improve all heavily modified and artificial water bodies in order to achieve good ecological potential and good chemical status;
- gradually reduce pollution from priority substances and eliminate emissions, discharges and losses of priority hazardous substances.

In relation to the groundwater de general objectives to assure are:

- avoid or limit the discharge of pollutants into the bodies of water and prevent deterioration of the condition of all bodies of water;

- maintain and achieve good water condition - good chemical and quantitative state ensuring the balance between captures and recharges;
- reverse any significant persistent trend to increase the concentration of pollutants.

In relation to the protected areas de general objectives that have been defined was to comply with the standards and objectives set out in the Water Framework Directive except where the legislation setting up the protected areas provides for other conditions.

Under the WFD and the Water Act, water management planning is structured in 6-year cycles. This way the work that is currently underway is related to the preparation of the River basin Management Plans for the third cycle.

Territorially, the intervention region of the Intermunicipal Community of Alto Minho corresponds to the hydrographic region of Minho - Lima (RH1). Is an international hydrographic region with a total area in Portuguese territory of 2,464 km^2. It integrates the river basins of the Minho and Lima rivers and the coastal streams, including their groundwater and adjacent coastal waters.

This hydrographic region comprises 15 municipalities, of which 10 are fully encompassed in this hydrographic region and 5 are only partially covered. The municipalities fully covered are: Arcos de Valdevez, Caminha, Melgaço, Monção, Paredes de Coura, Ponte de Lima, Ponte da Barca, Valença, Viana do Castelo and Vila Nova de Cerveira. The municipalities partially covered are Barcelos, Esposende, Terras de Bouro, Vila Verde and Montalegre.

The Minho River rises in Spain, in the Meira mountain range, at an altitude of 700 m and flows into Portugal in the Atlantic Ocean, in front of Caminha and La Guardiã, after a course of 300 km, of which 230 km are located in Spain serving the remaining 70 km, border between the two countries.

The limits of the basin are: to the south the Lima river basin and the streams of the Atlantic coast, to the southeast the Douro basin and to the north the watersheds of the northern coast of Spain. The Portuguese part of the Minho river basin is located in the extreme northwest of Portugal. The basin covers a total area of 9 091,45 km^2 of which 8 276.09 km^2 (91,03%) are located in Spain and 814,45 km^2 (8,96%) in Portugal.

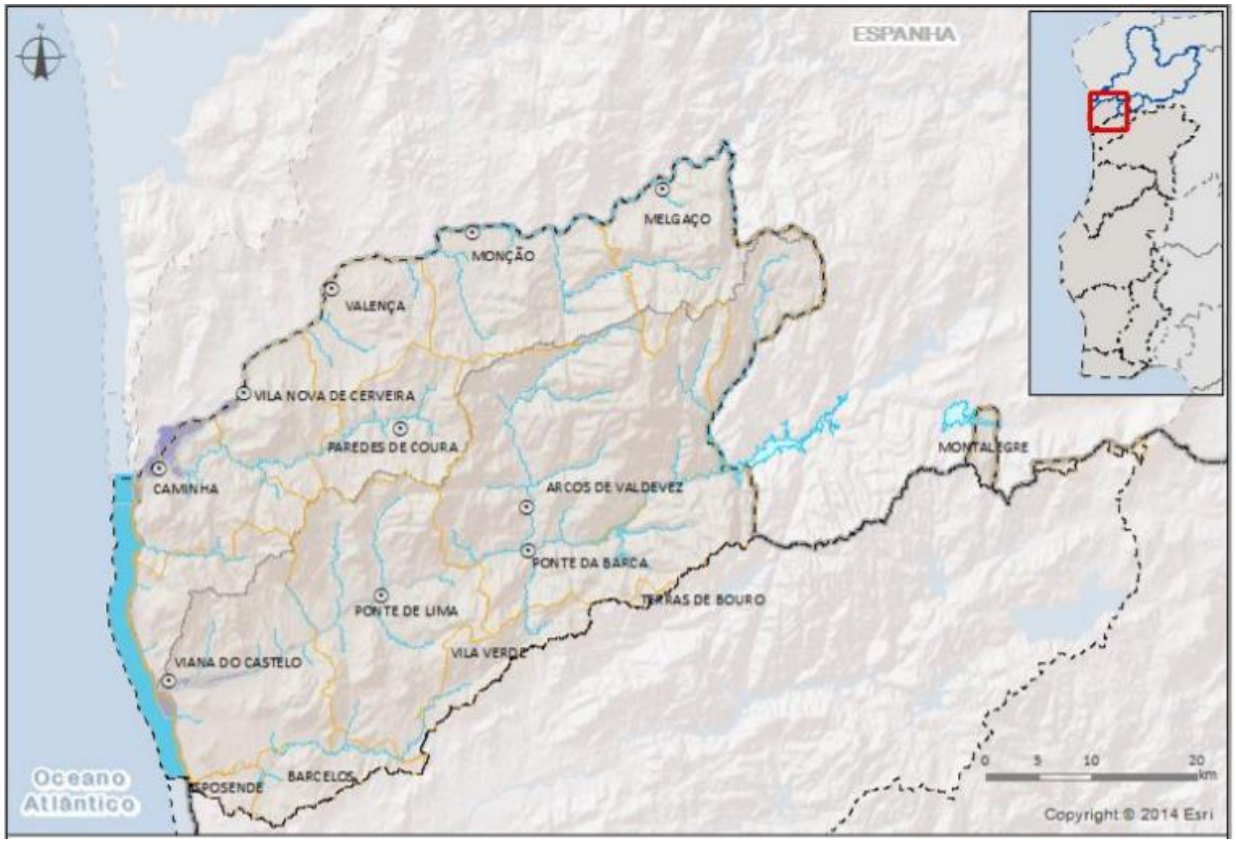
The main tributaries of the Minho River are, from upstream to downstream rivers: Trancoso (26 km2), Mouro (141 km2), Gadanha (82 km^2) and Coura (268 km^2).

The Lima River rises in Spain, in the Sierra de S. Mamede, at about 950 meters of altitude. It has about 108 km long, of which 67 km in Portuguese territory and flows into Viana do Castelo, in the Ocean. Its basin is limited to the north by the Minho river basin, to the east by the Douro River and to the south by the of the Cávado and Neiva rivers. The main tributaries are the Vez and Castro Laboreiro rivers. The Lima River watershed occupies an area of about 2,521.70 km^2 of which 1,199.10 km2 (47,55%) are located in Portuguese territory and 1,322.08 km^2 (52,43%) in Spain

The Minho and Lima river basin region is shared with Spain, with the territorial scope of the corresponding to the Spanish side set out in Royal Decree 125/2007 of 2 February, rectified by Royal Decree 266/2008 of 22 February. In the case Portuguese this basin was recently defined through the publication of Decree-Law Nº. 347/2007 of October 19, amended by Decree-Law Nº. 117/2015 of 23 October 2015 June.

In the net figure shows the geographical delimitation of hydrographic region of Minho – Lima is showed.

Figure 20 | Delimitation of hydrographic region of Minho – Lima



Source: APA

Other type of instruments is the Specific Water Management Plans. Complementary to the hydrographic region management plans they can be of territorial scope, covering a sub-basin or a specific geographical area. They can also as objective a sectorial scope, covering a problem, type of water, specific aspect or sector of economic activity with significant interaction with the waters.

On the other hand, the management of rivers and waters in addition to the National Water Program and Hydrographic Region Plans can be also complemented by policies and instruments associated with planning and development of the territory. It should be noted the following: Planning plan for Public Water Reservoirs; Coastal Waterfront Planning Plan; Estuary Planning Plan and Coastal Protection and Valorisation Action Plan.

Water management should therefore pursue three key objectives: the protection and requalification of the state of aquatic ecosystems and terrestrial ecosystems, as well as the wetlands that depend on them, with regard to their water needs; promoting the sustainable, balanced and equitable use of good quality water, with the allocation to various types of uses, taking into account their economic value, based on long-term protection of available water resources; and increased resilience to the effects of floods and droughts and other extreme weather events arising from climate change.

2.2.6. France - Cluster DREAM

Considering the national level the water policy the administrative organization of water management in France is based on three levels of local authorities: the Municipalities, the Departments, the Regions.

Municipalities are responsible for the management of public drinking water and sanitation services. They

may also undertake contractual steps to manage water resources and aquatic environments (e.g. river contracts) and/or planning procedures (local water management and management schemes) (Noêl 2009).

Departments have a role in rural development and equipment. Through the financial aid they provide to drinking water and sanitation systems. They can also intervene on the protection of natural environments. A technical assistance service to the municipalities has been set up in each General Council (Noêl 2009).

Regions are actors in financial solidarity and land-use planning (Agence de l'eau Loire-Bretagne 2018a). Regions participate in water management institutions and contribute to the application of planning documents and contractual procedures (Lesage 2013)(Noêl 2009).

At the scale of the French territory, three bodies have been created in order to implement a concerted management by basin: the basin committees, the basin coordination Prefect and water agencies (Lesage 2013).

There are 12 basin committees. The basin committee act as "water parliaments." A basin committee brings together stakeholders directly affected by water (consumers, farmers, industrialists, associations, the state, elected officials, etc.) (Eau France [2020]).

The missions of this basin committee is to ensure consultation and manage water in its natural territory (Eau France [2020]). Thus, their objectives are to set the broad guidelines for water management within each basin, in accordance with national and European water policies (Lesage 2013). To achieve this objective they develops:

- the large River Basin Management Plan (large RBMP);
- the basin's climate change adaptation plan;
- facilitates the consultation on the large RBMP and follows its realization.

Then they approves:

- water management and management schemes (the Wise);
- the rates and levies of the water agency within the framework defined by the National Assembly;
- the multi-year program of the water agency.

At the river basin level, the Basin Coordinator Prefect coordinates the actions of the various state water services, approves the large RBMP and stops measurement programs. He is assisted by the regional environment, planning and housing agencies (DREAL). Their role is to animate and coordinate the state's action in the field of water at the basin level (Lesage 2013).

In France, there are six water agencies in spread in the whole countries (Lesage 2013). This entities have the status of public administrative institutions of the state. Offices have the status of local public institutions. These establishments levy royalties on water uses and provide financial aid to actions of common interest carried out by local authorities, industrialists and farmers (water purification, production of quality drinking water, implementation of cleaner production processes, restoration and maintenance of aquatic environments, etc.) (Lesage 2013).

At local level the Local Water Commission (CLE) have the role of a consultation commission that concerns a limited hydrographic unit (affluent, sub-basin or aquifer). It's instituted by the prefect and he is responsible for the development, revision and monitoring of a water management and management scheme (RBMP) which must be done in consultation with the priorities of the large RBMP (Lesage 2013).

Figure 21 | Local Public Establishment Basin (EPTBs), River Unions and Authorized Trade Union Associations (ASA)

Source: eaufrance.fre

EPTBs are public institutions that can be the owner of watershed-wide operations or sub-basins alongside water agencies and basin committees (Lesage 2013).

The February 2005 Rural Area Development Act clarified the role of EPTBs in "wetland preservation and management. (Lesage 2013) “He has not intended to carry out all actions in the water sector but translated a willingness of communities to act basin scale and to pool means to carry out actions necessary for this (Le SDAGE du bassin Loire-Bretagne - DREAL Centre-Val de Loire [2020).

In the field of the planning activities is important to refer that are associate with the large River Basin The River Basin Management Plan, large RBMP, is a water policy planning document which aims to achieve good water condition. In each river basin, it is the implementation tool of the European Water Framework Directive and is a response to the main issues at the Loire-Bretagne basin. Defined for six years at the river basin level, the large RBMP has a real legal scope through its provisions:

- communities and public bodies must comply: their actions and decisions on water funding or development, certain planning documents such as local planning plans (PLU) and territorial coherence schemes (SCOT) must be compatible with the large RBMP;
- the water police must refer to the provisions of the RBMP to issue any authorisation;
- the RBMP, which is locally initiated, must also be compatible with the large RBMP.

In addition, the large RBMP is based on other planning documents framed by COMMUNITY law:

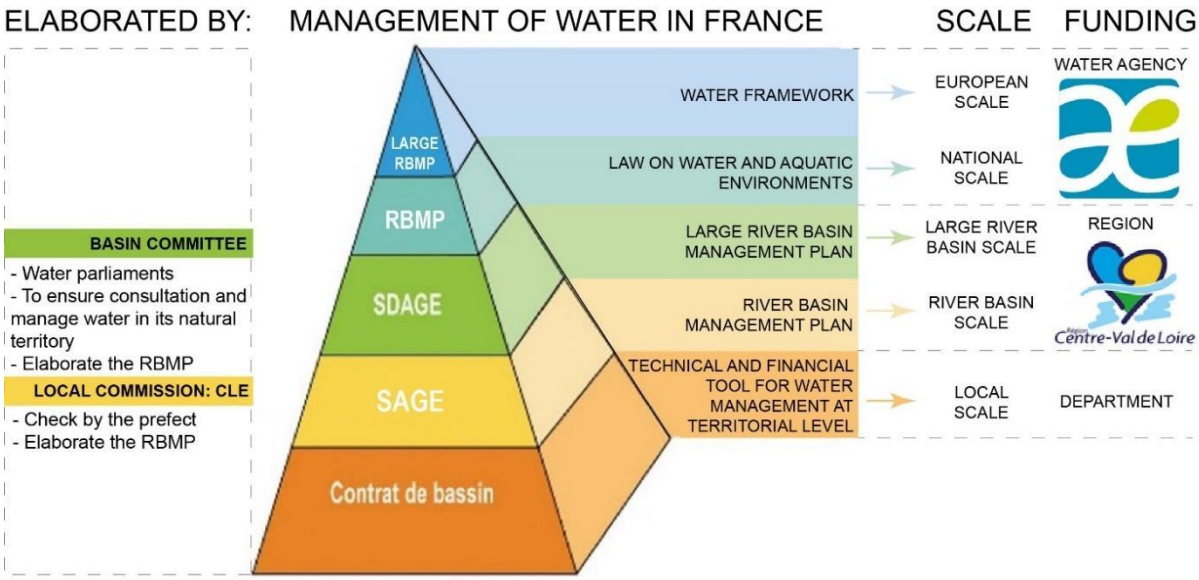
- the flood risk management plan (PGRI) defined at the Loire-Bretagne basin;
- the flood risk management plan (PGRI) defined at the Loire-Bretagne basin (Le SDAGE du bassin Loire-Bretagne - DREAL Centre-Val de Loire [sans date]).

At the local scale, the actions to be implemented are defined by a Water Development and Management Scheme, a RBMP. Complementing the large RBMP, it is an essential tool for the implementation of the large RBMP by concretely declining the guidelines and provisions while adapting them to local contexts.

The RBMP is developed by the local water commission, the CLE, (see above) which brings together partners who use the resource of the same river basin. It has a strong legal scope.

The RBMP sets, coordinates, and prioritizes general objectives for the use, enhancement and quantitative and qualitative protection of water resources and aquatic ecosystems. It also ensures the preservation of wetlands (Le SDAGE du bassin Loire-Bretagne - DREAL Centre-Val de Loire [2020]).

Figure 22 | A diagram of water management in France



Source: water agency

2.2.7. Lithuania - Kaunas University of Technology (KTU)

The European Water Policy and the EU Water Framework Directive (WFD) aim at ensuring clean waters. HELCOM Baltic Sea Action Plan (BSAP) has appointed eutrophication and hazardous substances as key issues requiring action. In achieving this, the roles of local actors and citizens are crucial. The local and regional levels are very important for the implementation of practical measures aiming at better waters.

The Nemunas RBMP and PoM were adopted by Government Order No 1098 of 21 July 2010. The Lielupe, Venta and Dauguva RBMPs and PoMs were adopted by Government Orders No 1618, No 1617 and No 1616 of 17 November 2010. The RBMPs were reported to the Commission in two stages, whereby the last 3 RBMPs were reported in November 2010. Updates were provided in January 2015. Reported plans and data are available on EIONET (http://cdr.eionet.europa.eu/lt/eu/wfdart13).

The RBMPs are developed clearly according to the elements provided in Annex VII to the WFD. The Programme of Measures also includes all groups of measures as indicated in Annex VI to the WFD. All major information is provided also according to sub-basins. No sub-plans or supporting documents were reported in addition to the RBMPs, but documentation refer to are available on the Competent Authority's webpage. The Government adopts the RBMPs with a resolution as the adopting act. The RBMPs and PoM are planning documents. In the hierarchy of legal acts they fall under regulations. They are approved by legally binding resolutions of the Government and they cannot contradict existing legislation. Practically, the RBMPs and PoM are legally binding documents. The public institutions and municipalities are liable for failure to implement timely programmes related to protection of environment, e.g. failure to implement timely the RBMP or PoM. There is a relationship between the RBMPs and individual decisions, through there is an obligation to take the RBMP into account in the decision-making process. The legislation only sets out general obligations for the compatibility of individual decisions with the

environmental objectives set out in the RBMP. This is ensured through the assessment of effect of draft individual decisions, programs, contracts, negotiating positions, in accordance with the Methodology for Effect Assessment of Draft Decisions (Government Resolution No. 194 of 7 February 2007). The effect assessment of draft individual decisions covers inter alia an assessment of how a proposed individual decision will affect water, ecosystems, nature, etc. This implies that proposed individual decisions, programs, contracts and negotiating positions must also be compatible with the RBMPs and PoM. However, there is no explicit provision requiring that the existing permit/concession must be reviewed in line with the environmental objectives.

There are four water categories in the Nemunas RBD and two water categories in the Lielupė, Venta and Dauguva RBDs. The water bodies within the Nemunas River Basin District are assigned to the following categories: rivers, lakes, transitional waters (the Curonian Lagoon and the plume of the Curonian Lagoon in the Baltic Sea) and coastal waters of the Baltic Sea. In addition, artificial and heavily modified water bodies are distinguished. The Lielupė, Venta and Dauguva RBDs have river and lake water categories. All surface water categories were further differentiated according to the type, taking into account the variety of the natural characteristics of surface waters and the resulting differences in the aquatic communities.

The map in the next figure show the Lithuania national network for the monitoring of the surface and ground waters quality. Monitoring is carried out in accordance with the National Environmental Monitoring Programme. The monitoring programmes of the lakes, transitional and coastal waters provided in the RBMPs are practically the same as those submitted to the European Commission in 2015, following Article 8 of the Water Framework Directive. Whilst there has been a decrease of river monitoring stations, an operational groundwater monitoring programme has now been reported.

The principals key strengths resulting from the RBMP can be summarizes this way. They are developed according to the elements provided in Annex VII to the WFD. The Programme of Measures includes all groups of measures as indicated in Annex VI to the WFD. All major information is also provided according to sub-basins. There is overall good availability of methods to assess the ecological status. The measures proposed for addressing hydro morphological pressures are clear and extensive. Various monitoring programmes are defined clearly, except for dangerous substances related monitoring. Agricultural pollution is one of the most important pressures and great attention is devoted to this source of pollution. The affordability of each supplementary measure is assessed. The information about costs is described in a constructive manner, the use of exemptions is transparent and provides the necessary information. Public participation during the development of the RBMPs was extensive, e.g. with active involvement of relevant stakeholders.

As major Key weaknesses of the RBMP it can be said that contain a lot of information on the ecological status assessment and groundwater related issues. However, the methodologies used are not described in detail. There is a lack of information regarding dangerous substances (stipulated by unclear legislation and the lack of monitoring on these substances). The chemical status classification is based on insufficient monitoring. The assessment of chemical status was based on maximum allowable concentrations (MAC) only, and does not include an assessment of exceedances of annual averages (AA).

Figure 23 | Maps of surface water (left) and groundwater (right) monitoring stations

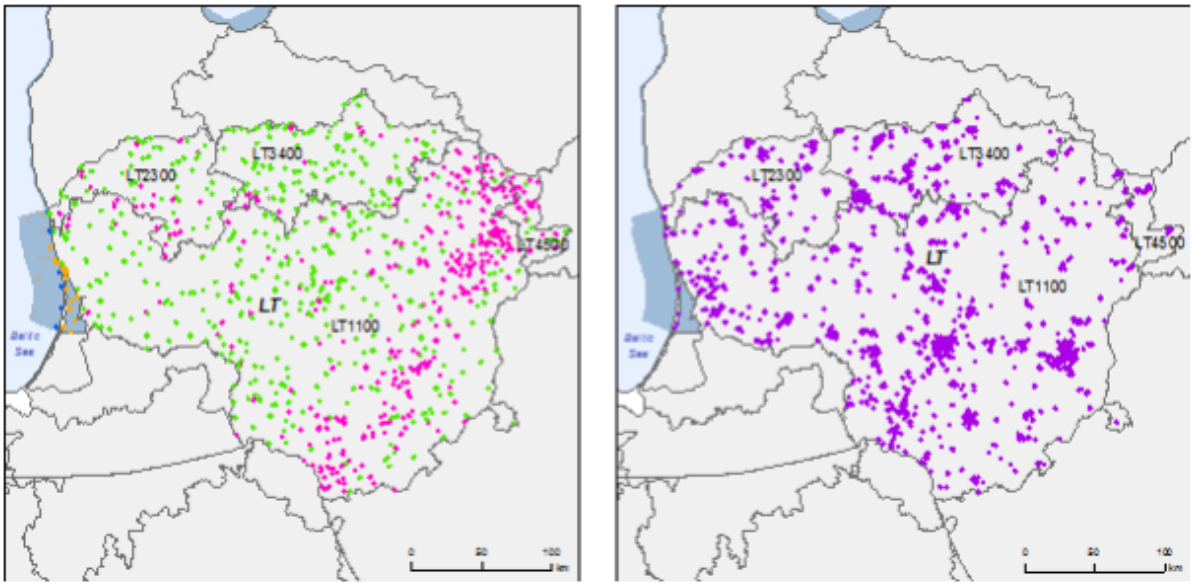


Figure 5.1.1: *Maps of surface water (left) and groundwater (right) monitoring stations*

- *River monitoring stations*
- *Lake monitoring stations*
- *Transitional water monitoring stations*
- *Coastal water monitoring stations*
- *Unclassified surface water monitoring stations*
- *Groundwater monitoring stations*
- *River Basin Districts*
- *Countries outside EU*

Source: WISE, EUROSTAT (Country Borders)

Figure 24 | Number of monitoring site by water category

RBD	Rivers		Lakes		Transitional		Coastal		Groundwater		
	Surv	Op	Surv	Op	Surv	Op	Surv	Op	Surv	Op	Quant
LT1100	110	190	187	89	0	25	0	6	185	1738	60
LT2300	8	21	1	5	0	0	0	0	19	280	5
LT3400	8	95	0	6	0	0	0	0	25	344	8
LT4500	2	3	0	1	0	0	0	0	11	140	3
Total by type of site	*128*	*309*	*188*	*101*	*0*	*25*	*0*	*6*	*240*	*2502*	*76*
Total number of monitoring sites[7]	*468*		*345*		*25*		*6*		*2754*		

Source: WISE, EUROSTAT

The PoMs have not been coordinated within the international RBDs, especially with the third countries (Russia and Belarus). The major gap is related to the absence of an international RBMP, which should be produced together with Latvia. The assessment methods for the classification of ecological status have not yet been developed for all water body types and all biological quality elements.

River Basin Management Plans (RBMPs) are the sum of restoration and protection measures for a river basin's water bodies. Water bodies are all interconnected. Their status depends on multiple factors, in

particular the pressures from the energy, agriculture, transport and housing sectors in the river basin. These pressures should be addressed in the RBMPs, which are the place to deliver integrated river basin wide planning to identify the strategic and cross-cutting problems and solutions. Only those can step up restoration and deliver large scale water status improvements while supporting the transition to sustainable economic development.

3. APPLICATION OF THE EU DIRECTIVES

3.1 Implementation of the Water Framework Directive

The European Union, realizing the importance of protecting and preserving the aquatic environment in the Community, developed the Water Framework Directive (2000/60/EC) that establishes the basic principles of a sustainable water policy in the European Union. The water framework directive (WFD) was adopted 23 of October 2000, later the same year the directive came into force and was published by the European parliament and council on in December 2000. It combines quality (ecological and chemical) and quantitative objectives for the protection of aquatic ecosystems and to achieve good condition of all water resources. It proposes an integrated management on the geographical scale of River Basins. In addition, it redefines the concept of the River Basin, which includes internal surface, groundwater, transitional and coastal ecosystems.

The implementation of the WFD has been done according to a sequence of activities for which there are set specific deadlines for implementation. This common strategy should ensure the following:

- sharing and disseminating information between the Member States and the Commission;
- integration of information for the development of River Basin Management Plans;
- ensuring coherence between the implementation of the directive and the other water-related directives as well as in relation to sectoral and structural policies that are directly or indirectly related to this natural resource;
- promote the training of human resources;
- promote the involvement of partners and civil society in the process of implementing the directive.

On the other hand, the actions to be developed by each country must ensure a common interpretation of the water directive and promote the harmonization of methodologies, in order to increase the degree of comparability of results between each member. Among these actions, the following were also established within the framework of the common strategy:

- definition of the types of water resources (rivers, lakes, transitional waters, coastal waters, artificial or heavily modified water resources;
- development of criteria for the designation of highly modified water resources;
- definition of reference conditions;
- definition of “maximum ecological potential”;
- development of criteria for the definition of significant impacts resulting from human activities;
- development of intercalibration exercises;
- development of methodologies for assessing diffuse pollution;
- development of methodologies for carrying out economic analysis;
- definition of pollution control measures for substances included in the list of priority substances;
- definition of quality standards for substances included in the list of priority substances.

Regarding the cycle management for the water framework directive implementation the following aspects should be mentioned.

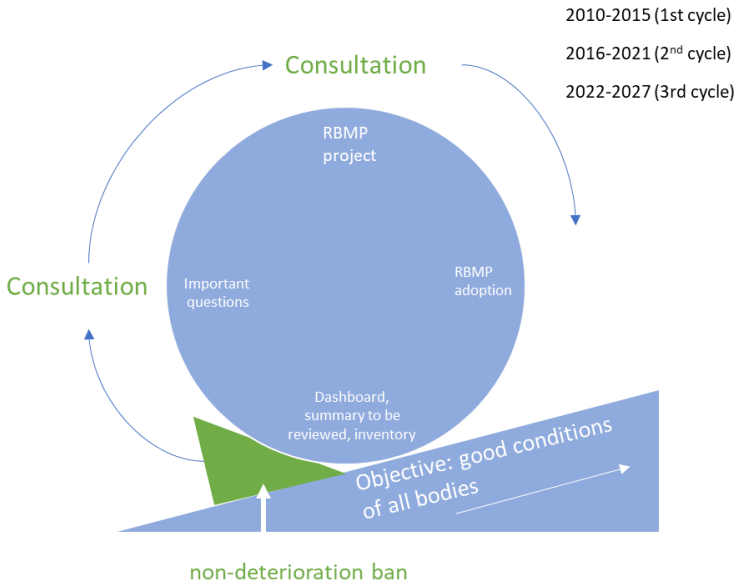
The adoption of the directive the key objective was to achieve good status in the over 111 000 surface waters and 13 000 groundwater's within the European Union member states by 2015. The directive however allowed extension of the deadline for two additional cycles post cycle 1 which ended in 2015. These two extended cycles were determined to encompass 2016-2021 (cycle 2) followed by 2022-2027 (cycle 3).

The Water Framework Directive cycles each has a duration of six years, corresponding, namely, to the effectiveness of the river basin management plans (RBMP). The methodology for developing the plans is identical for the different periods as well as the respective objectives that are inherent to the Water Directive (Figure 24).

The program of measures (POM) is the key element of the River Basin Management Plan for the achievement of the 2000/60/EC Directive objectives. The measures are divided into basic and supplementary:

- Basic measures result from the implementation of national and European legislation on water protection, including 2000/60/EC Directive and overall environmental policy;
- Supplementary measures include measures designed and implemented in addition to the basic measures.

Figure 25 | Cycle review of RBMP



There also are several EU-directives related to management of water quality in the European Union that affect the implementation of the water framework directive considered by the partners of BigData 4Rivers. These directives include:

- nitrates directive, Directive (91/676/EEC);
- urban wastewater treatment directive, Directive (91/271/EEC);
- drinking water directive, Directive (98/83/EC);
- bathing water directive, Directive (2006/7/EC);

- floods directive. Directive (2007/60/EC);
- directive of accident hazards involving dangerous substances (2012/18/EU);
- industrial Emissions Directive. (BAT, Best Available Techniques), Directive (2010/75/EU);
- conservation of wild birds, Sites, (2009/147/EC);
- protection of natural habitats and of wild fauna and flora, Natura 2000 92/43/EEC;
- assessment of the effects of certain public and private projects (2011/92/EU, 2014/52/EU);
- establishing a framework for Community action to achieve the sustainable use of pesticides (Text with EEA relevance) (2009/128/EC, 26/07/2019).

All EU-directives are law for members in the union and achievement of directive goals are mandatory. However, the individual countries need to devise their own legislation to accommodate the goals set by the directives either by incorporation.

The provisions of Annexes V and VI of the Regulation and the following basic principles shall be followed when determining the conditions (project, permit, etc.) for the discharge of wastewater (pollutants) into the environment:

- the Maximum allowable concentrations (MAC) for pollutants in effluents set out in the Regulation and other legislation or in the activity-specific Best Available Techniques (BAT) reference document (if developed and required by other legislation) shall not be exceeded, subject to the exceptions provided for in this Regulation;
- the permissible effect on the sewage receiver may not be exceeded:
  - the discharges must not affect a surface water body to an extent that it exceeds the EQS set out in Annex 1 and / or Annex 2, Part A, and / or the MACs set out in Annex 2, Part B and other legislation. EQS for surface water bodies shall apply without prejudice to the provisions of point 8.21 and in accordance with the requirements set out in Annex 3;
  - the effects of existing sources on the receiver must be taken into account in the planning of discharges and an assessment must be made as to whether the emergence of a new source will not affect the receiving surface water body Part B of Annex 2 (if EQS and / or MACs are already exceeded) and other water protection objectives set for the receiver (if set for a specific receiver).

As part of the IED directive the basic principle is to avoid pollution by applying all suitable measures, especially by applying the best available techniques (BAT). Which technology is the best available technology is determined by BAT Reference Document for each type of industry.

3.1.1. Spain - Iberian Association of Riverside Municipalities of Duero River

The transposition of the WFD (Directive 2000/60/EC) into Spanish law was made by Article 129 of Law 62/2003 regarding fiscal, administrative and social measures (Spanish Official Gazette (BOE) No. 313 of 31 December 2003) which amended the consolidated text of the Water Act, approved by Royal Legislative Decree 1/2001. A number of minor regulations closed transposition gaps and enabled the planning process. In this context, the following Royal Decrees (RDs) are of relevance:

- Regulation of hydrological planning process;
- Redefinition of the limits of river basin districts;

- Redefinition of the competences of the several authorities involved.

At Regional level, several Water Laws have been approved in the past decade to adapt legislation to comply with the WFD, including Catalonia, Basque Country, Andalusia and Galicia.

Although the work on the second cycle of implementation of the water directive has been finalized, there were some difficulties in its conclusion, the following should be noted:

- the definition and delimitation of river basin districts, that requires the incorporation of coastal waters in the already historical delimitation of territorial areas of management and planning of inland waters, embodied in the Spanish state for the territories under the jurisdiction of the Confederations Hydrographic, and more recently, the regional agencies. This topic is related to the different political-administrative competence over one and the other (autonomous, in the case of coastal waters, and state in that of waters continental intercommunity), as well as with the problem of river basins intracommunity whose management competencies have not been assumed by the autonomous authorities and that continue to date within the scope of intercommunity basin organizations, although they do not hold competences legitimate planning and management procedures for this territorial area;
- the introduction of scientific-technical specifications in order to ensure that the definition and assessment of ecological status were consistent and according to common principles and procedures in all states. But nevertheless, such specifications were finalized on the basis of non-cooperative binding of the Member States with the European Commission. In particular, in Mediterranean regions, the lower availability of flows can be used as pretext for lowering environmental targets, rather than restricting abusive uses in progress. In this sense, it was necessary to ensure rigorous scientific criteria that define the reference conditions of good ecological status in each geoclimatic context;
- the need to assure the integration with the territorial and sectoral policies namely a new development policy for the rural regions.

At this moment and as determined by the Community Directive, work is ongoing on the third phase of implementation of that legal document.

As result of the transposition of the WFD, the Spanish authorities produced a series of related legislative documents, in addition to those previously mentioned with the management of water and water resources, with the classification of water bodies and characterization of their quality. Worth mentioning are those associated with the following domains:

- monitoring and evaluation of surface water and environmental quality standards;
- rules applicable to the treatment of urban waste water;
- d development of regulations on urban wastewater treatment;
- definition of standards for bathing water quality;
- definition of standards for the quality of water for human consumption;
- norms referring to pollution produced by nitrates from agricultural sources;
- standards for air and use of treated water;
- rules for the protection of groundwater against contamination and deterioration;
- transposition of European standards for emerging pollutants.

Is also important to highlight legislative documents prepared for domains complementary, namely:

- the Evaluating and flood risk management;
- regulating the development of the Environmental Responsibility Law;
- law on water coastal waters;
- law for the protection and sustainable use of the coast;
- natural heritage and Biodiversity Law;
- urgent measures in relation to the environment;
- Law on the rights of access to information, public participation and access to justice;
- Cooperation fund for sanitation water;
- measures in relation to groundwater;
- measures urgent to alleviate the effects of drought in the basins of rivers

3.1.2. Greece - Regional Development Fund on Behalf of the Region of Attica

Transposition of the water framework directive into Greek national legal order were performed by the National Law 3199/2003 (Gov.Gaz 280A/09-12-2003) and the Presidential Decree 51/2007 (Gov.Gaz. 54A/08-03-2007).

General rules for costing and pricing of water services as well as the method and procedures for recovering the cost of water services in its various uses have been approved by the 135275/ 2017 Joint Ministerial Decision (Gov.Gaz. 1751B/22-05-2017). The purpose of this decision is to achieve sustainable use and improve the water situation, in accordance with the environmental objectives of Article 4 of Presidential Decree 51/2007 and to ensure the constitutionally guaranteed public character of water, as a social good, necessary for human life.

With the elaboration of Management Plans for the River Basins of the country's Water Departments, Greece completes the implementation of the requirements of Directive 2000/60 / EC on the establishment of a framework for Community action in the field of water policy.

A River Basin Management Plan (RBMP) is a strategic planning document, which corresponds to a River Basin District (RBD) and provides the necessary information and operational instructions for integrated water management within a river basin. It provides a general description of the characteristics of rivers, lakes, coastal waters, ground waters and water-related protected areas. The RBMP of each RBD is accompanied by a Strategic Environmental Impact Assessment (SEIA). The Content of MPs is defined in Article 13 and Annex VII of Directive 2000/60/EC (Article 10 and Annex VII of Presidential Decree 51/2007) and they are revised every five years. Both MP and SEIA go under public consultation before they are approved by the Central Administration. The approved MPs and their SEIA are available to the Special Water Secretariat's this website link.

Greece currently encompass fourteen River basin districts. In the jurisdiction of the Region of Attica fall the Management Plan for the River Basins of Attica to some degree the Management Plans for the River Basins of Eastern Peloponnese and Central Greece. In the measures of the current RBMP for the RBD of Attica there are implementation actions of the directives related to water management and the WFD mentioned in the introduction of this chapter.

It should be mentioned that since the assessment and management of flood risks refers to a different European Directive (2007/60/EC), there have also been approved management plans of flood risks for the River Basins. The current MP of flood risks for the River Basin of Attica Region has been approved by no ΥΠΕΝ/ΓρΕΓΥ/41369/327 Ministerial Decision (Gov.Gaz. 2693B/06-07-2018), while the current MP for

the River Basins of Attica has been approved by no Ε.Γ:οικ.903 Ministerial Decision (Gov.Gaz. 4672B/29-12-2017).

Additionally, there should be a reference about the EU policy for the adaptation to climate change. It is constitutional obligation for the Region of Attica, according to national law 4414/2016 (Gov.Gaz. 149A/09-08-2016), to elaborate the Regional Plan for the Adaptation to Climate Change, which consists a complete plan that identifies and prioritizes the necessary measures and actions for the adaptation to climate change. Attica's RPACC (currently in progress) would be compatible to the directions and objectives of the National Strategy for the Adaption to Climate Change. The latter has indicated that the Water Resources and Infrastructure sectors of Attica are considered of high vulnerability to climate change.

As mentioned above (section 3: State of Play), National Monitoring Network of the quantitative and qualitative status of surface water and groundwater in Greece was formed through the JMD 140384/2011 and meets fully the requirements of the Water Framework Directive (2000/60/EC) (Article 8 and Annex V), as well as the Directives on nitrate pollution from agricultural sources (91/676/EEC), for groundwater (2006/118/EC) and for priority substances (2008/105/EC). In the same section, there is reference to the bodies [General Chemical State Laboratory (GCSL), Hellenic Centre for Marine Research (HCMR), Institute of Geology & Mineral Exploration (IGME), Greek Biotope/Wetland Centre (EKBY), Municipal Water and Sewerage Company of Larissa (DEYAL) and Land Reclamation Institute (LRI)] undertaking the operation of the Network under the supervision of the Special Secretariat for Water.

The Environmental Quality Standards (EQS) on the concentrations of certain pollutants and priority substances in surface waters, in compliance with the provisions of the Directive 2008/105/EC of the European Parliament and the Council of the 16th December 2008 ""on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council" as well as the concentrations specific pollutants in inland surface waters and other provisions" have been legislated by the Joint Ministerial Decision (JMD) no Η.Π. 51354/2641/E103 (Gov. Gazette 1909B/08-12-2010). EQS are taken into consideration when elaborating the River Basin Management Plans. Ministries deciding on the EQS are:

- Ministry of Interior, Decentralization and Electronic Governance
- Ministry of Finance, Competitiveness and Shipping
- Ministry of Environment and Energy

The Special Secretariat for the Water of the Ministry of Environment and Energy is the agency responsible for:

- the preparation of programs for the protection and management of the country's water resources;
- the coordination of services and government agencies for any issue related to water protection and management;
- the elaboration of the national programs for the protection and management of the country's water resources and monitors and coordinates their implementation, in collaboration with the Water Directorates of the Decentralized Administrations. Prior to their approval, the programs are submitted for consultation to the National Water Council.
- Informing the Commission and the other member states about the EQS related issues (such as, catalogue of substances establishing EQS; documentation; methodology of and alternative EQS; water surface categories; monitoring frequency);

- analysing the long-term trends in priority substance concentrations set out in Part A of Annex I of the previously mentioned JMD.

The Water Directorates of the Decentralized Governments are responsible for:

- delineating mixing zones adjacent to discharge points in surface waters, after assent of the Special Secretariat for Water;
- the compilation of a list including any maps, emissions, discharges and leaks for all priority substances and all pollutants listed in Part A of Annex I of the JMD including their concentrations in sediments and living organisms' mechanisms, as appropriate, based on the information collected in accordance with Regulation (EC) no. 166/2006 and other available data;
- transmitting to the European Commission, via Special Secretariat for Water, the lists drawn up, including the corresponding reference periods;
- updating and publishing those lists.

Region of Attica, in its geographical jurisdiction, is responsible for environmental authorization of works and enterprises as well as inspecting any type of industrial activities and enterprises on their compliance with environmental legislation. Environmental inspections involve, amongst others, determining the compliance to authorized requirements of operational aspects of a company regarding the protection of environment; enforcing penalties (mostly fines) to persons or companies who cause pollution or any other degradation on the environment, or do not comply to regulations and provisions of environmental legislation.

Region of Attica, also, may monitor environmental parameters and samplings complementary to those of the central government and it also shares responsibility for the implementation of the Management Plans.

3.1.3. Romania - The National Union of Romanian Entrepreneurs

The Ministry of Waters and Forests and the National Administration of Romanian Waters are the public authorities in charge with the implementation of the Water Framework Directive in Romania.

The "Romanian Waters" National Administration applies the national strategy and policy in the field of quantitative and qualitative management of water resources; to this end it takes steps for inventorying water resources, their conservation, rational use and protection against depletion and degradation in order to ensure sustainable development, prevention of destructive impacts of water, ecological reconstruction of watercourses, and to ensuring hydrological and hydrogeological surveillance.

In Romania, water management is based on a long tradition: the "Law on Water Regimes" was adopted in 1924; in 1975 the foundations of water management were established on river basins, by founding the Water Directorates for the following river basins / hydrographic areas: Someş - Tisa, Crişuri, Mureş, Banat, Jiu, Olt, Argeş - Vedea, Buzău - Ialomița, Siret, Prut - Bârlad, Dobrogea - Seaside.

The national strategy on accelerating the development of public utility services, as they are defined in the legislation in force, was approved by GD no 246/16.02.20064. The strategy has as fundamental objective the fulfilment of the commitments targeting the sector of public utility services that Romania has assumed through the Treaty of Accession to the European Union.

The National Strategy aforementioned has the following general objectives:

- to reach the conformity with the provisions of the legislation of the European Union applicable to the public utility services;

- to ensure the compliance with the commitments assumed by Romania regarding the implementation of the acquis communautaire (EU regulations) valid for the public utility services;
- to achieve the compliance with Community standards on the quality and quantity of public utility services;
- to increase the capacity to absorb the financial resources allocated from community funds and to attract investment funds;
- to strengthen the institutional capacity for the elaboration, promotion and financing of investment projects related to the infrastructure of local interest;
- to gradually increase of the self-financing capacity of the public utility services and of the related technical & municipal infrastructure, at the levels accepted in the European Union;
- to meet the public requirements of the local communities and to increase the welfare of the population;
- to adopt legal norms and regulations that facilitate the modernization and development of the public utility services and of the related technical & municipal infrastructure, to ensuring opening of the market, efficiency of the provision / supply of services and to increase of quality thereof.

Through the Accession Treaty to the EU, Romania has assumed important commitments in the water and wastewater sector for the transposition of Directive 98/83/EC on the quality of water intended for human consumption, and the Implementation of Council Directive 91/271/EEC concerning urban wastewater treatment, as amended by Commission Directive 98/15/EC. From a legal point of view, the provisions of the Romanian normative acts on water sector have been made consistent with the common rights and obligations that are binding on all EU countries.

For its importance it is worth mentioning the measure adopted in the agricultural sector. The measures for local authorities and farmers can be financed from the local budget, from farmers 'own sources and from funds attracted by authorities and farmers' associations (National Rural Development Program, other European funds, loans, etc.). An important aspect is that all the farms in Romania are subjected to this legislative norm, without being differentiated according to their size.

In order to reduce the risks of surface and groundwater pollution associated with the use of plant protection products, "Romanian Waters" National Administration and the National Phyto-sanitary Authority have a protocol to improve the correlation of specific issues of the updated Management Plans of basins / hydrographic areas (according to the requirements of Article 13 of the Water Framework Directive 2000/60 / EC) and of the National Action Plan on reducing the risks associated with the use of plant protection products (as required by Article 4 of Directive 2009/128 / EC establishing a framework for action for the sustainable use of pesticides). http://www.madr.ro/ro/utilizarea-durabila-a-pesticidelor.html

At national level, National Strategies have been drawn up in the field of aquaculture, strategies and action plans specific to the irrigation sector, highlighting mainly the consolidation of the rehabilitation and modernization of the irrigation system, the introduction of new financing conditions for measures related to water bodies status and providing greater sources of funding for these measures.

For most construction measures of water supply infrastructure and wastewater collection and treatment infrastructure, the project design and planning take also into account the updated climate change scenarios.

3.1.4. Sweden - The County Administrative Board of Östergötland

Concerning the European water framework directive in Sweden has been adopted to Swedish legislation in:

- Chapter 5 of the Swedish environmental code (national law)
- Decree (2004:660) concerning management of quality in the aquatic environment
- Decree (2017:868) concerning the instruction for the county administrative boards

The Swedish Environmental Code contains 33 chapters and almost 500 sections. However, only fundamental environmental laws are included in the Environmental Code. More detailed provisions are laid down in ordinances made by the Government. Environmental quality standards are regulated through chapter 5 of the Swedish environmental code which is the main legislative document for all matters related to the environment. It states that EQS can be decided by the government for either soil, air, water or the environment in general. The code also states that this can be delegated to authorities appointed by the government. For EQS in water the Swedish Agency for Marine and Water Management (HaV) is the appointed authority responsible for declaring decrees on a national level and for development of guidance documents used for determining EQS of waterbodies.

In Ch. 5, § 4 of the Swedish environmental code it is clearly stated that governmental authorities or municipalities may not allow/give permits to activities that are initiated or changed, if these would be expected to cause increased pollution or disruptions which would mean deterioration in an inadmissible manner in the aquatic environment or if the activity jeopardize the possibility of reaching the status or potential set by the EQS of the waterbody, even if measures to reduce such negative impacts are taken.

For classification and environmental quality standards in surface water HaV have been appointed as the responsible governmental authority. The agency has issued regulations (latest updated in HVMFS 2019:15) to be use by during classification of surface water status. The water authorities and county administrative board are in turn responsible for applying the regulations in assessment of status in water bodies. The regulation (HVFMS 2019:15) contains instructions and benchmark values for evaluation of ecological and chemical status. Other decrees and regulations issued by the Swedish agency for marine and water management are:

- regulations on mapping and analysis of surface water in accordance with the decree concerning (2004: 660) the management of the quality of the aquatic environment (HVMFS 2017:20);
- management plans and action programs for surface water (HVMFS 2015:34);
- regulations on monitoring of surface water (HVFMS 2015:26);
- regulation on classification and environmental quality standards regarding surface water (HVMFS 2019:25).

Regarding the priority substances related to the WFD are included in the decree issued by Swedish agency for marine and water management HVMFS: 2019:25.

The issues related with the groundwater directive the National authority Geological Survey of Sweden (SGU) are responsible for implementation of directive 2006/118/EC regarding protection of groundwater against pollution and deterioration. The directive had been adopted by the implementation of the water frame work directive as well as by regulations issued by SGU.

The Industrial Emissions Directive (IED)

The Environmental code of Sweden use the term Best possible technique (BPT) to describe what is

required of industrial activities to achieve requirements of environmental considerations. In the Swedish environmental code, chapter 2 section 7 describes that both economic and environmental consideration must be made if these are not deemed unreasonable (i.e. unreasonable costs). In the proposition of the Environmental code (proposition 1997/98:45, part 1, page 217–218) it was stated that the IED constitutes the minimum level of regulation. This results in a stricter application of 'best technique' than if Sweden only were to consider BAT and the BREF documents (Swedish EPA, 2019). The only limitation of applying the Best possible technique is that the technique has to exist and that it is not in an experimental stage of development (Swedish EPA, 2019).

3.1.5. Portugal - CIM Alto Minho

In the case of the hydrographic region of Minho and Lima, its Lima management plan was approved by the Resolution of the Council of Ministers no. 52/2016, of 20 September, rectified and republished by Statement of Rectification no. 22-B / 2016, of November 18th.

It is also worth mentioning, also as foreseen in the Water Directive, in March 2019 the reverent report on the Interim Evaluation of the Implementation of Measures was published,

Currently, preparatory work is underway for the preparation of river basin management plans for the 3rd cycle (2022 to 2027).

In Portugal, the Water Framework Directive (Directive 2000/60 / EC of the European Parliament and of the Council, of 23 October 2000) is the main instrument of the European Union's Water Policy, establishing a framework for community action for the protection inland surface waters, transitional waters, coastal waters and groundwater. It was transposed into national law through Law No. 58/2005 , of 29 December, amended and republished by Decree-Law No. 130/2012 , of 22 June.

Its implementation was carried out according to a sequence of activities for which the specifics of execution were established in order to ensure compliance with the environmental objectives, principles and guidelines inherent to the WFD.

One of the works carried out consisted of classifying the different types of water existing in the country in order to ensure, as determined by the directive, sustainable water management in order to achieve the good status of all water bodies.

As a result of the transposition of the WFD, the following legislative documents that correspond to issues associated with where produced:

- Decree-Law No. 83/2011 , which establishes technical specifications for the chemical and physical-chemical analysis and monitoring of the state of the water, transposing Directive 2009/90 / EC;
- Decree-Law No. 103/2010 , which establishes environmental quality standards in the field of water policy and transposes Directive 2008/105 / EC and partially Directive 2009/90 / EC;
- Decree-Law no. 172/2009, which creates the Water Resources Protection Fund;
- Ordinance No. 1115/2009 , which approves the regulation for the assessment and monitoring of the quantitative status of groundwater bodies;
- Ordinance No. 702/2009 , which establishes the terms for the delimitation of the protection perimeters of abstractions destined to the public supply of water for human consumption, as well as the respective conditions;
- Decree-Law no. 208/2008 , which establishes the regime for the protection of groundwater against pollution and deterioration, transposing Directive 2006/118 / EC;

- Decree-Law No. 97/2008 , which establishes the economic and financial regime for water resources;
- Decree-Law No. 347/2007 , which approves the georeferenced delimitation of hydrographic regions;
- Decree-Law No. 226-A / 2007 , which establishes the regime for the use of water resources;
- Ordinance No. 1450/2007 , which sets the rules for the regime for the use of water resources;
- Decree-Law No. 77/2006 , which complements the transposition of the Water Framework Directive;
- Law No. 54/2005 , which establishes the ownership of water resources;
- Decree-Law no. 261/2003 , which sets new quality objectives for substances detected in aquatic environments, changing the Decree-Law No. 506/99;
- Decree-Law no. 506/99 , which sets the quality objectives for a set of substances selected as a priority according to the respective conditions of persistence, toxicity and bioaccumulation;
- Decree-Law no. 236/98 , which establishes quality standards, criteria and objectives in order to protect the aquatic environment and improve the quality of the waters according to their main uses;
- The Priority Substances Directive was transposed into the national legal order by Decree-Law no. 103/2010 , of September 24th amended and republished by Decree-Law no. 218/2015 , of October 7th.

With regard to the assessment of the Chemical State of surface waters, the substances to be considered are those identified as priority substances under the WFD and the daughter Directive of Priority Substances (Directive 2008/105 / EC , of the European Parliament and of the Council, of 16 December, as amended by Directive 2013/39 / EU of the European Parliament and of the Council, of 12 August 2013).

In view of the evolution of technical and scientific knowledge, Directive No. 2013/39 / EU, of 12 August 2013, amends Directives No. 2000/60 / EC, and No. 2008/105 / EC, and reviews the list of priority substances, identifies new substances for priority action establishing the corresponding Environmental Quality Standards (EQS), updates the EQS of certain existing substances and also defines EQS in the biota for existing and new priority substances.

Thus, and in accordance with article 3, 1a (ii) of Directive 2008/105 / EC of priority substances as amended by Directive No. 2013/39 / EU, Portugal has established a monitoring program for each of the Hydrographic Regions and a preliminary program of measures for the new substances previously defined.

3.1.6. France - Cluster DREAM

Organization of the water framework directive

In 2005 France established a national action program intended to prevent, reduce or eliminate pollution of the aquatic environments by certain dangerous substances (INERIS, 2008). The action program was created as an application of the requirements from the Directives relating to releases of dangerous substances and to the protection of the aquatic environment. This action program has resulted in the

following regulations:

- amended Decree of January 25, 2010 relating to the methods and criteria for evaluating the ecological status, the chemical status and the ecological potential of surface water taken in application of articles R. 212-10, R. 212-11 and R 212-18 of the environment code. The first text aims to specify the methods for characterizing and evaluating surface water (ecological status, chemical status and ecological potential). It also specifies:
  - the conditions for establishing the EQS of "specific" pollutants of the ecological status;
  - the list of “specific” pollutants of the ecological status and the corresponding EQS. For the 2009-2015 management cycle, there are 9 the list of pollutants concerned for the evaluation of the chemical status and the corresponding EQS. This is the list of the 45 substances in Annex X of the WFD and are identical to those defined in the abovementioned order of 20 April 2005;
- amended decree of January 25, 2010 establishing the water condition monitoring program in application of article R. 212-22 of the environment code;
- this text aims to frame programs for monitoring the status of surface and groundwater in accordance with Annex V of the WFD. It specifies in particular the frequency of control of priority substances and "specific" pollutants of the ecological status as well as the methods to be used for the control of the quality elements of surface water monitoring programs (Somon 2012).

More recently, two amended decrees modified the decrees of 2010:

- Decree of August 7, 2015 amending the decree of January 25, 2010 establishing the water condition monitoring program;
- Decree July 27, 2018 relating to the methods and criteria for assessing the ecological status, chemical status and ecological potential of surface water taken in application of articles R.212-10, R.212-11 and R.212-18 of the environment code (Ministère de la Transition écologique et solidaire 2019).

Other directives concerning water quality

Nitrates directive

The national application of the nitrate directive in France (under the articles R.211-75 to R.211-84 of the environment code) is implemented through designation, by prefectural basin decrees (territorial level), of zones known as “vulnerable zones”. These areas contribute to the water pollution by the discharge of nitrates from agricultural activities. Each department of the Center-Val de Loire region is partially or totally affected by this classification. An action program is applied in vulnerable areas.

The Climate Change Adaptation Plan for the Loire-Bretagne Basin

An initiative to draft a climate change adaptation basin plan emerged in November 2015, on the side-lines of COP21. The Loire-Bretagne basin committee has built this adaptation plan in a concerted approach, by identifying the actions to perform according to the challenges of the territories and actors. The dynamics concern all water managers and users. This is based on solidarity between water users and between territories, and on the implementation of measurements without regret whatever the uncertainties. The basin committee enriched this plan by consultation with water stakeholders in the basin territory (Agence de l’eau Loire-Bretagne 2018).

The flood directive

As part of the implementation of the "flood directive", the French state adopted the first national flood risk management strategy (SNGRI). This strategy, adopted by an interministerial decree issued on October 7 2014 by the Ministers of the Environment, Housing, the Interior and Agriculture, has three priority objectives:

- Increase the safety of exposed populations
- Short-term stabilizer, and reduce the cost of flood damage in the medium term
- Drastically shorten the time it takes for disaster-stricken areas to return to normal.

Environmental quality standards in legislation

The status of a surface waterbody is defined according to its ecological and chemical conditions. The surface water status assessment rules are defined at national level by a ministerial decree (national level) of January 25, 2010 reviewed in July 27, 2018 relating to the methods and criteria for assessing the ecological status, chemical status and ecological potential of surface water taken in application of articles R.212-10, R.212-11 and R.212-18 of the environment code (Ministère de la Transition écologique et solidaire 2019).

The origin of the monitoring data to be used to draw up the water status maps is that disseminated by the basins as part of the water information system (SIE) (Secrétariat technique de bassin Loire-Bretagne 2015). It is therefore exclusively validated data acquired in compliance with standards, methods, specifications and, in general, all the existing good practice guide. This data includes the results of field surveys relating to the various quality elements, as well as other information, required in order to apply the evaluation methods (Ministère de la Transition écologique et solidaire 2019).

3.1.7. Lithuania - Kaunas University of Technology (KTU)

Lithuania has adopted the second generation of river basin management plans under the Water Framework Directive. The main legal instruments for water policies are the Law on Water (No. VIII-474 adopted by the Parliament on 21.10.1997), the Programme for the Reduction of Water Pollution by Hazardous Substances (approved by Order No. D1-71 of the Minister of Environment on 13.2.2004, as last amended 8.7.2015) and the Regulation on Wastewater Management. Lithuania applies a wide range of regulatory (pollution permits and standards) and economic instruments (e.g. tax on water abstraction and pollution discharges) to manage water quantity and quality.

The Ministry of Environment is the main ministry in charge of water policies. It collaborates with the Ministry of Agriculture and the Lithuanian Geology Survey to coordinate pollution reduction measures in the agriculture sector. The Environmental Protection Agency monitors and collects data on discharges of pollutants in surface water and evaluates the status of water bodies. It is responsible for granting, updating and cancelling pollution permits. Regional Environmental Protection Departments control compliance with pollution permit conditions.

Regarding the EQS is important to refer that the Wastewater Regulation (hereinafter referred to as the Regulation) lays down basic environmental requirements for the collection, treatment and discharge of wastewater in order to protect the environment from pollution. In order to achieve good surface water chemical status, this Regulation establishes Environmental quality standards (EQS) for priority substances and certain other pollutants listed in Annex 1 and Part A of Annex 2 to this Regulation (Minister of Environment of the Republic of Lithuania, 2006 May 17 by order No. D1-236 (Republic of Lithuania Minister of the Environment in 2007 October 8 order no. D1-515 edition) WASTEWATER MANAGEMENT REGULATION).

The Methodology for Determining the Status of Surface Water Bodies (hereinafter - the Methodology) establishes the criteria for assessing the ecological status of rivers, lakes, intermediate, coastal water bodies, artificial and heavily modified water bodies according to the types of water bodies specified in the Surface Water Body Type Description Minister 2005 May 23 by order no. D1-256 “On the Approval of the Description of Surface Water Body Types and the Description of Reference Conditions for Surface Water Body Types”, the criteria for assessing the chemical status of surface waters and the rules for classifying the status of surface water bodies. The methodology was prepared by implementing the methodology for setting water protection objectives approved by the Minister of Environment of the Republic of Lithuania in 2003. September 15 by order no. 457 “On the Approval of the Methodology for Setting Water Protection Objectives” (hereinafter - the Methodology for Setting Water Protection Objectives). The methodology shall be used to assess the status of surface water bodies for which water protection objectives have been established. The status of a surface water body shall be assessed on the basis of data from a study site or study sites representative of the status of the water body or on the basis of the results of water quality modelling. The data of the study site or study sites used for the assessment of the status of a surface water body shall comply with the General Requirements for Monitoring of Water Bodies approved by the Minister of Environment of the Republic of Lithuania in 2003. 31 December by order no. 726 “On Approval of General Requirements for Monitoring of Water Bodies” Chapter VIII.

In the context of policies and legislations is worth to mention the general legislation and regulatory framework for water management includes (UN, 2004):

- Lithuanian Environmental Strategy and Action Program (1996)
- Law on Water (1997, amendments in 2000)
- Law on Taxes on State Natural Resources (1991, amendments in 1996, 2000)
- Law on Pollution Taxes (1991, new wording in 1999, amendments in 2000, 2002)
- Law on Environmental Impact Assessment of the Proposed Economic Activity (1996, new wording in 2000)
- Code on the Internal Water Transport (1996)
- Regulations on the Establishment of the Water Bodies Protection Zone

The Law on Water regulates the ownership of the internal water bodies, the management, use and protection of water resources and the rights and obligations of users of internal bodies of water and their resources. According to the law, the use of water resources shall be regulated considering the needs of the economy and population. It should guarantee a sustainable use of surface and groundwater resources, prevent waters from pollution and protect the rights of owners of bodies of water and users of their water resources (UN FAO, 2016).

Lithuania applies a number of economic instruments to foster water quality and quantity management such as taxes on pollutants discharged into water bodies (established by the Law on Environmental Pollution Tax) and a tax on water abstraction and water resources (established by the Law on State Natural Resources Tax). Revenues generated from pollution taxes are directed to special funds earmarked for environmental protection projects, while revenues from the water resources tax are transferred to the national budget.

The Water Sector Development Program 2017- 2023 and its Action Plan foresee a series of measures to address water quality including reducing pollution from agriculture with i.e. the implementation of fertilization plans, financial support to farms growing catch crops, strengthening the control of point source pollution, requirements to reduce hydro morphological impacts of projects (including re-naturation etc). However, implementation is facing a number of challenges including financing.

Although farmers benefit from subsidies (through the Common Agricultural policy) to reduce diffuse pollution from agriculture and improve the management of pollutants such as nitrogen, their capacity to invest in new measures for pollution reduction is limited. Farmers estimate that yearly investments of EUR 50 million would be needed. There is strong opposition from farmers to the introduction of new technical requirements or taxes related to the use of fertilizers and pesticides. Still, taxes on fertilizer and pesticide may be considered, to reflect environmental externalities associated with water pollution.

Lithuania has adopted the second generation of river basin management plans under the Water Framework Directive albeit not finished the electronic reporting to WISE as agreed by the water directors under the common implementation strategy related to the Water Framework Directive, in June 2014. The European

Commission has therefore not yet conducted an assessment and not been able to assess the status and development since the first EIR report.

In the context of the Nitrates Directive, Lithuania applies mandatory measures on its whole territory. The measures implementing the Nitrates Directive are set out in the water field development program for the year 2017-2023 and implementation plan of the water field development program for the year 2017-2023.

Lithuania has a high level of compliance with the requirements of the Urban Wastewater Treatment Directive. All except one of its 65 agglomerations comply with the requirements of the Directive in terms of collection and treatment. An infringement procedure has been launched to address the remaining agglomeration (Kėdainiai) and issues related to the use of individual or other appropriate systems (IAS) across the country, which frequently lack regulation and control. The estimated investment needed to ensure adequate collection and treatment of the remaining agglomeration is EUR 38 million.

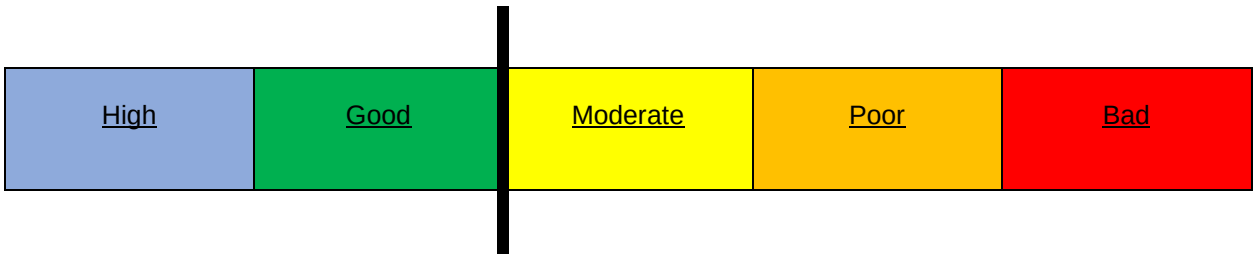
Lithuania’s Flood Risk Management Plans do not yet include a baseline to assess the progress achieved in implementing measures. Also, the coordination with the National Climate Change Adaptation Strategy could be reinforced. In addition, there is scope for clarifying the legal status of the Flood Risk Management Plan (EC, 2019).

3.2 Results

All member states of the EU are required by the WFD to protect, enhance or restore water bodies with the aim of reaching good status or potential. The environmental objects of the directive are outlined in article 4 which set out the objectives for natural surface water bodies, groundwater bodies and artificial and heavily modified water bodies (HMWBs). Surface waters and groundwaters were required to achieve good ecological and good chemical status while HMWB’s had to reach good ecological potential and chemical status by 2015. Article 4 also outlines the necessary measures to prevent deterioration of the status in waterbodies. The same classifying system is used by the member of the EU where ecological status is expressed on a scale of five classes where two (high and good) indicates achievement of the required objectives of status set by the water framework directive (see the next figure).

All partner countries face different challenges in implementation of the water framework directive in terms of impact in water bodies and which measures to take in order to reach good status in water bodies.

Figure 26 | Grading system of ecological status in waterbodies



Source: Figure adapted by Sara Lönnerud (CAB Östergötland) 2020; elements were adapted from https://www.vattenmyndigheterna.se/vattenforvaltning/tillstandet-i-vattnet.html

It should be noticed the exceptions from the environmental objectives described in the WFD is outlined in article 4 of the directive. Article 4 states the conditions under which the deterioration can be accepted, or the achievement of good status/potential may be allowed extended deadlines or not achieved at all. These are:

- Article 4.4: Extension of the time limit
  - Good status or potential must be achieved by 2021 or 2027
- Article 4.5: A less strict environmental objective
  - Under certain conditions
- Article 4.6: Temporary deterioration in status
  - In case of natural causes
- Article 4.7: New Modifications- Activities
  - As a result of new sustainable human activities

If one of the exemptions specified in article 4 are applied for a waterbody, the RBMP have to set out and explain the conditions of the exemptions for the river basin. In this context and as an example it is considered of interest to mention the Weser case.

The case regarding the river Weser in Germany set the grounds for application of the environmental objective. Origin of the case were three projects concerning the expansion of water related traffic on the river. Consequences related to the project were increased flow rate in streams, increased difference in water levels at low- and hightide, increased salinity and increased forming of sludge outside of the fairway. These effects were predicted to affect the ecological status of the river. The German court responsible for the trial of the projects requested interpretation by the Court of Justice of the European Union regarding article 4 and the environmental objectives.

The Court of Justice of the European Union concluded that the members of the union are required to deny permission to activities if they risk deterioration of the ecological or chemical status or ecological potential with regard to the environmental objects stated in article 4 of the directive. Exemptions from the conclusion can however be allowed with referral to article 4:7 of the WFD. The court of justice also specified how “deterioration” should be interpreted. The specification stated that it is applicable to any quality factor where status deteriorates one class i.e., from good to moderate or from moderate to poor. This applies even if the combined status of all quality factors of the waterbody remains unchanged, the deterioration-ban is therefore applicable on a quality factor level as opposed to the water body level.

3.2.1. Spain - Iberian Association of Riverside Municipalities of Duero River

The results of the transposition of the directive of water were of diverse nature but the followings can be

highlighted:

- strengthening of the role of the hydrographic basin as the unit based in the politics management of hydric and water resources;
- an improving in the cooperation with France and Portugal on river basin management;
- a better definition of the RBMPs regarding different aspects like de quality of river´s water, biological and environmental indicators;
- a better classification of the groundwater bodies and their integration in the RBMPs;
- environmental objectives for ecological and chemical status of surface water bodies have been defined for all RBDs as well as for chemical and quantitative status of groundwater;
- elaboration of new legislation or regulations to assure the fulfilment the water directive.

It also deserves to be highlighted the reform carried out that drove to the fusion between the contents of the hydrological plans that were imposed by the Directive, and those of the Water Law having results in new contents for the hydrological plans more detailed and comprehensive.

Currently, in national terms, a monitoring program is in place, considered a basic tool for water management and which must provide the necessary information to assess the effectiveness of the measures adopted and the degree of compliance with the objectives set.

Its definition was made in order to allow, among others, to know the state of the waters; identify the health of aquatic ecosystems taking into account their sustainability, wealth and biodiversity; determine the degree of water contamination; assess the consequences of the emission of pollutants from sources of point and diffuse pollution; avoid or reduce deterioration caused by the presence of priority substances; evaluate the effect of hydromorphological changes; etc. Likewise, the implementation of monitoring programs is essential to monitor the quality of the water destined for certain uses, especially those destined to supply populations. There are currently two types of monitoring programs: one of a periodic nature and the other of a continuous nature.The first aims to:

- control and surveillance in order to allow establishing a global view of the state of the bodies of water;
- control operational, which is intended to determine the status of water bodies at risk and non - compliance with environmental objectives and also evaluate changes that occur in the state of these bodies as a result of measurement programs.
- additional control of protected areas;
- investigation if the source of non- compliance with environmental objectives is unknown .

The second is associated with the assessment of water quality for human consumption and is based on a network analysers and sample automatic pains that allow to obtain the physicochemical data continuously and their transmission of analytical results in real time.

3.2.2. Greece - Regional Development Fund on Behalf of the Region of Attica

In the context of no. 135275/2017 Joint Ministerial Decision (Gov. Gazette 1751B/22-05-2017), for monitoring and improvement of water services in its various uses, a mechanism was created, through an appropriate information system. The information system has been put into operation on the website of the Ministry for the Environment and Energy, http://wsm.ypeka.gr, through which water service providers are obliged annually to enter electronically the required aggregate data regarding their activity. The access to the information system by the water service providers and by the Water Directorates of the Decentralized Administrations will be done by authorized users of each institution. The data provided by the water

service providers will be used by:

- the Water Directorates of the Decentralized Administrations for the preparation of annual reports on the degree of implementation of the policy management of water services in water systems, according to the current Management Plans, etc. and
- the Special Water Secretariat[1] for the preparation of the annual national report[2] on the implementation of the political management of water services.

In the framework of the preparation of the Management Plans, geospatial data sets are produced. The data are related to the determination of River Basin Districts, River Basins, underground and surface Water Bodies.

The degree of the implementation of the program's measures is directly related to the implementation and effectiveness of the Management Plan. Major management issues for the MP for the River Basin of Attica have been the following:

- groundwater deterioration of the (chemical) quality condition due to the strong anthropogenic effects;
- the re-assessment of the pressures exerted and the revision of the program's measures in order to respond to the intensity and origin of the pressures;
- wastewater management in the agglomerations;
- prioritize reuse of treated wastewater as a disposal method, but also for saving irrigation water;
- the peculiarities of the Crop Recording Scheme in the Water District limit the information on individual irrigation water wells;
- the disproportionately large number of poultry farms with very little capacity;
- insufficient financial data.

Additional critical issues that determine the degree of implementation of the MP:

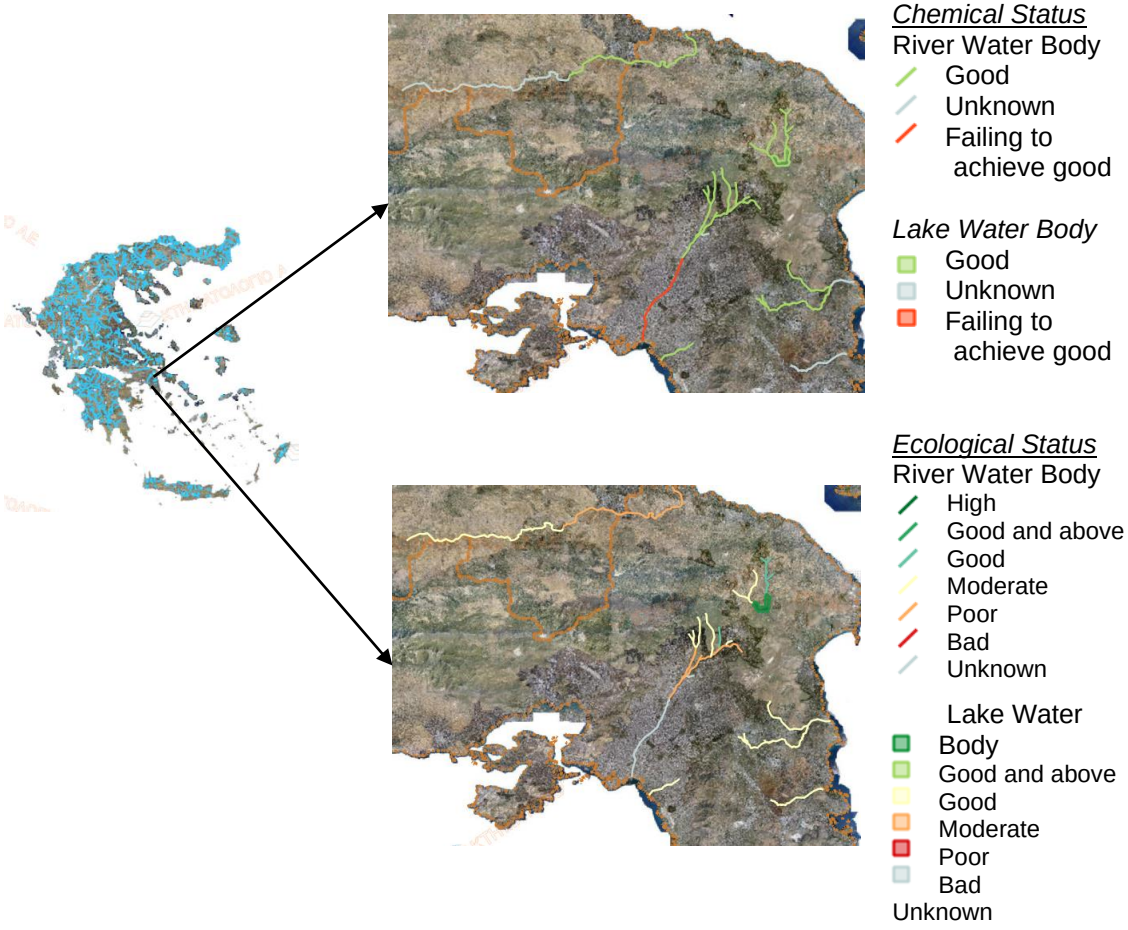
- coordinate the actors involved in its implementation and ensure channels of communication with other stakeholders.
- evaluation of the results of the Water Monitoring Network

In the MP for the River Basin of Attica 7 waterbodies are included: river Kifisos, 5 streams (Laka, Paliomiaouli, Rafina, Pikrodafni, Erasinos) and lake Marathon (or Marathon reservoir). Part of Asopos river in the geographical jurisdiction of Attica is included in the MPs for the River Basin of Central Greece. The chemical and ecological status of these water bodies are illustrated in the following images:

[1] The (former) Special Secretariat for Water is the authority to prepare programs for the protection and management of the country's water resources and the coordination of services and government agencies on any issue related to the protection and management of water.

[2] The link refers to "*The Environmental Implementation Review 2019*"

Figure 27 | Status of waterbodies, River Basin of Attica



Source: The images have been produced in the Geoportal application of the (former) Special Water Secretariat of Greece website

According to the 1st RBMP approved (in 2013) implementation of Article 4.4 (extended deadline) exemption, with the justification of "technical infeasibility", was proposed for fourteen (14) surface water bodies and twelve (12) ground water bodies from the total water bodies of the river basin district of Attica that are included in the list of "exemptions". Amongst them, stream Laka, Paliomiaouli and Rafina and Kifisos river.

When arguing for the operation of an industry or other development, environmental quality standards (ESQ) are taken into consideration via environmental impact assessment study approval resulting in specific requirements and restrictions on operational aspects of the industry or activity.

3.2.3. Romania - The National Union of Romanian Entrepreneurs

In order to comply with the requirements in terms of quality of the water for human consumption, Romania has taken over the ownership of following responsibilities:

- implementation of a drinking water quality monitoring system for the entire country;
- implementation of technological improvements at water treatment plants;

- rehabilitation of drinking water transmission and distribution networks;
- replacement of water installations up to the level of end users and generalization of metering.

Romania has obtained transition periods for compliance with the EU regulations for the collection, discharge and treatment of municipal wastewater - by 2015 for 263 human agglomerations of more than 10,000 inhabitants and by 2018 for 2,346 agglomerations between 2,000 and 10,000 inhabitants. Transition periods were also obtained for drinking water quality until 2015, for compliance with Directive 98/83/EC on the quality of water intended for human consumption. Moreover, following the accession negotiations, Romania declared its entire territory as a sensitive area, this aspect implying the obligation that all human agglomerations populated by more than 10,000 inhabitants be provided with advanced wastewater treatment plants.

Despite the efforts already made, Romania is still behind the path to reaching the objectives of the EU Accession Treaty, according to which all agglomerations with more than 2,000 PE must be equipped with water collection systems and wastewater treatment plants (secondary and tertiary), and human agglomerations of less than 2,000 PE must carry out appropriate water treatment in appropriate centralized systems and/or individual systems. To achieve this goal, the Romanian authorities are carrying out strategic projects to support the implementation of the EU regulations in the field of environment and to reduce the gap between Romania and EU standards. Regarding the type of treatment, advanced wastewater treatment is specific to agglomerations larger than 10,000 PE, and secondary treatment (biological stage) is a general rule for human agglomerations of less than 10,000 PE. In addition, for human agglomerations smaller than 2,000 PE which are located in hilly or mountainous areas, geo-morphological and climatic conditions require specific and individual solutions (small treatment plants, natural water treatment in aerobic lagoons or other unconventional water treatment methods).

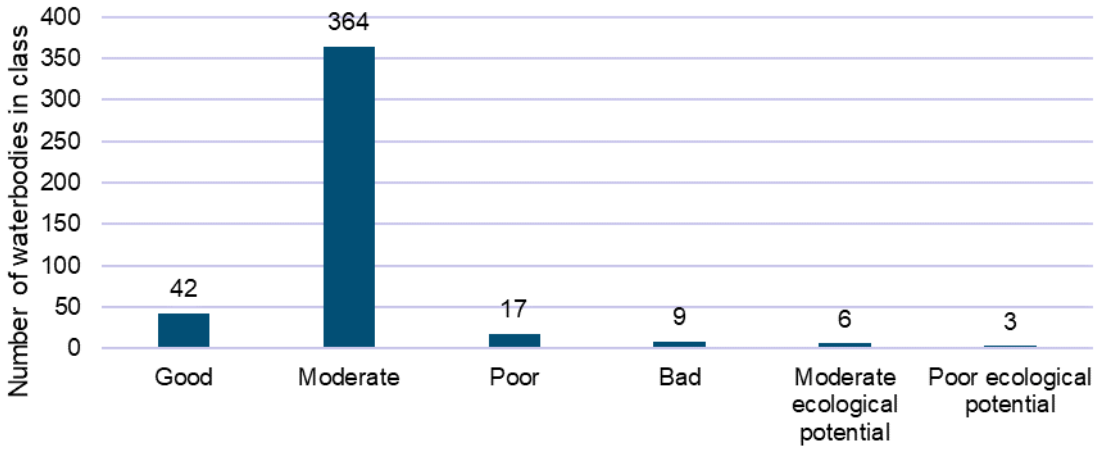
3.2.4. Sweden - The County Administrative Board of Östergötland

The county of Östergötland has many waterbodies of all four categories (coastal, rivers, lakes and groundwaters). The distribution in the different water types in Östergötland are:

- 45 coastal waters;
- 273 rivers;
- 123 lakes;
- 174 groundwater aquifers.

During 2019, the latest status classification of water bodies in Östergötland was performed where 441 waterbodies received classifications for cycle 3 (2016-2021). Most of the waterbodies in the region are considered to be in moderate status (Figure 27).

Figure 28 | Status of waterbodies in Östergötland, in cycle 3 (2016-2021)

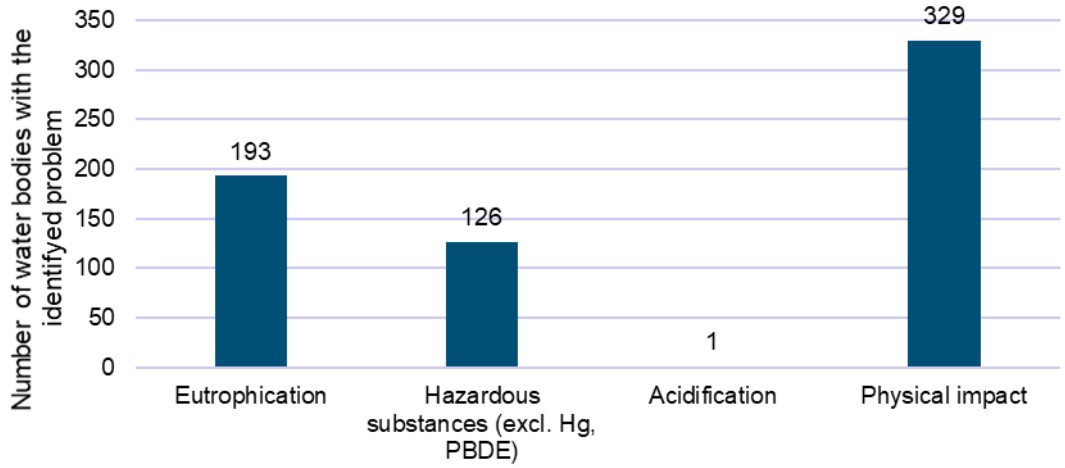


Source: Figure based on data from WISS 2019 (https://viss.lansstyrelsen.se/)

Problems such as eutrophication, hazardous substances (PBDE and Mercury excluded), acidification and physical impacts (i.e. hydro morphology) were identified causes for status lower than good (Figure 28).

All classifications, suggested measures and EQS are made available for the public at the webpage VISS (water information systems Sweden). The information is given for each water body and all parameters that have been measured and evaluated during the cycle are presented. Motivations for classifications, suggested measures and EQS are also presented for each water body.

Figure 29 | Identified environmental problems causing moderate, poor or bad status in water bodies in Östergötland, cycle 3 (2016-2021)

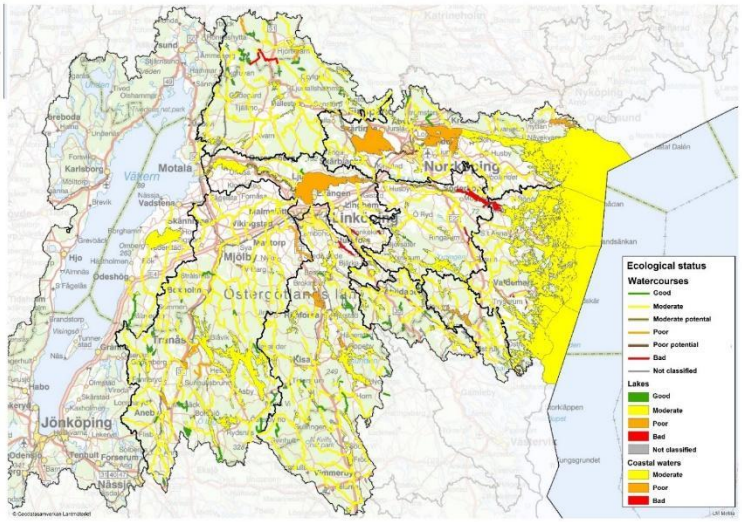


Source: Figure based on data from WISS 2019 (https://viss.lansstyrelsen.se/)

Regarding the ecological status it can be said that the main environmental problem causing less than good ecological status in watercourses, lakes and coastal areas in Östergötland were physical impact, followed by eutrophication. The region of Östergötland is highly productive in regards of producing crops and livestock, resulting in a higher amount of nutrient loss from fields by runoff to rivers and subsequently to lakes. Other large sources for nutrients are wastewater treatment plants, and in urban areas surface runoff from cities. Many measures have been taken to reduce the effects of nutrients such as removal processes in WWTP, wetlands and protective areas in proximity to agricultural lands to reduce nutrient

loss.

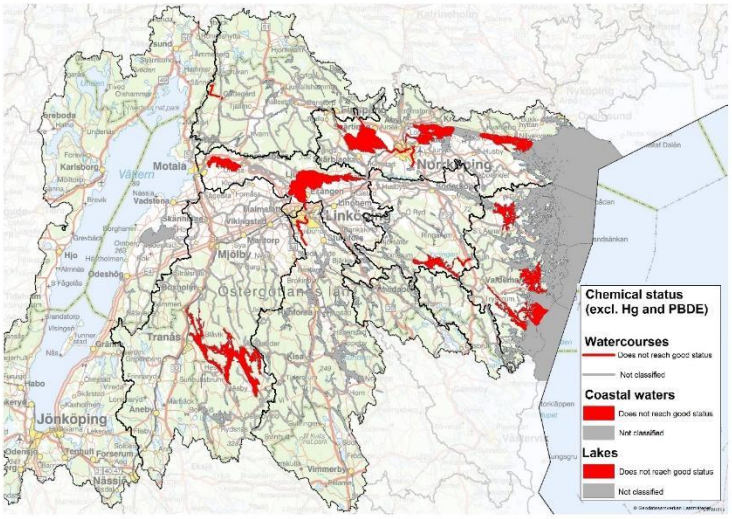
Figure 30 | Preliminary Ecological status in surface waters, Östergötland county 2019



Source: Ostgotakartan 2019 https://ext-geoportal.lansstyrelsen.se/standard/?appid=57213faf51ad4e918140e23a11a47dc0

The chemical status was determined for surface waters where Sweden has determined thorough measurements on national level that all surface waters contain levels of mercury (Hg) and polybrominateddiphenyleters (PBDE) above limits in biota stated by the WFD. Therefore, all surface waters in Sweden are considered to not reach good chemical status. The water authorities have concluded that the main reason for the high levels of these substances is due to large-scale atmospheric deposition but in some cases local emissions have occured.

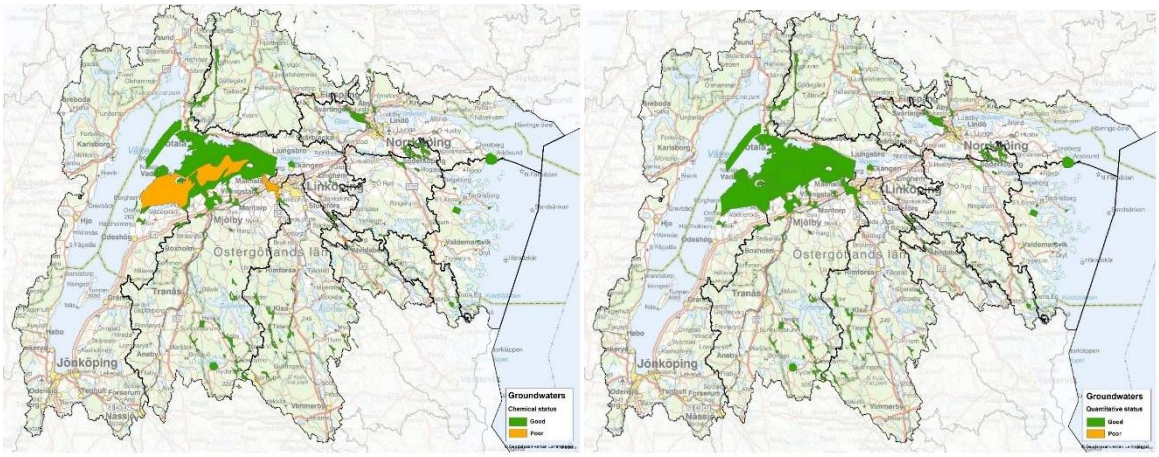
Figure 31 | Preliminary chemical status in surface waters, Östergötland county 2019



Source: Ostgotakartan 2019 https://ext-geoportal.lansstyrelsen.se/standard/?appid=57213faf51ad4e918140e23a11a47dc0

For groundwaters there are two classification categories regarding chemical status and quantitative status. In five groundwater aquifers status were assessed as poor, the resason for this classifiction were pesticides (BAM and Bentazone) and several other substances were at risk of deterioration of status (PFAS11 and Clorides) (Figure 31). Similarly, quantitative status was only assessed as less than good in one groundwater aquifer, but several has been found to be at risk for deteriorated status.

Figure 32 | Preliminary chemical (left) and quantitative (right) status in groundwaters, Östergötland county 2019



Source: Ostgotakartan 2019 (https://ext-geoportal.lansstyrelsen.se/standard/?appid=57213faf51ad4e918140e23a11a47dc0)

Regarding the compliance with the environmental quality standards (ESQ) as cycle 3 is still in progress reported data is from the previous cycle. In cycle 2 the exemptions were decided by CAB and the Water agencies. Decisions concerning if an exception can be applied can only take place following evaluations of the possible measures and if the cost of these are reasonable an exception from the EQS is made (HaV, 2014). The total distribution of the parameters that caused exceptions made during Cycle 2 can be seen in Table 11.

Table 11 | Exemptions from basic requirement of good status/good potential by 2015 in Cycle 2 (2009-2015)

Water bodies with EQS (2010-2015)				
	2015	**2021**	**2027**	**Exemptions from EQS**
Ecological Status				
Continuity	0	145	90	0
Eutrophication	0	21	103	0
Morphological changes	0	63	101	2
Flow regulations	0	32	9	0
Acidification	0	3	0	0
Fish	0	0	3	0
Connectivity in rivers	0	0	3	0
Hydrological regime in rivers	0	0	3	0
Nutrients	0	2	0	0
Morphological conditions in rivers	0	0	2	0
Zinc and copper	0	4	0	0
Chemical Status				
Anthracene	0	0	5	0
Lead and lead compounds	0	1	1	0
Brominated diphenyl ether	0	0	0	448*
Cadmium and cadmium compounds	0	0	3	0
Mercury and mercury compounds	0	0	0	448*

Water bodies with EQS (2010-2015)				
	2015	2021	2027	Exemptions from EQS
Tributyltin compounds	0	0	5	0

*National exception decided by the water agencies S

Source: WISS 2020

Environmental quality standards can and are used in applications for permits and development of activities in Sweden that can affect water quality. This procedure has been applied in applications for permits or updated permits for activities. One activity involving a slaughterhouse and food production by preparation and handling of animal produce and sewage treatment was handled in the region of Östergötland.

The slaughterhouse was planned to handle 80 000 tonnes of chicken, south west of Händelö in Norrköping. The point of discharge was planned to be located in different parts of Bråviken (Loddbyviken-Pampusfjärden-Bråviken). Calculated dischargers were 8,1 tonnes of nitrogen and 0,3 tonnes of phosphorus. Lindö Canal would be the first recipient of discharge, which due to its high flow would reach Pampusfjärden quickly.

Figure 33 | Location of slaughterhouse

Source: CAB-Östergötland 2019

Pampusfjärden and the downstream located waterbodies Inner- and Middle-Bråviken are in poor ecological status, while Outer-Bråviken are in moderate ecological status and then continues into the Baltic sea. Waterbody Pampusfjärden was already in a need for mitigating measures regarding nitrogen and phosphorus with large reductions needed (140 t/N/y and 41 t/P/y). Each CAB has an independent function which make decisions concerning permits of hazardous activities, this function is the County environmental appeal delegation (MPD) where both legal and environmental competences are included. Assessment by the MPD resulted in conclusions:

- the activity was not compatible with the EQS and PoM determined for receiving waterbodies Loddbyviken and Pampusfjärden.

- compensatory measures could not be found
- contribution of nutrients from the activity are at risk of deterioration of quality factors such as benthic fauna
- emission from the planned chicken factory would in a non-insignificant way contribute to not been able to achieve an EQS defined in 5 Ch. 2 § first section of the environmental code.

The MPD recommended the application to be denied and permission to be rejected in January of 2019. Following the rejection, the case was appealed to Land and Environment Court which however ruled the appeal to be dismissed in October of 2019.

3.2.5. Portugal - CIM Alto Minho

The transposition of the Water Framework Directive into Portuguese national law made it possible to reinforce the role of river basins in water management as well as to introduce the concept of ecology as well as the preservation of ecosystems in the management of water resources to the detriment of an earlier view more focused on water issues of physicochemical quality of water.

On the other hand, with the implementation of the directive, new instruments were introduced in Portuguese national law and the existing ones were readjusted to the new legislation. The programs and measures for water quality, the PGRH and the creation of the hydrographic regions deserve to be highlighted. The elaboration of the River Basin Plans, during the various cycles of implementation of the directive, allowed a more systematic and sustained identification of the environmental problems associated with the use of this natural resource. When looking at the development of the basin's water resources, integrating the hydrological, ecological, social and economic components in the context of the basin's realities, ensure a greater impact on the effective improvement in the quality of rivers and waters and are also responsible for effectively guiding and directing the implementation of the principles planning for the sustainable use of water resources

There was also an administrative reformulation of the various state bodies that existed until then and competences in this domain, which constitutes an important result of this transposition.

These changes, operational, administrative and technical, resulting from the transposition of the Water Quality Directive, have led to a significant improvement in the water quality of the different water sources, as well as in the respective ecosystems and even more knowledge of the reality associated with each hydrographic basin, with very positive impacts on the planning and management of this natural resource.

The loss of some autonomy of the regional authorities in defining the different river basin instruments and plans is pointed out as one of the least positive aspects resulting from the transposition of the directive. The demand placed on the level of technical, human and financial resources is one of the greatest difficulties experienced throughout the various implementation cycles.

In the case of the Minho and Lima hydrographic basin, the revision of the delimitation process of water bodies, carried out in the 2nd planning cycle in the hydrographic region, resulted in 71 surface water bodies, of which 61 are natural water bodies, and 2 water bodies underground. The classification concludes that 68% with good or better status, 32% with less than good status and 0% with unknown status. Regarding groundwater bodies, this classification was that 100% with good or higher status (source: APA).

The application of WFD in the industrial context led to an increase in the demand for limit values for various parameters for the rejection of wastewater in water environments. On the other hand, there was a significant investment, both public and private, in wastewater treatment systems, which led to an

improvement in the overall water quality in the country. Awareness-raising programs and incentives for the application of the best available technologies regarding the use of water in the various sectors of industrial activity were also implemented.

3.2.6. France - Cluster DREAM

Cause for water bodies not reaching EQS

From the inventory validated by the basin committee of the Loire-Bretagne water agency:

Table 12 | Causes of the risk of non-achievement of environmental objectives (WFD)

	Risk	Conformity	Total
Number of water bodies	86	22	108
Risk causes	YES	NO	
Phosphorus	72	36	
Nitrates	64	44	
Pesticides	14	94	
Micropollutants	0	108	
Pressures on the morphology	2	106	

The territory is subject to various pressures:

- Water quantity:
  - Withdrawn water is probably the most striking. The overall annual withdrawals in the basin are around 4 billion m³, half of which for power stations.
  - Irrigation is the usage that has the highest net consumption at low water in a large central part of the basin. The pressures exerted on some bodies of underground water (such as Beauce in the Centre-Val de Loire Region) have an impact on the water supply of rivers (and therefore their ecological status).
- Diffuse pollution remains a strong challenge in Loire-Bretagne. Diffuse inputs of nitrates, phosphorus and pesticides remain a major risk cause for the water bodies.

Cost recovery:

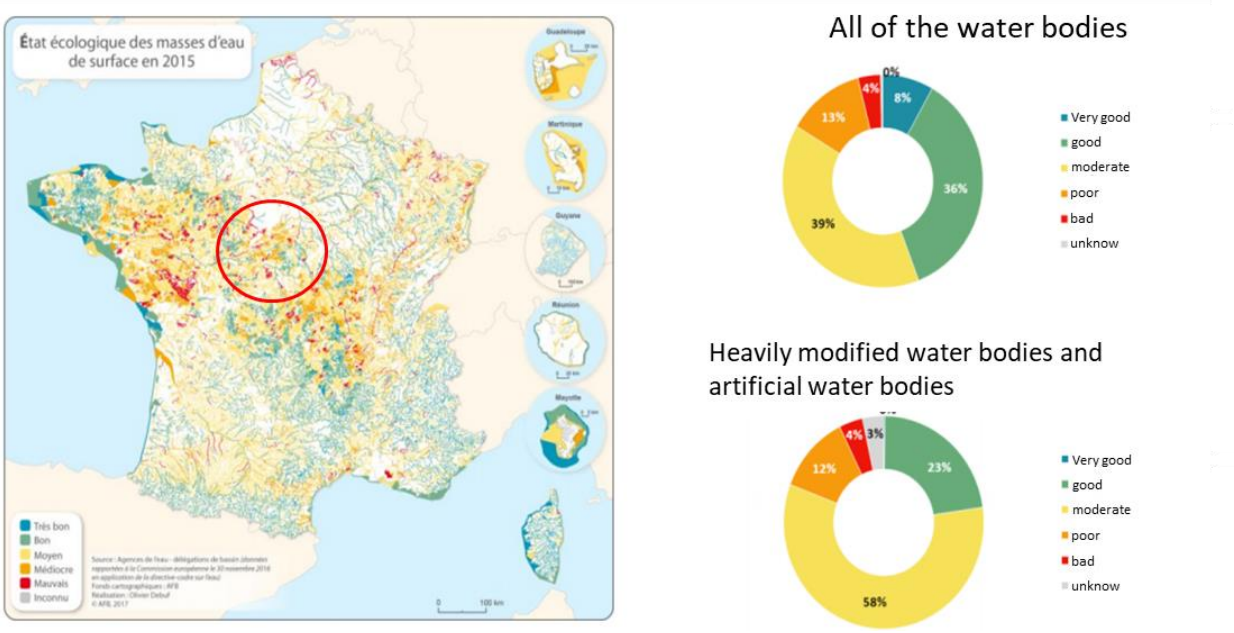
The characterization of the hydrographic basins requested by Article 5 of the WFD must be based on an economic analysis of water uses. The annual cost of services related to the use of water in Loire-Bretagne is estimated at 5.215 billion euros. The Loire-Bretagne water agency dedicated the majority of its budget to the financing of operations for achieving good water status. Over the period 2013-2016, the average amount of funding is valued at 280 million euros, including pollution reduction and treatment operations (Comité de bassin Loire-Bretagne 2019).

Ecological status

In France 44.2% of the 11,414 bodies of surface water (all categories of water combined) were at least in

good ecological condition in 2015 (Figure 34). Of these water bodies 62.9% were in good chemical condition.

Figure 34 | Repartition of ecological water mass body in France 2015



Source: (Eau France [2020]).

The proportion of water bodies in good chemical condition differs according to the water category. The distribution in 2015 were: 62% for watercourses, 84.4% for water bodies, and 51.1% for transitional waters (Eau France [2020]).

Groundwater

Good quantitative condition was reported for 89.8% of the 645 bodies of groundwater in 2015. In addition, 69.1% of these water bodies were in good chemical condition. This distribution of condition percentage is explained by the presence of pesticides which are considered as downgrading parameters. Indeed, 72.9% of groundwater bodies that do not reach good chemical status are in fact downgraded by one or more of these pollutants (Eau France [2020]).

Status of water bodies at the scale of the Loire Bretagne River basin

For watercourses, a preponderant part of the risk is linked to the pressures exerted on hydrology, morphology, by obstacles to the flow as well as by pesticides. Approximately 79% of watercourses (or 1,492 bodies of water out of 1,887 existing) present a risk of non-achievement of their environmental targets in 2027 (Table 12).

Table 13 | Status of water bodies at the scale of the Loire Bretagne River basin

Loire-Bretagne River Basin				
Type of water body	**Ecological status**	**Chemical status**	**Objectif SDAGE (2016-2021) Ecological status**	**Objectif SDAGE (2016-2021) - Chemical status**
Stream	• 2% in very good status (2013) • 26% in good status (2019) • 43% in moderate status (2013) • 21% in poor status (2013) • 10% in bad status (2013) (Agence de l'eau Loire-Bretagne 2018a)	-	• 61% in good status (Agence de l'eau Loire-Bretagne 2018a)	-
Water bodies	• 1% in very good status (2017) • 16% in good status (2017) • 6% in moderate status (2017) • 16% in poor status (2017) • 1% in a bad status (2017) (Comité de bassin Loire-Bretagne 2019)	-	• 54% in good status (Agence de l'eau Loire-Bretagne 2018a)	-
Groundwaters	-	• 64% in good status (2017) • 36% in poor status (2017) (Comité de bassin Loire-Bretagne 2019)	-	• 75% in good status
	Quantitative status		**Objectif SDAGE (2016-2021)- quantitative status**	
Underground waters	• 88% in good status (2017) • 12% in bad status (2017) (Comité de bassin Loire-Bretagne 2019)	-	• 100% in good status (Agence de l'eau Loire-Bretagne 2018a)	-

Ecological status

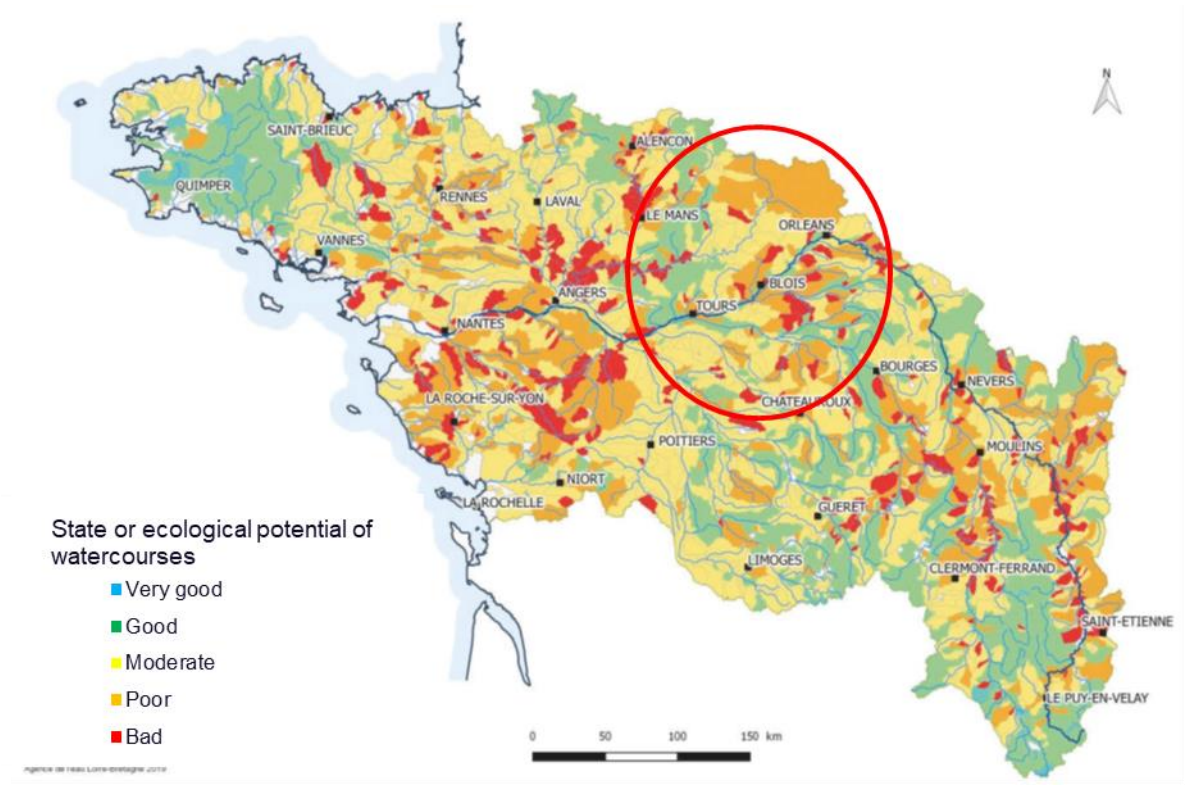
Rivers

- Loire-Bretagne River Basin

The main downgrading biological quality elements of the ecological status are fish index (for 62% of water bodies) and diatom index (for 52%) (Comité de bassin Loire-Bretagne 2019). For the nutrient quality element, 38% of rivers suffered reduced status, mainly due to the total phosphorus parameter.

Pollutants specific to the ecological status are downgraded to 29% while they were almost never downgraded during the previous inventory, this being linked to the passage from 5 to 12 pesticides in the new assessment rules for ecological status (Comité de bassin Loire-Bretagne 2019). As shown on Figure 35, the red circle identifies the Centre Val de Loire Region.

Figure 35 | 2017 ecological status of rivers - 2015-2017



Source :(Comité de bassin Loire-Bretagne 2019)

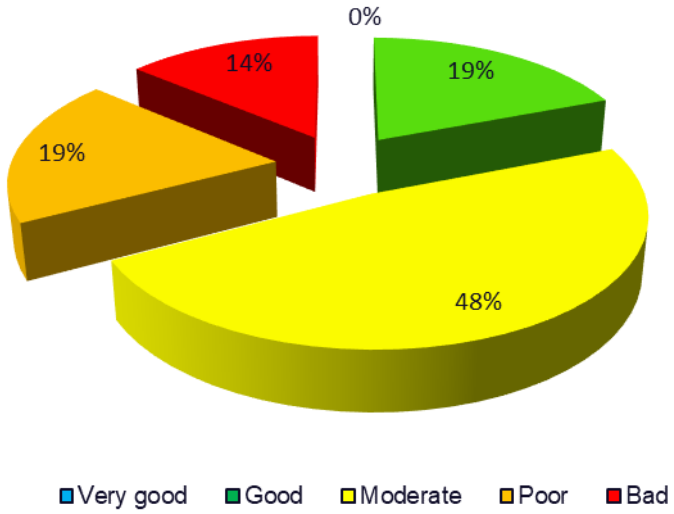
Waterbodies

The main downgrading factor remains eutrophication due to excess nutrients, especially bad phosphorus. Majority of water bodies which are classified as in poorer than good condition (i.e. moderate to bad) are shallow. Four natural lakes are downgraded to less than good condition solely because of the fish indicator. The pressure-impact relationships on this compartment are not clearly established and, for the moment, make it impossible to establish a program of measures to remedy the problem.

The main cause for degradation was eutrophication due to excess nutrients, especially phosphorus, whether brought by tributaries or already stored in the sediments of the water body (Comité de bassin Loire-Bretagne 2019).

Almost 50% of the water bodies in the Centre-Val de Loire region are in a moderate ecological status.

Figure 36 | 2017 ecological status for Centre-Val de Loire Region



Chemical status

Loire Bretagne River Basin

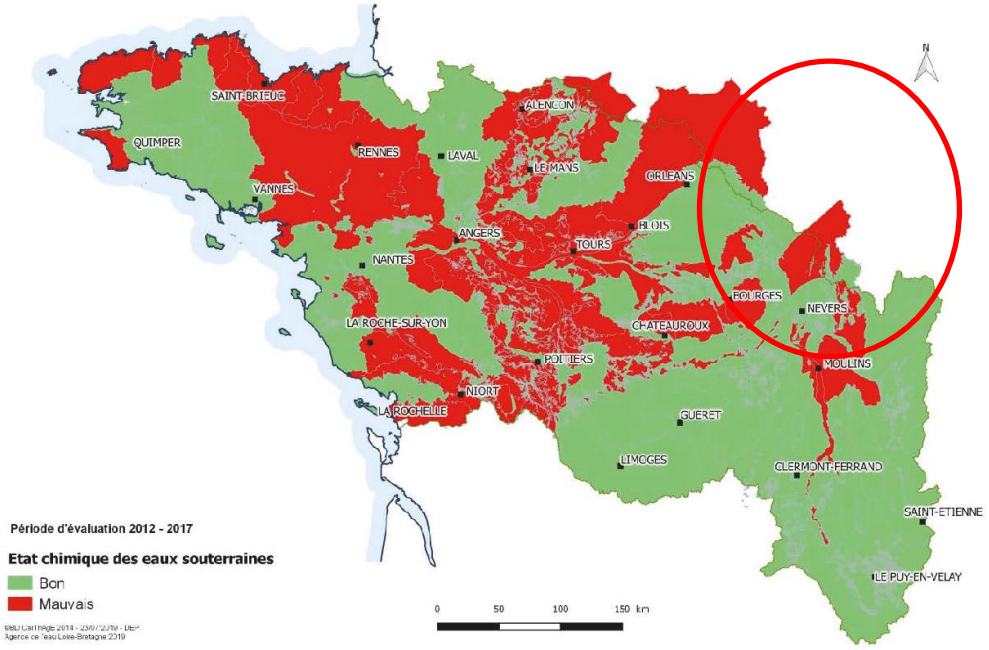
- Continental surface waters

Over the period 2009 to 2014, less than 3% of streams presented a bad chemical status. This was mainly due to the levels of pesticides in 70% to 100% of cases depending on the year (Secrétariat technique de bassin Loire-Bretagne 2015).

- Groundwater

The assessment of the chemical status of groundwater shows that almost 2/3 of the bodies of groundwater (64% or 93 water bodies) are classified in good chemical condition. Water bodies classified as having poor chemical status (36%) are degraded by high levels of nitrates alone (42%), pesticides alone (23%) or both (36%). In addition, many bodies of groundwater have a natural geochemical background for different elements. The parameters concerned are mainly manganese, iron, arsenic, aluminum and more locally orthophosphates, fluoride ion, selenium, total phosphorus, sulfates, ammonium, chlorides and nickel (Comité de bassin Loire-Bretagne 2019).

Figure 37 | Chemical status 2017 of groundwater - 2012-2017(the red circle = Centre -Val de Loire Region)

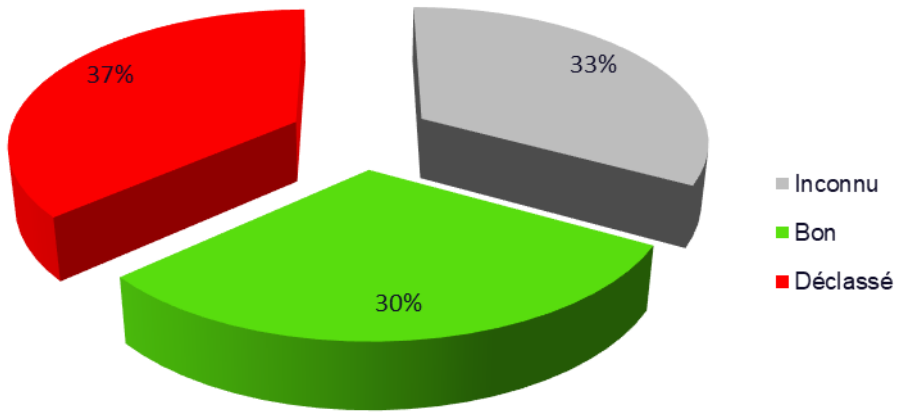


Source: (Comité de bassin Loire-Bretagne 2019)

Centre- Val de Loire Region

30% of the water bodies are in a good chemical status.

Figure 38 | 2017 Chemical status all molecules



Source: (Comité de bassin Loire-Bretagne 2019)

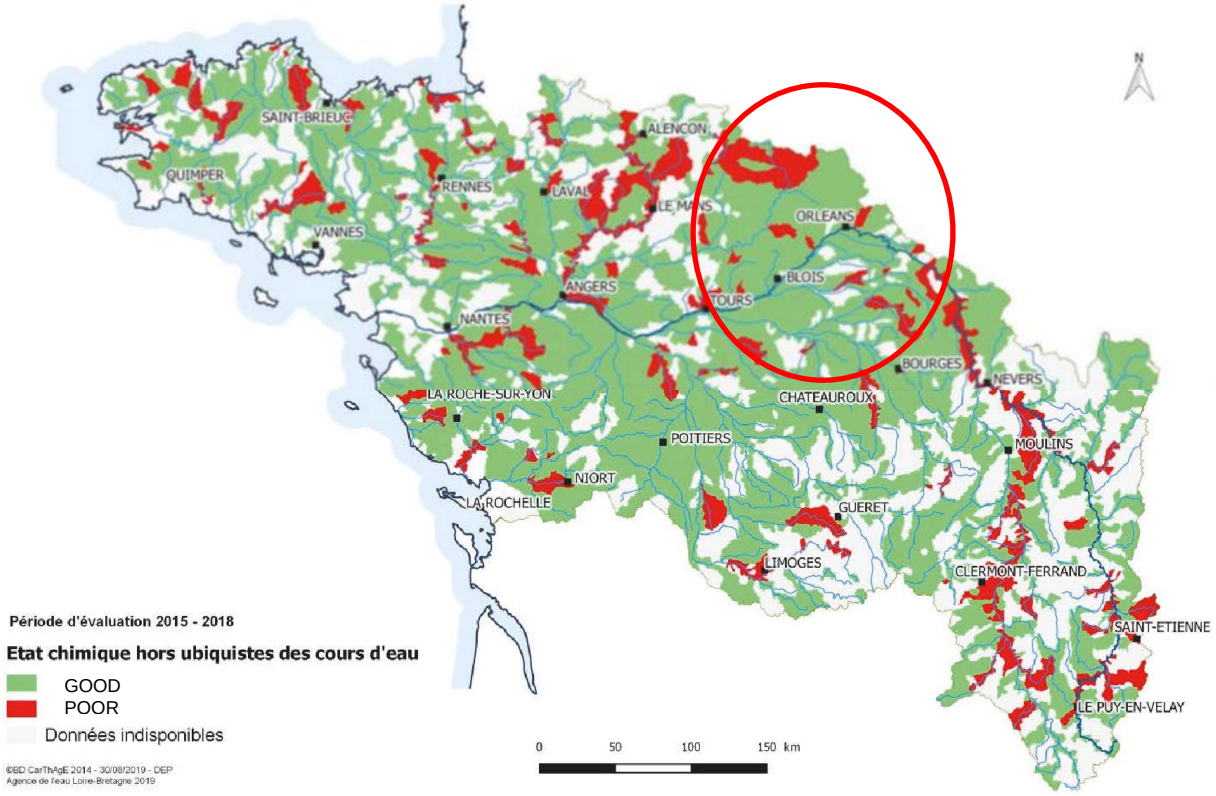
Physico-chemical status

All water bodies

- Loire Bretagne River Basin

The main downgrading physicochemical parameters of the ecological status were dissolved organic carbon (COD, 46%), phosphorus (total phosphorus for 33% and PO43- for 19%), oxygen saturation rate (32%) and dissolved oxygen (23%). Nitrates were involved in the decommissioning of only 7.5% of the water bodies (Comité de bassin Loire-Bretagne 2019).

Figure 39 | Chemical status excluding ubiquitous watercourses 2015-2018



Source: (Comité de bassin Loire-Bretagne 2019

Water body

- Loire Bretagne River Basin

The quantification rate for waterbodies is only 2.9%, which is half the rate for rivers. Of the 108 water bodies in the 2009-2017 benchmark, 6 of them were in poor condition. The responsible parameters were:

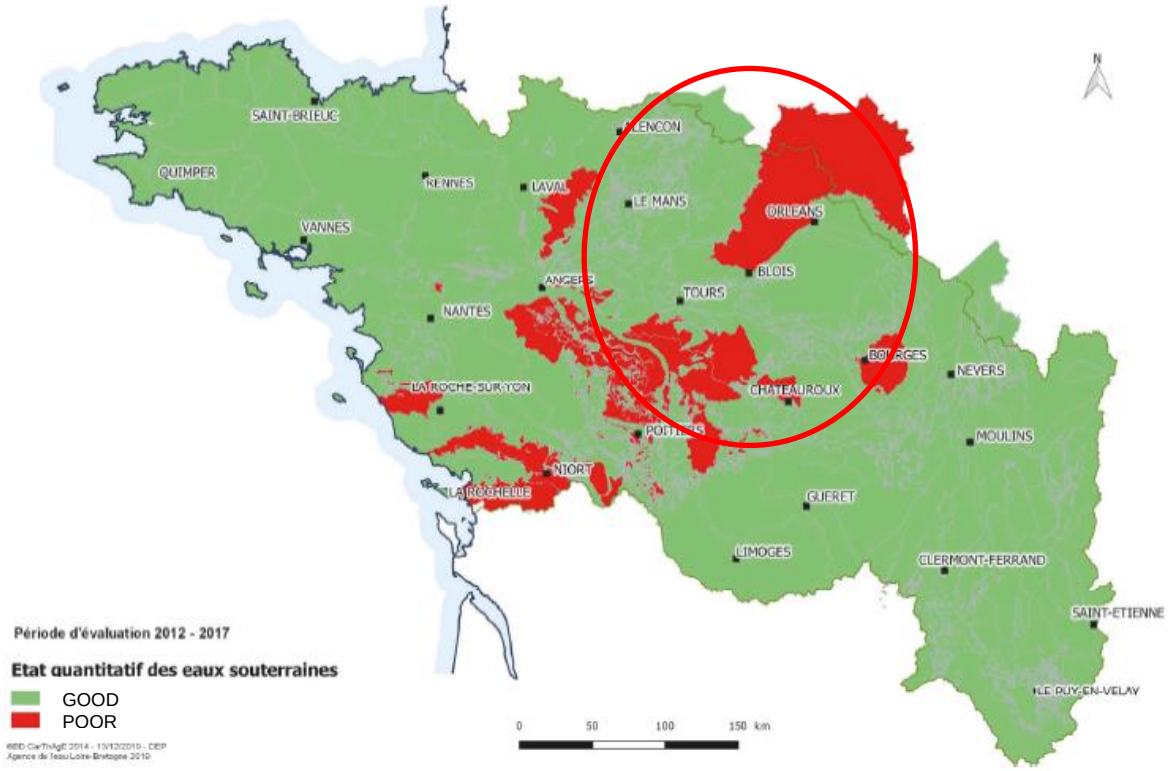
- fluoranthene for 5 water bodies;
- 4-nonylphenols for 3 bodies of water;
- dichlorvos, DEHP and terbutryne for 2 bodies of water each LINK.

Out of these 69% of the water bodies have kept the same status, 22% improved of which 15% however remained in less than good condition. For 9% of the waterbodies a deteriation of condition was observed (Comité de bassin Loire-Bretagne 2019).

Quantitative report

The assessment of the quantitative status of groundwater shows that 88% of the water bodies are in good quantitative condition (i.e. 128 water bodies),12% of the water bodies are in poor quantitative condition (i.e. 18 water bodies). They are downgraded because they do not guarantee a sufficient supply of water for the proper functioning of the associated surface and / or terrestrial aquatic ecosystems (Comité de bassin Loire-Bretagne 2019).

Figure 40 | 2017 quantitative status of groundwater - 2012-2017



Source: (Comité de bassin Loire-Bretagne 2019)

SWOT-analysis

The SWOT analysis below presents a summary of the main challenges for the water management in the region.

Table 14 | Analysis of management problems and water quality (SWOT)

Analysis of management problems and water quality	
Strengths	**Weaknesses**
• Integration of socio-economic issues associated with the preservation of water resources and aquatic environments included in the RBMP (example services provided by aquatic environments in	• Diffuse pollution Whether it is pollution by nitrates, phosphorus, pesticides, dangerous substances, pathogenic microorganisms or more simply by organic matter, all

Analysis of management problems and water quality	
Strengths	**Weaknesses**
decision-making or the value of natural heritage). • anticipation of climate change issues with, for instance, a focus on sensitive environments, such as the river basin heads. • Subsidies oriented towards: - the decrease of the domestic pollution - subsidies until 2021 to structure public sanitation services and to complete the self-monitoring implementation. - to modernize and improve treatment plants and priority sanitation networks that meet the challenges of wastewater treatment (quality of aquatic environments and preservation of sensitive uses). - Initiatives fostering the implementation of clean technologies everywhere to reduce micropollutants pollution at the source. - the decrease of agricultural pollution: by implementing agricultural action programs within the framework of ambitious territorial contracts which aim to change practices and systems favo**u**rable to water combining different support systems. • With the compliance of urban treatment plants, the Loire-Bretagne basin has a park of modern and efficient stations. • A better consistency between the water policy and the regional planning. For example, some local authorities support tools to better integrate water into urban planning. • The development of new technologies supporting the access to information, the exchange of data and the improvement of knowledge of water stakeholders. • A strong knowledge of the water status, thanks to the major campaigns to measure the water quality carried by the water agency. • The involvement of local actors in the water debate and in the implementation of water actions.	environments, rivers, bodies of water, groundwater underground and coastal waters are affected by this pollution. Governance issues: Difficulties to identify the right contact for small and large water cycles.
Opportunities	**Threats**
• Improve knowledge, communication and awareness of the functioning and services provided by aquatic environments. • The reorganization of local water skills (optimal structure) to promote the sustainable management. • Prevent further degradation and restore the functioning of degraded environments. • Take better account of the preservation of biodiversity by protecting the remarkable environments and species of our basin. • A necessary link with the flood directive and strategy for the marine environment.	• Impact on the quality of aquatic environments from direct discharges of effluents by collective sanitation networks. • The Loire-Bretagne basin is partly covered by “water distribution zones” where summer withdrawals exceed the availability of the resource. • The winter resource is generally more important than the summer resource. • One of the main obstacles to interventions in aquatic environments remains, in some territories, the weak involvement of contracting local authorities.

Source: (Agence de l’eau Loire-Bretagne 2018a) (Ministère de la Transition écologique et solidaire 2019) (Porteneuve 2020)

3.2.7. Lithuania - Kaunas University of Technology (KTU)

Around half of Lithuanian surface water bodies are not reaching good ecological status (51% of rivers and 40% of lakes). The 12 Lithuanian groundwater bodies benefit from good chemical and quantitative status in all river basin districts although high concentrations of fluorides, sulphates and chlorides have been detected in some areas.

More specifically, diffuse pollution from agriculture (undermining water quality in 30% of water bodies) and straightening of rivers (undermining 45% of the good ecological status of rivers) have major impacts on water quality.

Lithuania is divided into 4 river basin districts and comprises 1185 surface water bodies (approximately 2/3 of which include rivers and 1/3 lakes). The country has 2 coastal bodies and 4 transitional water bodies. It also shares three river basins with Latvia and one river basin with Belarus, Poland and Russia.

According to the EU Water Framework Directive 2000/60/EC (hereinafter referred to as the WFD) a decision was made to consider the river basins to be the most important objects of the management of the status of water bodies instead of individual polluters or other sources of pollution. The basins are natural hydrological-geographic systems; therefore, their management should be based on a complex approach. In Lithuania, this policy was consolidated in the Law Amending to the Law on Water of the Republic of Lithuania, which was harmonized with WFD. Based on the WFD, the main aim of water policy is to ensure “the good status of water bodies”.

In 2004, when Lithuania joined the European Union, same as other EU Member States, it obligated to prepare river basin districts management plans and determine the measures enabling the achievement of good ecological and chemical status of the national water bodies. For the purposes of management of water bodies, the basins of Lithuanian rivers were divided into four river basin districts – Nemunas, Venta, Lielupė and Dauguva – that were thoroughly described, the main natural, social and economic conditions were indicated and the water bodies were grouped according to the natural characteristics.

In 2007, the society was introduced with the main water protection issues in Nemunas, Venta, Lielupė and Dauguva River basin districts. Later the management plans and action programs of measures were prepared for the aforementioned river basin districts. These documents were approved by the resolutions of the Government of the Republic of Lithuania in 2010. The river basin districts management plans are updated every six years. The first management plan was implemented during the period from 2010 to 2015.

After Lithuania joined the European Union, the progress in the reduction of pollution from point pollution sources has been observed. Modernized or newly built wastewater treatment facilities in major cities allowed the national-scale reduction of release of main pollutants into surface waters.

Pursuant to the requirements of the Council Directive concerning urban waste water treatment (91/271/EEC), from 31 December 2007, the waste water from the agglomerations with a population equivalent (p. e.) of more than 10,000 should be treated according to the established requirements, from 31 December 2009, waste water collection systems meeting the established requirements should be operating in the agglomerations with p. e. of more than 2,000 and, from 31 December 2009, the waste water should be treated based on the established requirements in agglomerations with p. e. from 2,000 to 10,000.

The main short-term objective is to reduce the pollution with nitrogen and phosphorus from diffusive sources. The diffusive pollution sources are distinguished into two main groups: pollution conditioned by

agricultural activity and pollution conditioned by residents discharging wastewater, which is not collected and treated. In agriculture, the diffusive pollution is formed due to fertilization of crops by using livestock manure and mineral fertilizers. One of the main measures reducing the pollution of the Nitrates Direction (91/676/EEC) is the construction of manure storages in the farms keeping more than 10 livestock units (hereinafter – the LU). Until 2012, such stock-raising farms had to install manure storages. Another measure stipulated in the Nitrates Directive is the fertilization procedure by indicating the standards of fertilization with chemical fertilizers and livestock manure and the fertilization of soggy, flooded, frozen soils or soils covered with snow.

Marine Strategy Framework Directive (2008/56/EC) obliges the Member States to prepare the marine strategy for sea waters pursuant to which the good marine environment state should be achieved and/or maintained. The properties of good environment state of the Baltic Sea and associated aims were established pursuant to the qualitative indicators indicated in the Marine Strategy Framework Directive.

The long-term objective is the development of effective system of evaluation and management of the risk of floods in view of the social, economic and environmental aspects. In 2007, the European Union adopted the Floods Directive (2007/60/EC) the aim of which is to create the system of evaluation and management of risk of floods by 22 December 2015 in order to minimize the negative consequences of floods caused on human health, environment, cultural heritage and economic activity.

The Law on Water regulates the ownership of the internal water bodies, the management, use and protection of water resources and the rights and obligations of users of internal bodies of water and their resources. According to the law, the use of water resources shall be regulated considering the needs of the economy and population. It should guarantee a sustainable use of surface and groundwater resources, prevent waters from pollution and protect the rights of owners of bodies of water and users of their water resources. The Government of the Republic of Lithuania formed a Co-ordination council of the Dauguva, Lielupė, Nemunas and Venta RBDs, which was made up of both representatives of public authorities (ministries and municipalities) and stakeholder representatives. Key sectors were involved, such as fishermen, geological enterprises, environmental non-governmental organisations, industrialists, chambers of commerce, industry and crafts, water supplier's association, agriculture, green movement, management and hydraulic engineers and the Water Problem Council at the Lithuanian Academy of Sciences.

Lithuania proceeded with the adoption of the RBMP's according to the timelines of the Water Framework Directive and adopted the subsequent all four RBMPs. All RBD Management Plans (RBMPs) follow the same national implementation approach; there are no methodological and approach differences among the RBDs.

The RBMPs are developed clearly according to the elements provided in Annex VII to the WFD. The Program of Measures also includes all groups of measures as indicated in Annex VI to the WFD. All major information is provided also according to sub-basins. No sub-plans or supporting documents were reported in addition to the RBMPs, but documentation refer to are available on the Competent Authority's webpage.

The Government adopts the RBMPs with a resolution as the adopting act. The RBMPs and PoM are planning documents. In the hierarchy of legal acts, they fall under regulations. They are approved by legally binding resolutions of the Government and they cannot contradict existing legislation. Practically, the RBMPs and PoM are legally binding documents. The public institutions and municipalities are liable for failure to implement timely programs related to protection of environment, e.g. failure to implement timely the RBMP or PoM.

There is a relationship between the RBMPs and individual decisions, through there is an obligation to take the RBMP into account in the decision-making process. The legislation only sets out general

obligations for the compatibility of individual decisions with the environmental objectives set out in the RBMP. This is ensured through the assessment of effect of draft individual decisions, programs, contracts, negotiating positions, in accordance with the Methodology for Effect Assessment of Draft Decisions (Government Resolution No. 194 of 7 February 2007). The effect assessment of draft individual decisions covers inter alia an assessment of how a proposed individual decision will affect water, ecosystems, nature, etc.

Water categories in the RBD

There are all four water categories in the Nemunas RBD and two water categories in the Lielupė, Venta and Dauguva RBDs. The water bodies within the Nemunas River Basin District are assigned to the following categories: rivers, lakes, transitional waters (the Curonian Lagoon and the plume of the Curonian Lagoon in the Baltic Sea) and coastal waters of the Baltic Sea. In addition, artificial and heavily modified water bodies are distinguished. The Lielupė, Venta and Dauguva RBDs have river and lake water categories. All surface water categories were further differentiated according to the type, taking into account the variety of the natural characteristics of surface waters and the resulting differences in the aquatic communities.

Typology of surface waters

Five river types were identified, which differ by the characteristics of their aquatic communities. Three main types of lakes were identified, and the major factor that determines the most significant differences between the communities of aquatic organisms (fish and macrophytes) is the average depth of lakes. Transitional waters (within the Nemunas RBD) are divided into three types on the basis of salinity, wave exposure and the average structure of the substrate. The Lithuanian coastal waters of the Baltic Sea are divided into two types, using the average structure of the substrate as an optional factor.

Why EQS is not met

Analysis of pollution sources and the assessment of their impact have revealed the following key factors which affect the ecological status of the water bodies in all the four RBDs:

- diffuse pollution, the main driver of which is agricultural pollution loads;
- point pollution, which consists of loads from dischargers of wastewater treatment plants (WWTPs), storm water (surface) runoff, and industrial wastewater in towns and settlements;
- transboundary pollution coming from the neighboring countries.

Diffuse agricultural pollution

Is one of the most important and significant factors affecting the quality of the water bodies in the Nemunas and Lielupė RBDs. Diffuse agricultural pollution with nitrate nitrogen is one of the major sources of pollution.

The point source pressure was regarded as significant if the following concentrations were exceeded in a receiving water body: 3.3 mg/l BOD7, 0.2 mg/l ammonium nitrogen, 2.3 mg/l nitrate nitrogen and 0.14 mg/l total phosphorus. According to the RBMPs, the problems of the quality of the water bodies as a result of point pollution significantly decreased during the last few years due to the continuously improved operation of the WWTP. In many cases, stretches where the water quality parameters still exceed the threshold values for good ecological status are rather limited. A significant impact on the main rivers is

still exerted by the WWTP of larger cities, meanwhile pollution by the WWTP located in smaller towns and settlements is rather low and its impact is limited to the location of the WWTP in question. The largest amounts of wastewater enter the water bodies from large agglomerations (where the pollution loads exceed more than 2 000 p.e). Dischargers in such agglomerations emit about 70 % of the total wastewater volume and approximately 60% of the pollution load.

Overall, according to the last report on the implementation of the Nitrates Directive (referring to the period 2012-2015), nitrate levels in surface water and groundwater remain low in Lithuania. However, eutrophication of surface freshwater remains problematic, with a slight increase of stations reported in eutrophic and hypertrophic status, from 47 % to 49 %. Protection of the Baltic Sea is also an issue as all saline water stations were reported to be in eutrophic or hypertrophic status. Under the Nitrates Directive report for 2012-2015, Lithuania also reported that nitrate concentrations in surface water are not likely to decrease if no additional measures are taken to reduce pollution.

Chemical pollution

Chemical pollution by hazardous substances was examined based on the data of the water quality monitoring carried out in 2005-2015. Some rivers are adversely affected by pollution from hazardous substances. The exact sources of pollution with hazardous substances cannot be identified yet due to a lack of data and, consequently, it is difficult to identify polluted river stretches and their length. However, it has been identified that pollution is coming from the wastewaters discharged from larger cities located near the sites where exceedances were observed. Some hazardous substances were detected in the transboundary rivers at the border with Belarus (the river Neris) and thus it was assumed that the entire stretch of the river flowing in the territory of Lithuania was adversely affected by significant pollution. The concentrations of the regulated hazardous substances in the Neris may exceed the established MAC as a result of transboundary pollution. Further work is said to be on-going on the identification of the origin of the hazardous substances.

Pressures and impacts in transitional and coastal waters

Analysis of the pollution loads that directly enter the Curonian Lagoon and the Baltic Sea from point pollution sources has revealed that the largest amounts come from Klaipeda city. The overall status of transitional and coastal waters is determined by diffuse pollution from the basin, mostly the inflow of excessive nitrogen and phosphorus with the river waters, mainly the Nemunas. The load transported to the Curonian Lagoon by the rivers includes both pollutions generated in Lithuania and transboundary pollution. As modelling shows, transboundary pollution may account roughly for 60 % of the total load of BOD7, 42 % of ammonium nitrogen, 28 % of nitrate nitrogen, and about 50 % of the load of total phosphorus transported by all the rivers to the Curonian Lagoon. The greatest risk for the environment of transitional and coastal waters is posed by air pollution, illegal, deliberate and accidental spills of oil and other dangerous substances, dumping of waste, as well as arrivals of new species with ballast waters or from ship hulls.

Most common exception

Having assessed the current status of water bodies, natural and anthropogenic reasons for this status and established criteria for achieving good status, as well as analyzed pressures of economic activity and their impacts on water bodies identified as being at risk of failing to achieve good status by the deadline (hereinafter – water bodies at risk), the Environmental Protection Agency and the Lithuanian Geological Survey has drawn up this Program of Measures for all RBD. The Program analyses the effects of the basic measures and proposes supplementary measures which are necessary in order to achieve good status for water bodies. The basic measures include the implementation of all the measures, actions and

program which have already been envisaged in water legislation and financed or included in financing program (construction of wastewater treatment facilities in agglomerations with a p.e. of more than 2 000, installation of manure storage facilities on large farms, compliance with recommendations of good agricultural practice, solution of drinking water quality problems, etc.).

Application of EQS in permits

The EQS are important for issuing IPPC permits or PP (Pollution permits) for industrial companies. However, there are no known any example when EQS have stopped an industry or other development in Lithuania.

Where information concerning EQS can be found

Several questions were raised:

- What are good practices from other EU regions for implementation of the green infrastructure measures for pollution reduction?
- What are the Best available techniques or economically feasible technologies for the reduction or treatment of the Priority Substances or Substances of very High Concern (SVHC) and Emerging pollutants?
- What are other countries 'practices for reduction of the Priority substances, SVHC or Emerging pollutants in wastewater treatment plants and as well as in surface waters?
- How other countries solve the N and P problems and the Eutrophication of surface waters?
- What could be the most effective involvement of local communities/municipalities in water resources management?

4. AREAS WHERE ICT CAN SUPPORT / IMPROVE

4.1 Water management

4.1.1. Spain - Iberian Association of Riverside Municipalities of Duero River

The use of ICT technologies is already a reality in Spain. For example, in the centralized management of water at national level and the availability of data related to the water cycle there is an Integrated Water Information System (SIA) used by the central authorities that consists in four subsystems that provide the following information:

- direct access to disaggregated data through a geographic display with access to all information sources;
- structured access to information about water to facilitate a better understanding of environmental information for the people who don't have a specific knowledge in hydrology;
- access to aggregated data in the form of indicators that reflect, in low values, the most relevant aspects of water in Spain;
- information regarding the national inventory of dams and reservoirs.

4.1.2. Greece - Regional Development Fund on Behalf of the Region of Attica

Information and communications technology (ICT) is a broad subject and the concepts are evolving; it is by definition an extensional term for information technology (IT) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage, and audiovisual systems, that enable users to access, store, transmit, and manipulate information. ICT is an umbrella term that includes any communication device and the various services and appliances with them such as video conferencing and distance learning.

ICT can be used efficiently for monitoring and management of water quality and microbiological monitoring of water bodies. It could be used for developing user-friendly water monitoring strategies and systems based on innovative or state of the art technologies that will provide real time data for important parameters, supporting green growth, as well as increasing adaptation and resilience to climate change.

It could also contribute to developing an efficient Decision Support System.

Weaknesses may relate to:

- Lack of knowledge of new technologies and their capabilities.
- Lack of coordination and collaboration in the water sector and water using sectors in the EU.
- Need to ensure the proper integration of the various legal instruments.

Despite the weaknesses mentioned above water management may benefit by using ICT:

- The water governance can be enhanced using cloud data linked to a decision making support system and eco-innovative technologies;

- Enhance the performance and competitiveness of the water sector and water using sectors;
- Improve Cost Efficiency and Intelligent Asset Management;
- Promote Network Development and Renovation;
- Permanent Quality Improvement and Environmental Approach;
- Customer Care.

4.1.3. Romania - The National Union of Romanian Entrepreneurs

Water management is the activity of planning, developing, distributing and optimum use of water resources under defined water policies and regulations. Fewer solutions are already in use for large basins of rivers, able to do real time management. If solutions for flood are everywhere, integrated solutions for an integrated management are rare to be found.

An integrated water management approach produces “triple bottom line” benefits (social, economic, and environmental) in an equitable and sustainable manner and creates flexible, resilient water infrastructure that can respond to a range of scenarios. Integrated water management considers the urban water cycle as a single integrated system, in which all urban water flows are recognized as potential resources. Integrated water management is practiced through inclusive and jointly planned management of all water systems– where all waters are resources and are valued and put to use.

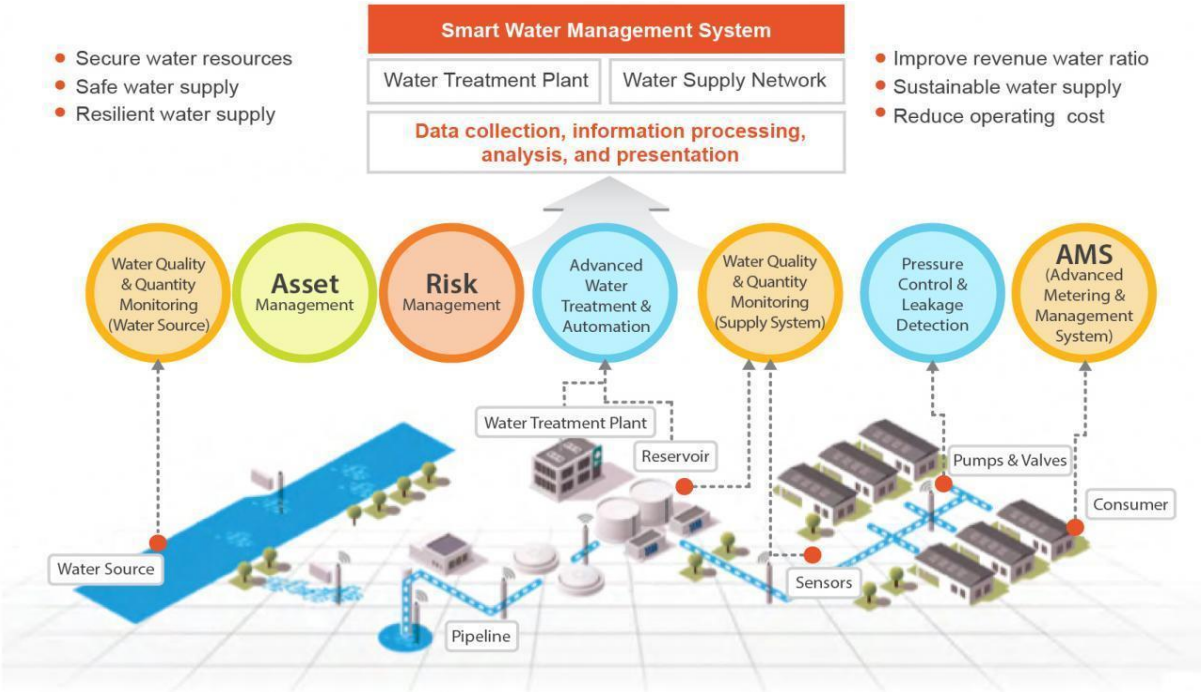
The Intelligent Water solution helps make your operations and infrastructure more reliable and efficient. It integrates and analyses a wide variety of data sources and provides both an intuitive way of visualizing and understanding patterns and anomalies, and an easy way of acting on them. The result is a view of water or wastewater operations that transcends individual systems, devices, and departments. This end-to-end view gives you the key information you need to make better decisions that help lower costs and risk while increasing or recapturing revenue and enhancing customer satisfaction.

The Intelligent Water solution helps water and wastewater operators:

- leverage operational data holistically to create insights and improve water management.
- anticipate potential delivery disruption and better forecast long-term water demand.
- coordinate resources to protect water supply and drive conservation and sustainability.

Current water management systems are not fully prepared to meet the challenges of a rapidly changing world and its need for clean, sustainable water management on all fronts.

Figure 41 | Smart Water Management System

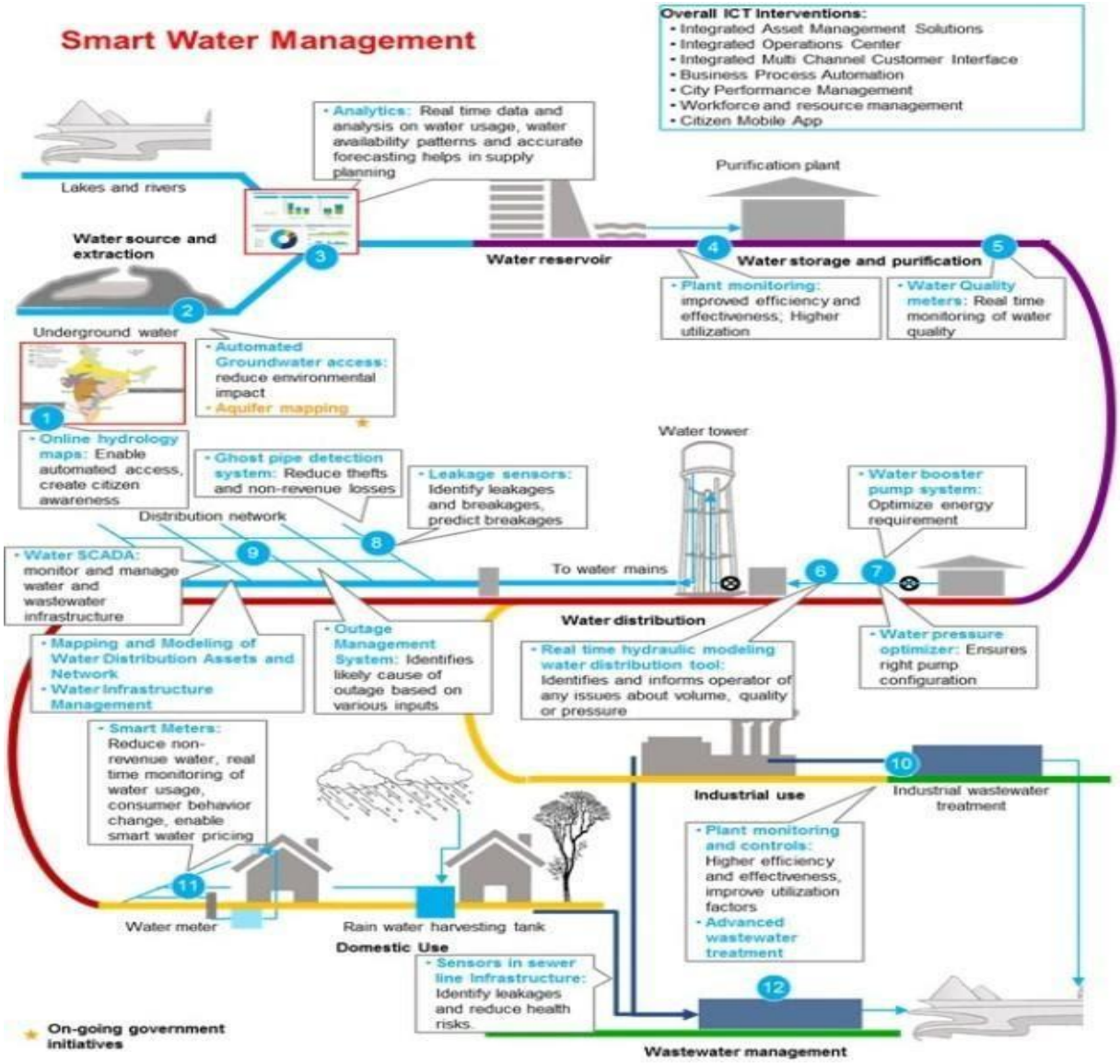


Source: Kwangtae, Y. (2019)

Table 15 | Technology for Smart Water Management

Components	Purpose	Example Applications
1. Digital output instruments (meters and sensors)	To collect and transmit information in real time.	- Rain gauges, flow meters, water quality monitoring and other environmental data - Acoustic devices for real-time leakage detection - Video camera for asset management - Smart water meters for measuring consumption - Pressure monitoring for leakage detection and pump optimization
2. Supervisory control and data acquisition (SCADA) systems	To process information and remotely operate and optimize systems and processes.	- Pressure management - Pump station optimization - Water treatment plant control - Sewage treatment plant control - Environmental controls, reservoirs, flows, etc.
3. Geographic information system (GIS)	To store, manage, manipulate, and analyse spatial information.	- Asset mapping and asset management - Fully integrated network models - Environmental data analysis and management
4. Software	To store, use, and report data.	- Usually integrated with GIS and/or SCADA systems to manage water networks, control pressure, monitor leakage, etc. - Improved decision making and risk management - Customer data bases - Smart metering, billing and collections - Hydraulic design and optimization - Water resources and hydrological modelling for water security - Cloud-based data management and hosting options

Table 16 | Fewer vendors provide IT solutions for Smart Water Management



Combining advanced analytics with information management, technology services, and business consulting capabilities, **strategic water management solutions** can help governments, water utilities, and companies monitor and manage water operations more effectively. These kind of vendors provide Intelligent Water including Intelligent Operations for Water product, which is a water management platform that enhances infrastructure visibility to deliver an advanced level of situational awareness, event and incident management, informed decision-making, and collaboration among stakeholders. This Intelligent Operations for Water helps with:

- Intelligent Water Efficiency Analytics;
- Combined sewer overflow mitigation;
- Water conservation and smart metering;
- Smarter irrigation for parks and golf courses;

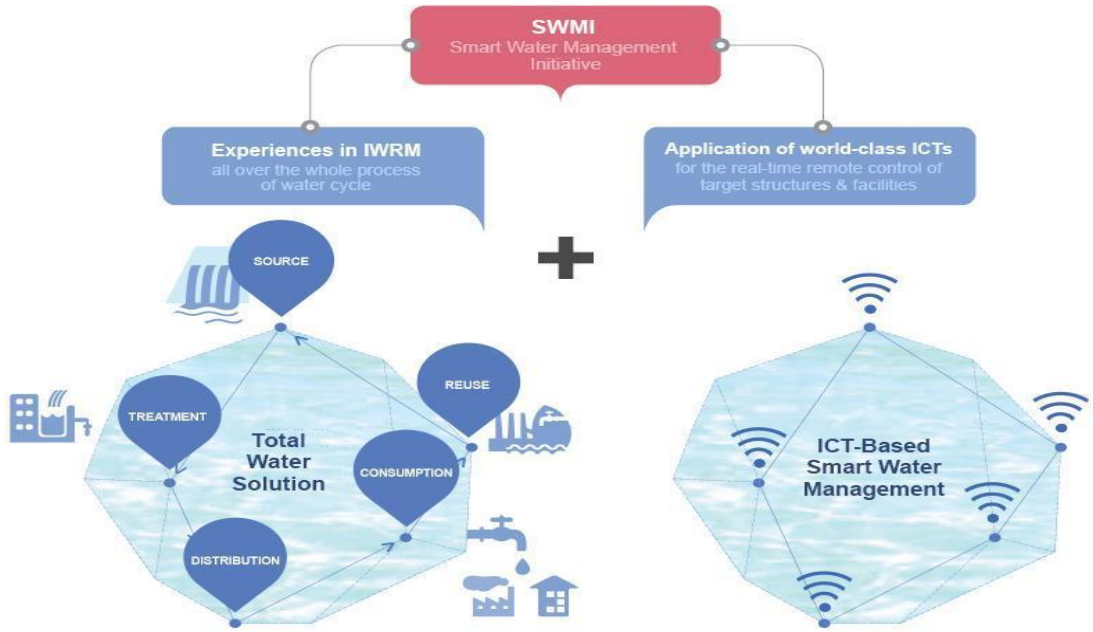
- Water and wastewater situational awareness and quality management;
- Pressure and leak management;
- Urban flood management;Work scheduling optimization.

The Intelligent Water solution is available in a variety of deployment options. The software can reside in a data center. For utilities and cities with limited IT infrastructure or resources that prefer a subscription service model, the solution is also available on the tCloud.

Most water service providers are increasingly utilizing capacities of Internet of Things and Big Data for leakage detection, water metering, planning, monitoring and distribution. The era of Industry 4.0 has brought about different innovative solutions across various industrial sectors. Internet of Things (IoT) provides new solutions to the water industry, improving water management, and reducing operational expenses as relating to water infrastructure maintenance. A challenge in the water industry is the ability to turn the available data into insightful information, permitting effective decision making.

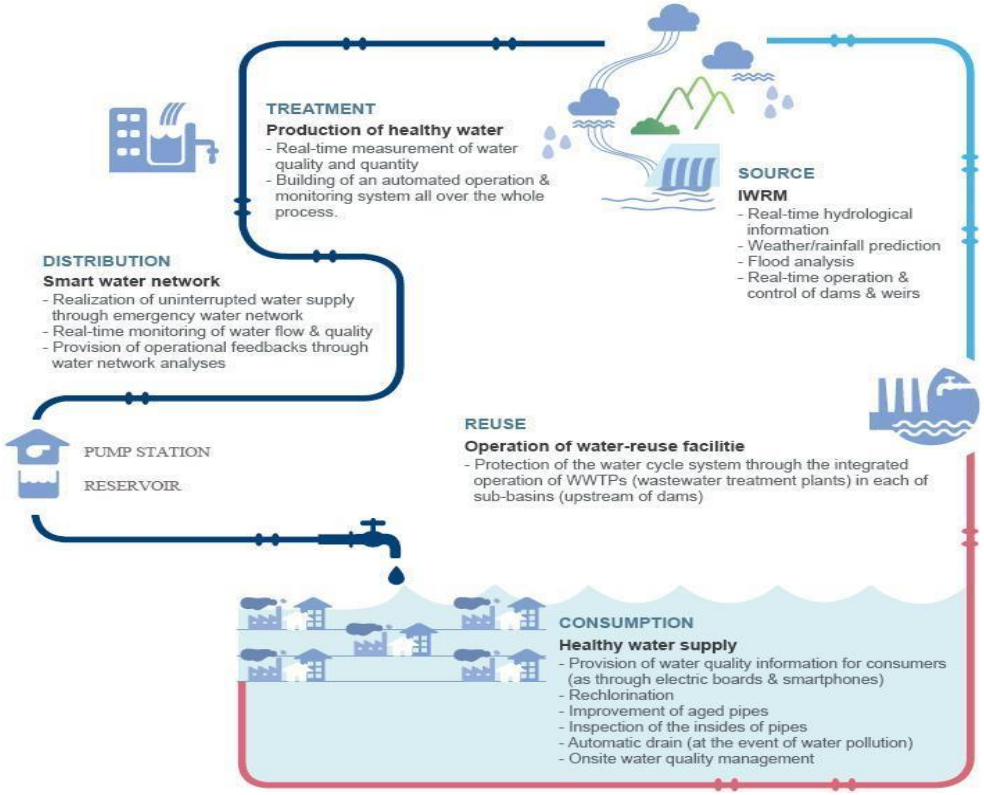
Other providers are oriented their solutions, to provide an **advance integrated river management solution**. It is a water management system that measures the water level, flow, and quality, and interoperates with a river GIS-based system, designed as an alarm system intended to identify the river quantity and water consumption and transmit various disaster information. They use IS Technologies, a reliable provider of ultrasonic measurement instruments and water management solutions.

Figure 42 | K-water Co., Ltd, another Korean company, will open the future of water management with its own ICTs technologies



SWMI (Smart Water Management Initiative)

SWMI, an IWRM model involving in the whole process of water cycle that was designed by K-water, helps improve the reliability, soundness and efficiency of water management with ICT-based water management systems all over the water cycle, which ranges from water sources to end users.



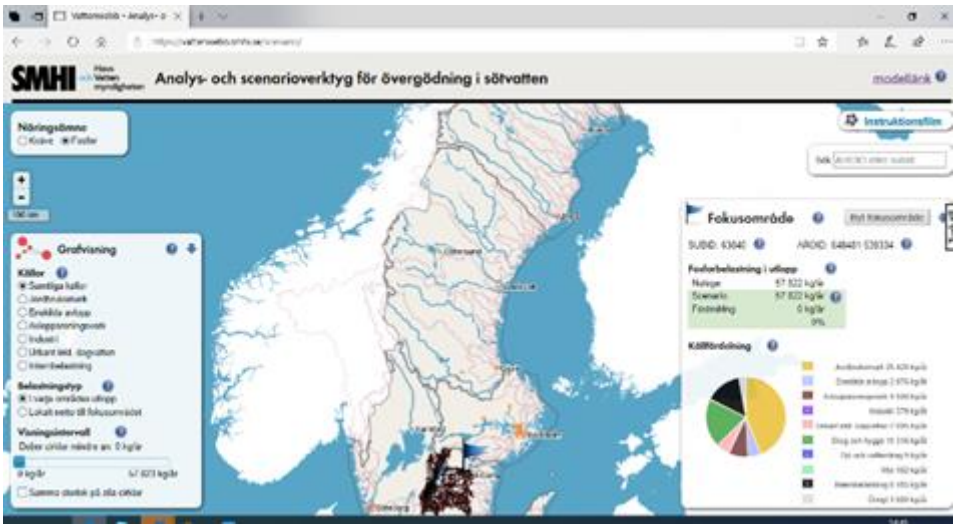
All these solutions, from different providers and vendors, need to be combined with monitoring ICT and IoT solutions, in order to have in the end, a single real-time system, able to offer monitoring and data transmission in real -time, and a full integrated management for all components that are needed to be included.

4.1.4. Sweden - The County Administrative Board of Östergötland

For water management, the universities and Swedish meteorological and hydrological institute (SMHI) and Geological survey of Sweden (SGU) are important actors. Data storage and sorting of data for lakes and rivers are supplied in databases like MVM (https://miljodata.slu.se/MVM/). Similar services for sediments, groundwater and screening are being developed by SGU where data is currently stored but not yet visualized.

Transformation of data, visualization of data, sharing data and creating usable tools is done through web applications like “vattenweb” by SMHI: https://www.smhi.se/data/hydrologi/vattenwebb. One example in this website is hydrological modelling of nutrients (Figure 12). Data is supplied as concentrations and flows in selective time spans, transports and the need for reduction to reach the environmental quality standards are calculated. Another way of using this web application is to use a tool to add and remove different measures to see the effect has been developed, see application below by SMHI.

Figure 43 | Application for visualization of data – Vattenweb, SMHI

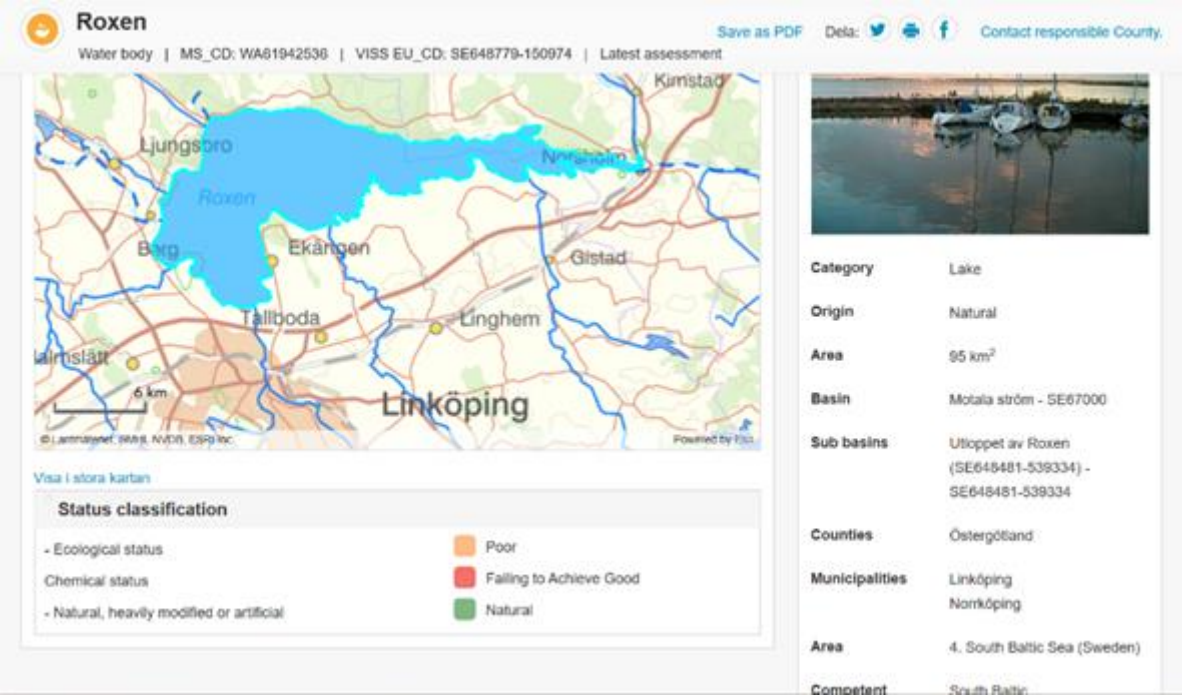


Source: Damm- och sjöregister | SMHI - Vattenwebb

For characterization and environmental quality standards, all supporting data for deciding the environmental quality standard and explanations are visualized in Water information system Sweden, VISS: https://viss.lansstyrelsen.se/. The database is accessible for all but CAB are responsible for supplying and entering the information presented in VISS. The information for each cycle can be selected so there is an oppotunity to observe if status has improved or gotten worse since the last cycle.

The over all status can be observed easily upon entering the specific page of each waterbody. For example, lake Roxen has a poor ecological status, fails to achieve good chemical status and is classified as a natural water (Figure 13).

Figure 44 | Application for visualization of data – VISS, overlook of lake Roxen

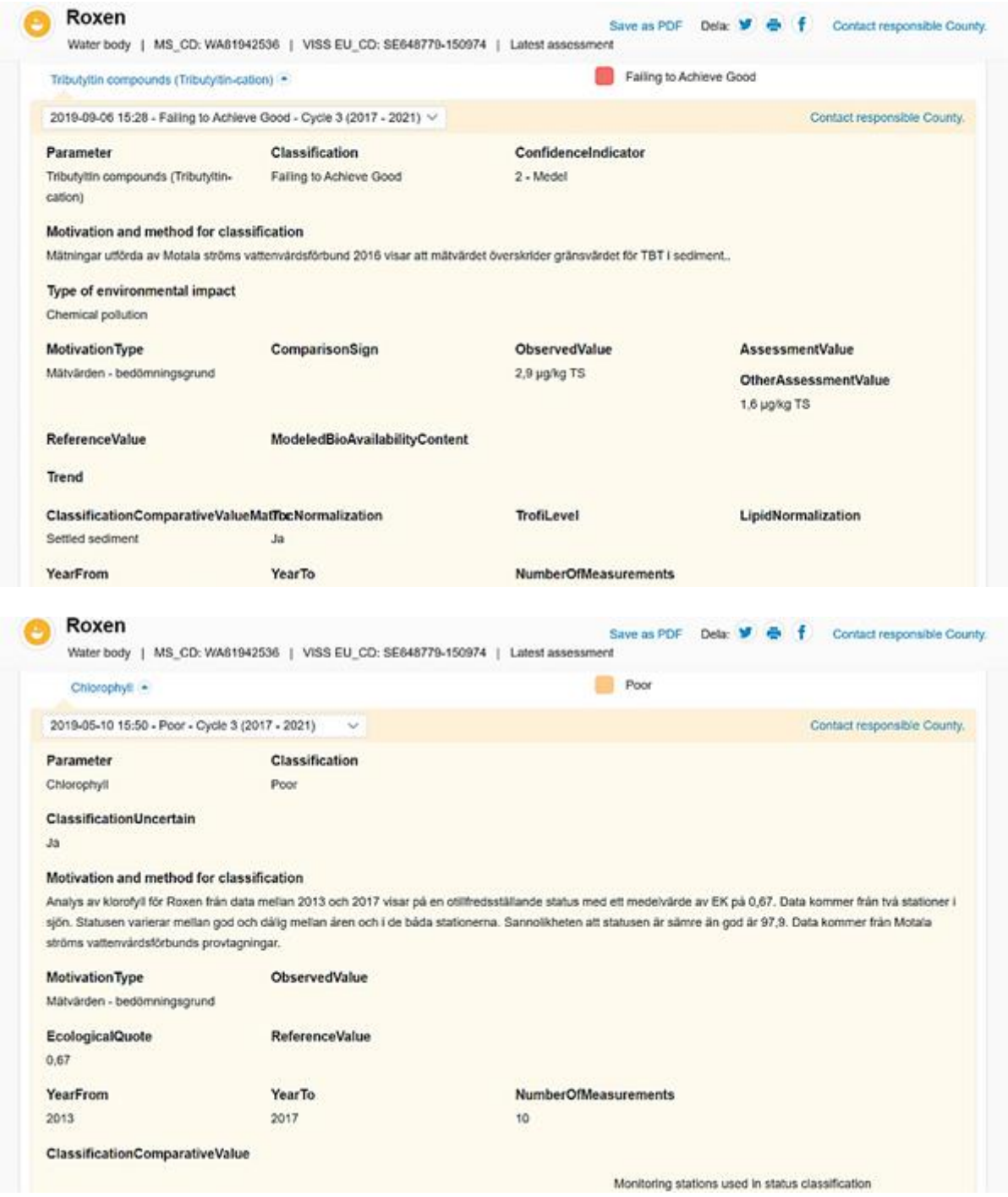


Source: VISS – Lake Roxen

For each waterbody there is a number of parameters visible and there are also multiple categories covered in the database such as:

- EQS (MKN)
  - Quality demands of the waterbody
- Status Classification
  - Description by element, both ecological and chemical elements (Figure 14)
- Impact sources, such as
  - Possible contaminated areas
  - Modelling of possible impact of nutrients
  - Urban wastewater
  - Physical alteration of channel/bed/riparian area/shore of water body for agriculture
- Measures
  - Possible measures to cope with identified pressures from status classification
- Risk
  - Identified risks of selected cycle
- Monitoring
  - Stations of monitoring connected to type of investigation
- Protected area

Figure 45 | Visualization of ecological and chemical status – lake Roxen



Source: (VISS, 2020)

These evaluations are performed for each waterbody where data is available, to visualize not only for governmental proposes but also for the general public to take part of.

4.1.5. Portugal - CIM Alto Minho

Following the guidance of the European Commission, Portugal identified the environment, and in particular the water resource, as one of the major societal challenges for the future. The specific objective

of this challenge is to allow an efficient economy in the use of resources and resilient to climate change and ensuring a sustainable supply of raw materials, in order to satisfy the needs of a population considering the sustainable limits of the planet's natural resources. In general terms, the general lines of the activities under evaluation consider:

- combating and adapting to climate change;
- sustainable management of natural resources and ecosystems;
- ensuring sustainable supply of non-energy and non-agricultural raw materials;
- making the transition to an ecological economy viable through eco - innovation;
- development of comprehensive and sustained global observation and information systems;
- cultural heritage.

The multidisciplinary nature of the research required requires the pooling of complementary knowledge and resources in order to effectively address this challenge. Reducing resource use and environmental impacts, while increasing competitiveness, will require a decisive transition at a societal and technological level. In this context, eco-innovation will provide new and valuable opportunities for growth and jobs. There is a need for a significant research effort to tackle problems in the field of water, both in terms of the management of water systems, and of applicable or developing environmental technologies. In this aspect of the research challenges that are perceived as relevant according to the available information, the following themes can be indicated:

- optimizing the sustainability of ecosystems;
- development of solutions that reduce the demand for water for irrigation purposes (which increases the pressure on existing surface and underground aquifer resources);
- strengthening the competitiveness of the sector's industry, namely through the implementation of more efficient water resources management systems as well as the development of new solutions in terms of environmental technologies.

The use of a very diverse range of technologies, namely in the field of information and communication technologies, may allow the development of very innovative solutions, contributing to a more efficient use of natural resources and to a greater competitiveness of industrial actors. With regard to the use of ICTs, the use of sensors is promising, particularly for the purposes of system monitoring. In Portugal, this type of use is already diverse, as well as decision support systems, often with the support of automation and control systems infrastructures.

Currently, in Portugal, begin to take the first steps in the application of ICT technologies in the designated system Smart water management that aims to make the exploitation of water at regional or city level, based in the ideals of harmony, sustainability and self-sufficiency, contributing to aspects such as the reuse of water, among other water treatment technologies, the water cycle recording system. In this context, water distribution systems deserve special mention since they are essential infrastructures that must be properly managed and maintained in order to provide the expected levels of service to consumers. However, these systems need real-time decision support, being systems based on continuous monitoring of hydraulic parameters and water quality in a fine temporal and spatial “mesh”. An accurate, continuously updated view of the status of the water system distribution allows the entity responsible for water management to improve the optimization of the system's operation, manage loss control more effectively and reduce the duration and interruption for repair and network maintenance.

As a result, the “advanced measurement infrastructures, data management and analysis systems will allow us to act in a more conscious and fair manner”. Simply put, “The support technology base of

a smart city should evolve in all branches, namely the infrastructures associated with water and river management. The system intelligent water management, it is a great medium for conservation, efficiency and safety objectives to be achieved, representing therefore a wide range of application opportunities of ICT.

The smart water system translates a system that promotes the security of water supply considering the uncertain but significant future risks, such as population growth, hydrological variability, extreme events and intensification of demand in water supply systems. Water, agriculture, industry and ecosystems. Strategic and transparent decision-making regarding the exploitation of water resources is essential to achieve sustainable use of water. The concept of smart water system uses advances in information technologies to monitor the data system and to obtain greater efficiency in the allocation of resources. In addition to greater efficiency in loss control, prevention and rapid detection of leaks, the smart water system also allows the development of best asset management practices, improving system efficiency in emerging areas, such as demand-oriented distribution. Rather than simply following existing practices that pump high pressure into the water supply system to reach more distant customers, a smarter system could use real-time data, variable speed pumps, dynamic control valves and smart flow meters. In order to balance demand, minimize overpressures in aging ducts and save energy. For water service management entities, the smart water system can break the downward spiral of operational and financial performance. The use of the smart water system improves the situation of many networks characterized by degraded infrastructure, irregular supply, and low levels of customer satisfaction or payment of bills not proportional to actual consumption. The smart water system can lead to more sustainable water services, reducing financial losses and leveraging innovative business models to serve the population.

With the emergence of smart pipes and sensor networks, it is intended to manage demand and minimize leakage. Water resource management means managing and ensuring that any system losses are minimal with several smart ducts installed in critical sections of a public water system, real-time monitoring automatically detects flow, pressure, low flow points speed, leakage in pipes and water quality, without changing the operating conditions in the hydraulic circuit.

Another issue in terms of infrastructure control, such as water pipeline networks, is data processing. The systems must be able to deal with the data locally and then send the processed data to the control centre in order to minimize the size of data postprocessing and transmission required.

Another type of application of ICT in this field to water measurement (water metering). The use of “smart metering” equipment allows to have the capacity to store and transmit consumption data of the different consumers, it records the date and the time when the consumption occurs. Therefore, while traditional water meters are read monthly or 18 bimonthly and a water bill is generated from that manual meter reading, the smart meter can be read from a distance and more often, providing instant access to information about the water consumption for customers and managing entities of the water supply network. These “smart water meters” are a component of the Advanced Metering Infrastructure (AMI) system that water companies can choose to implement. On the other hand, with the use of “smart meters” the water bill is associated with the volume consumed, instead of a fixed rate or a fee based on the size of the property. Individual measurement, through Smart Water Metering (SWM), also allows for the introduction of increasing tariffs based on a different volume of consumption to allow, in the first place, cross-subsidization of low consumption customers by the largest consumers, and secondly to encourage end customers to reduce their consumption of limited resources. In summary, smart water measurement essentially offers the opportunity to improve the balance between providing access to drinking water, the right of a management entity to receive payment for services provided, as well as the joint responsibility of everyone to preserve scarce water resources.

Another application of ICT is associated with the use of a Geographic Information System (GIS) should be understood that this tool allows to be applied to different areas and, when

applied to intelligent management technologies of water, allows us to have a better idea clear picture of its evolution. The advantage of a GIS is the modulation of reality based on data and assumes a prominent role in today's society since they are information systems designed to collect, model, store, receive, share, manipulate, analyse and present geographically referenced information. With a sophisticated communication network of the intelligent network superimposed on the network, data management with GIS becomes absolutely critical. Geographic Information Systems (GIS) allow the incorporation of the spatial component into an object-oriented model, allowing an improvement in the planning and management of public network systems and facilitating an evolution of geographic network models.

Other platforms that make up the information technology system include SCADA, customer billing / financial systems and document management systems. The main business applications involve combining the data served from the GIS, SCADA, and customer systems, together with other information outside the system, such as weather systems, or satellite images. Users can use this combined information for business applications, from viewing a common operational image for inspection and maintenance to network analysis and planning.

Many of the companies or public services associated with the distribution of water in Portugal adopted a monitoring online where the supervision, control and data management is done through the designated SCADA (Supervisory Control and Data Acquisition). In this way, it is possible for an operator at a central location in widely distributed processes to make changes to the set point on distant process controllers, to open or close valves or switches, to monitor alarms, and to gather measurement information as well as more data. Detailed information about the current state of the water network in terms of flow, pressure. Its integration with decision support systems corresponds to one of the areas of development of the application of technologies based on ICT.

The complexity of the current major challenges facing society in urban centres requires the large-scale deployment of solutions and services based on accurate and timely information. This will allow cities to move towards sustainable transformation by spending fewer public resources and improving the services offered to their citizens. The application of a common performance measurement framework based on a set of relevant indicators and the application of data and decision support interfaces by management entities allows interested parties to learn from each other, build trust in solutions and monitor the progress.

The models of hydraulic networks and water quality represent the most effective and feasible way to predict the behaviour of the water distribution system under a wide range of demand conditions and system failures. The models use the laws of mass kinetics and energy conservation to determine the pressure, flow and characteristic conditions of the specified system as well as the operating conditions of water quality (movement and transformation). Through their predictive capabilities, these deterministic models provide a powerful tool for assessing the system's response to various operational and management strategies to meet specific performance goals. In turn, real-time operations (optimization models), extend the use of the intelligent water network in order to help operators improve the efficiency of the water network and ensure more reliable operations and maximizing cost savings. Models read automatically field data in real time, instantly update the network model, show the characteristic parameters of the pump and treatment plant, as well as the hours of operation that will produce the lowest operating costs, as long as they meet the objective system requirements (for example, path curves, minimum and maximum flow and velocities in the pipelines and total pump flows).

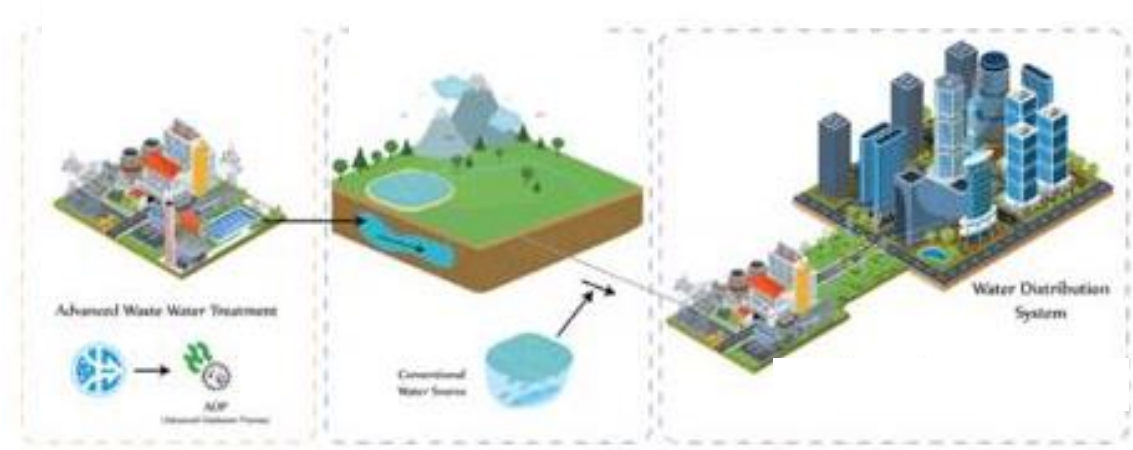
4.1.6. France - Cluster DREAM

To monitor and identify levers for reaching the objectives of WFD, the following "smart" tools have been developed in the territory of the Centre Val de Loire Region. Most of these tools developed are adapted to

a multi-partners approach and to divers sectors. They mainly aim at saving time and cost: easy to use remotely by actors in the field to react quickly and give a rapid response to problems:

- Production of interactive maps agglomerating "field" data on the territory;
- Wave Network: A quantitative stream observation network which is an application on the phone. The application gives the opportunity to fill in real-time information about the status of rivers (ex low flow, pollution, etc.) (Porteneuve 2020);
- Development of continuous measurement devices in response to problem identification: For example, of “river unions” which have put in place continuous measurement devices to track the flow of nitrate (Agence de l’eau Loire-Bretagne et DREAL de bassin Loire-Bretagne 2015);
- Application developed within the FRAME project (Water JPI Fund and expertised by DREAM Cluster). This project aims at assessing and managing the impact of wastewater treatments used indirectly for the increase of drinking water resources on post-drinking water pollution (Pierre 2020).

Figure 46 | Frame Tool developed in the FRAME project



Source: Daniel Pierre 2020

4.1.7. Lithuania - Kaunas University of Technology (KTU)

Main Challenges for Water Utilities:

- Digital Transformation
- Network Development and Renovation
- Permanent Quality Improvement and Environmental Approach
- Cost Efficiency and Intelligent Asset Management
- Customer Care

Figure 47 | Digital Data Management and Analysis

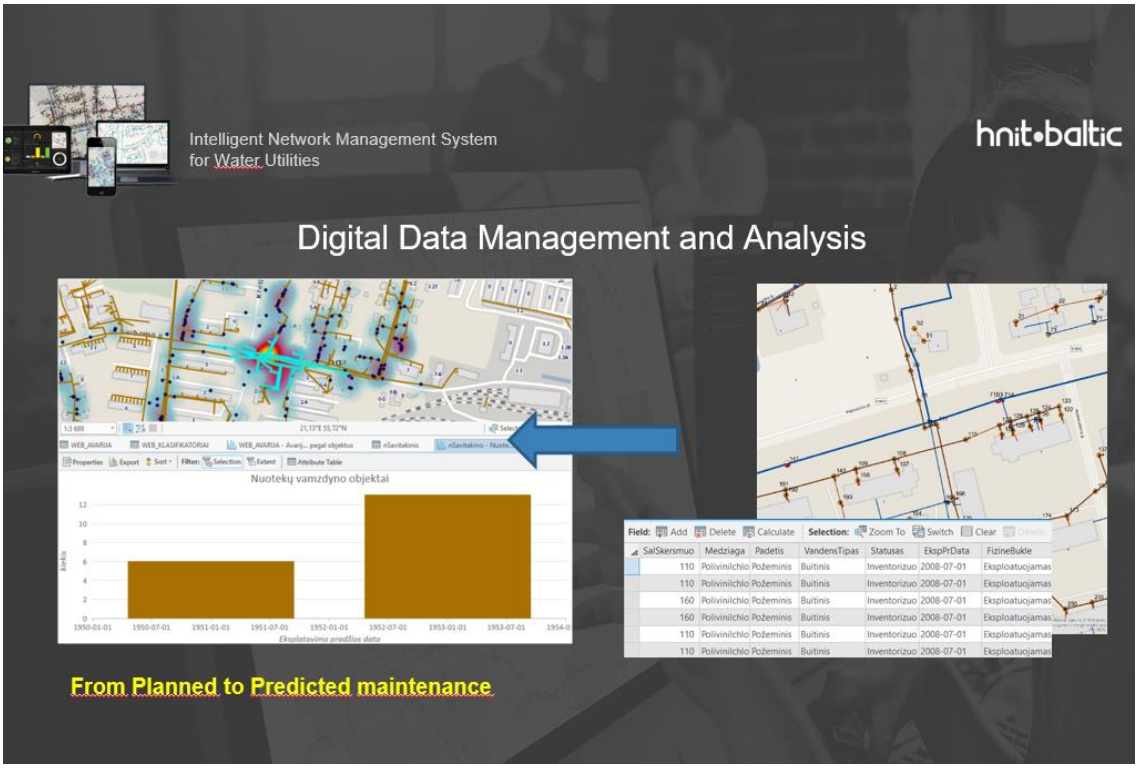


Figure 48 \ Interfaces with SCADA and other "Real-time"Sensors Systems

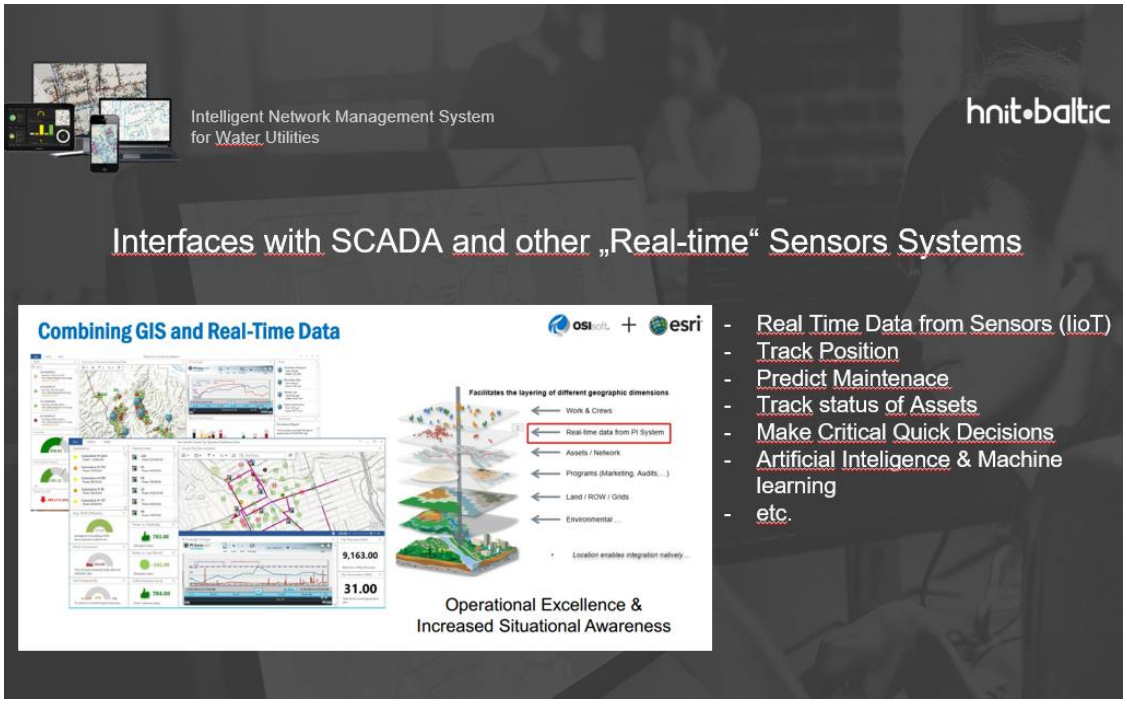


Figure 49 | Integrated Communication Inside the Organization and with Customers

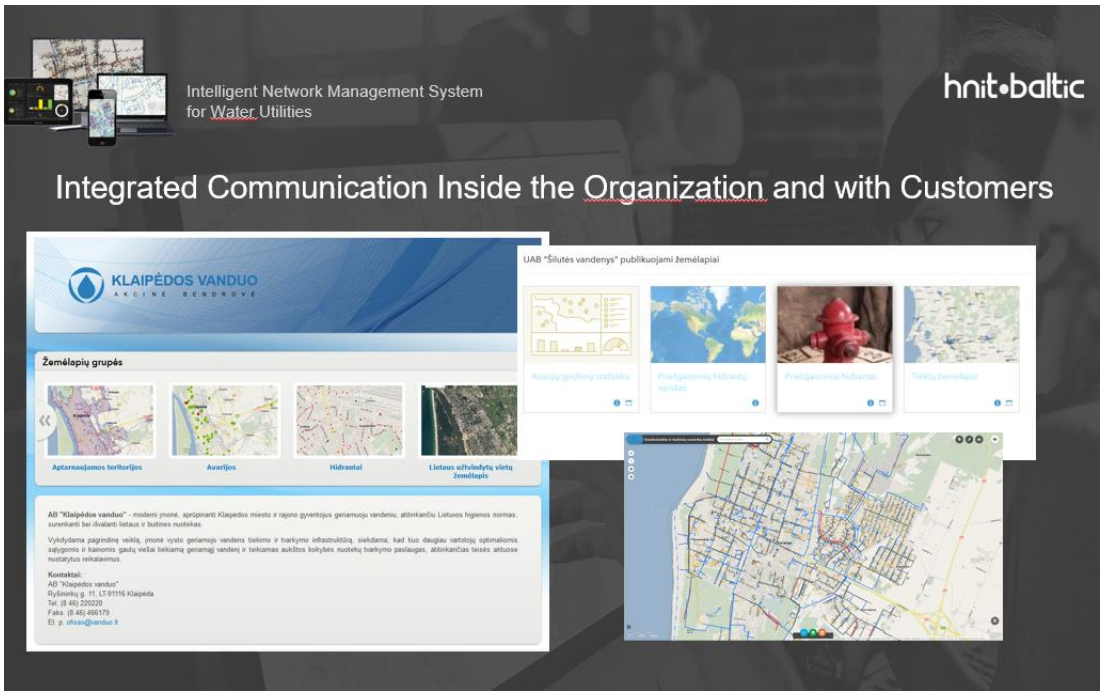


Figure 50 | Data and App Share between Organizations

Figure 51 | Tools and apps

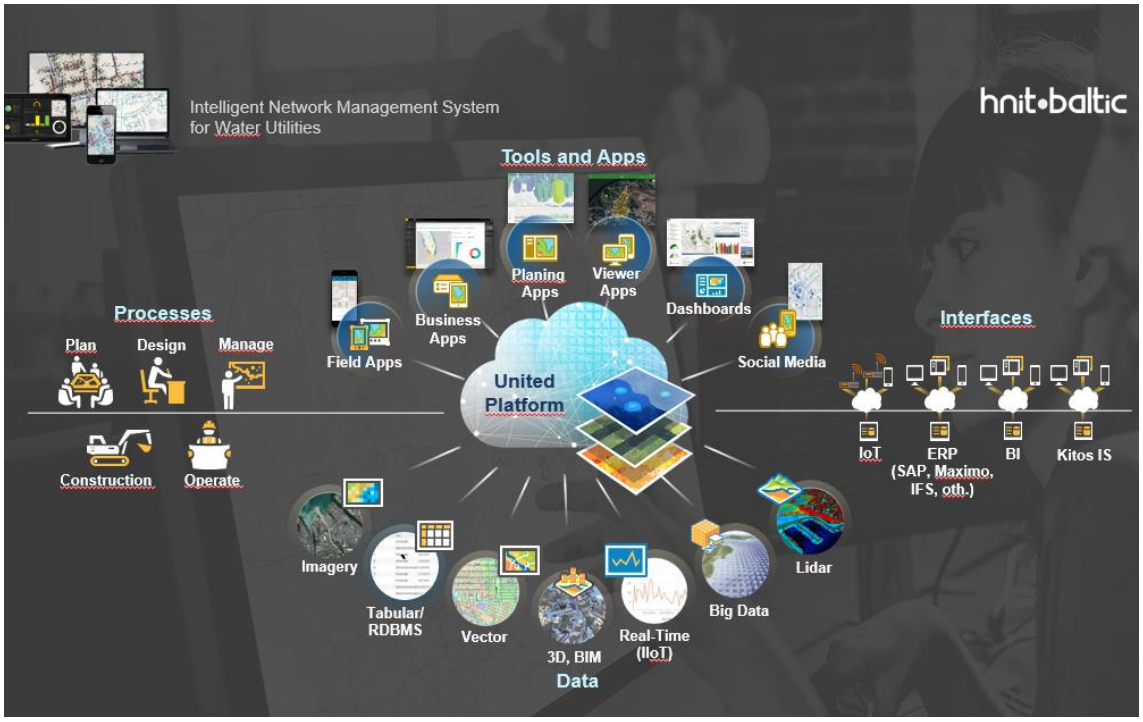


Figure 52 | Data and App Share between Organizations

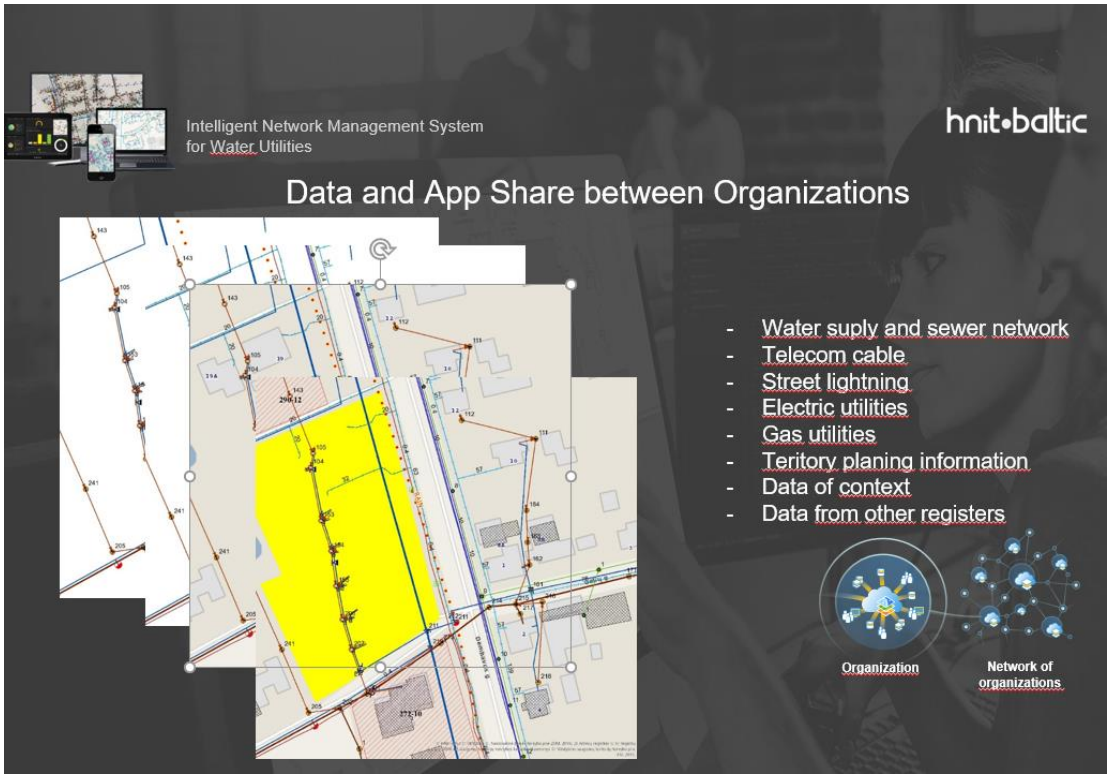


Figure 53 | Hydraulic Modeling for Predicted Maintenance and Planing

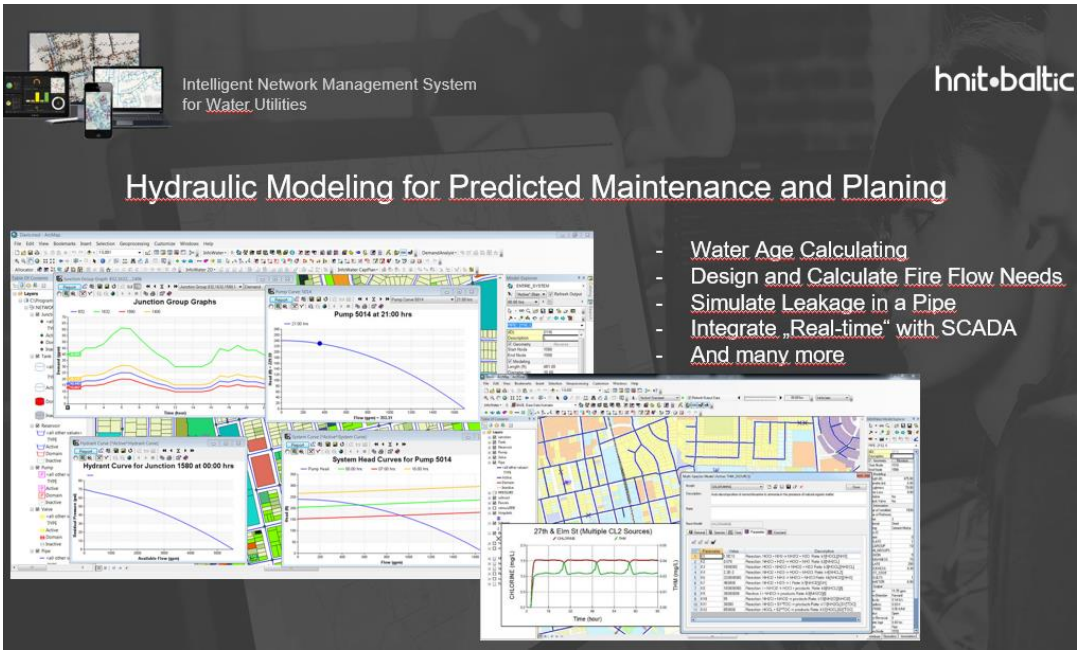


Figure 54 | Flood hazard and risk maps, Environmental Protection Agency, Lithuania

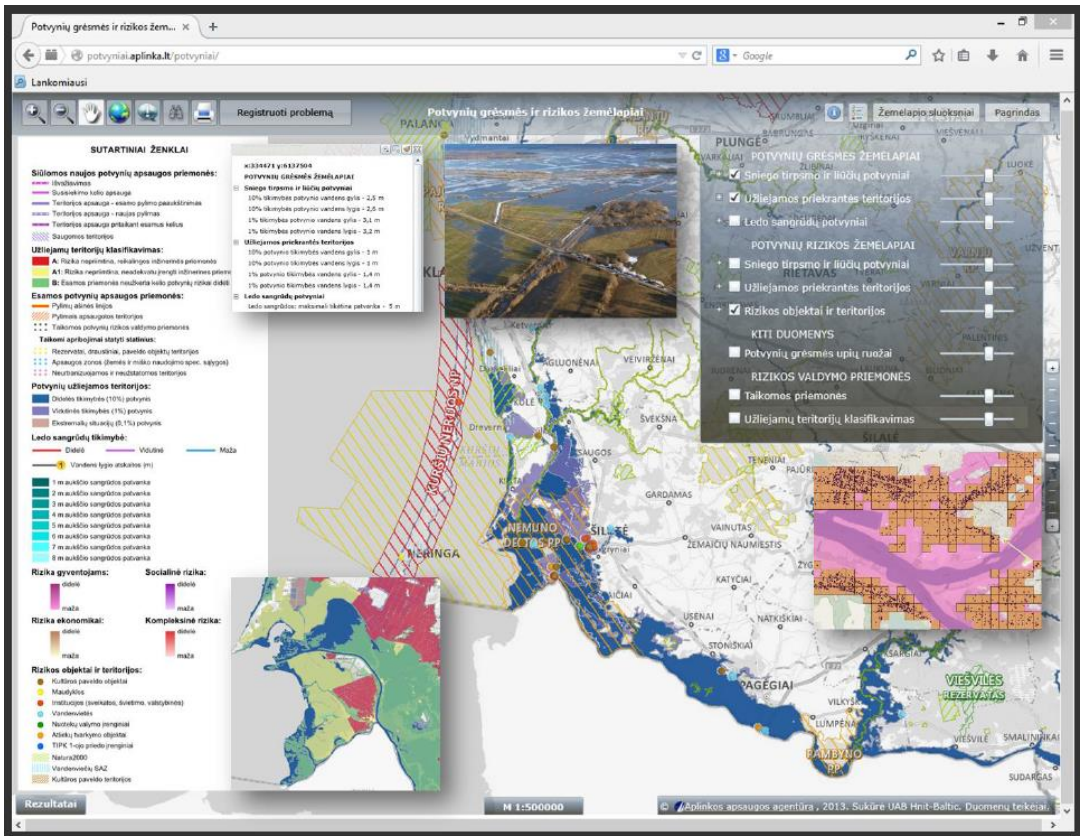


Figure 55 | Water level monitoring and prediction, Lithuanian Hydrometeorological Service

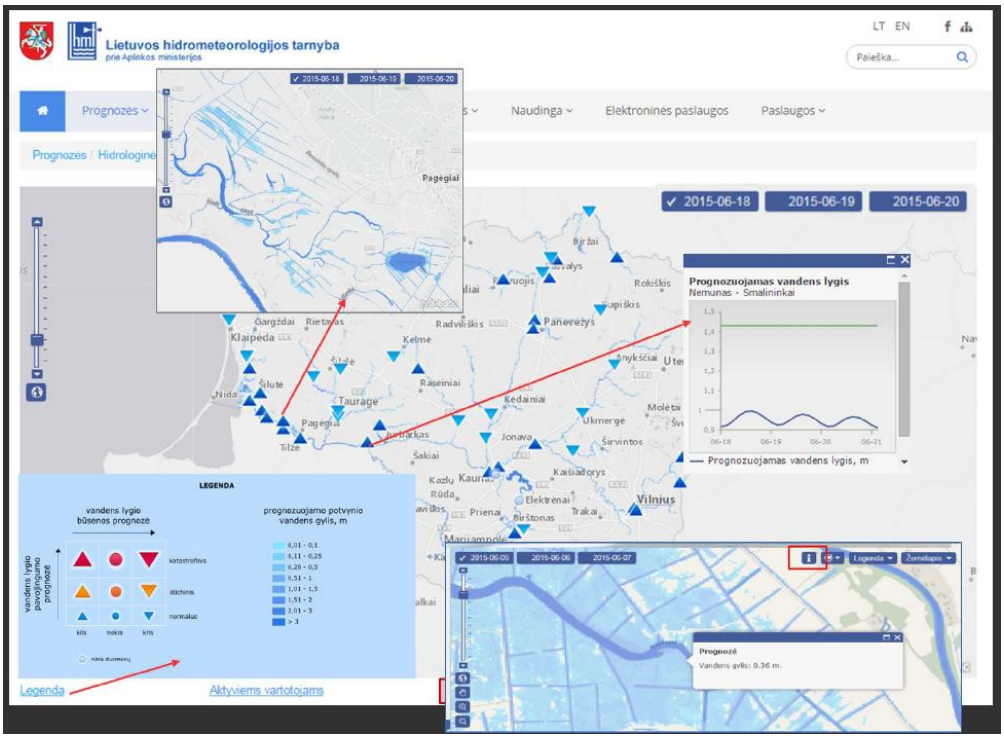


Figure 56 | Monitoring of achievements in Environmental projects "BENCO Baltic Engineering Company" Ltd.

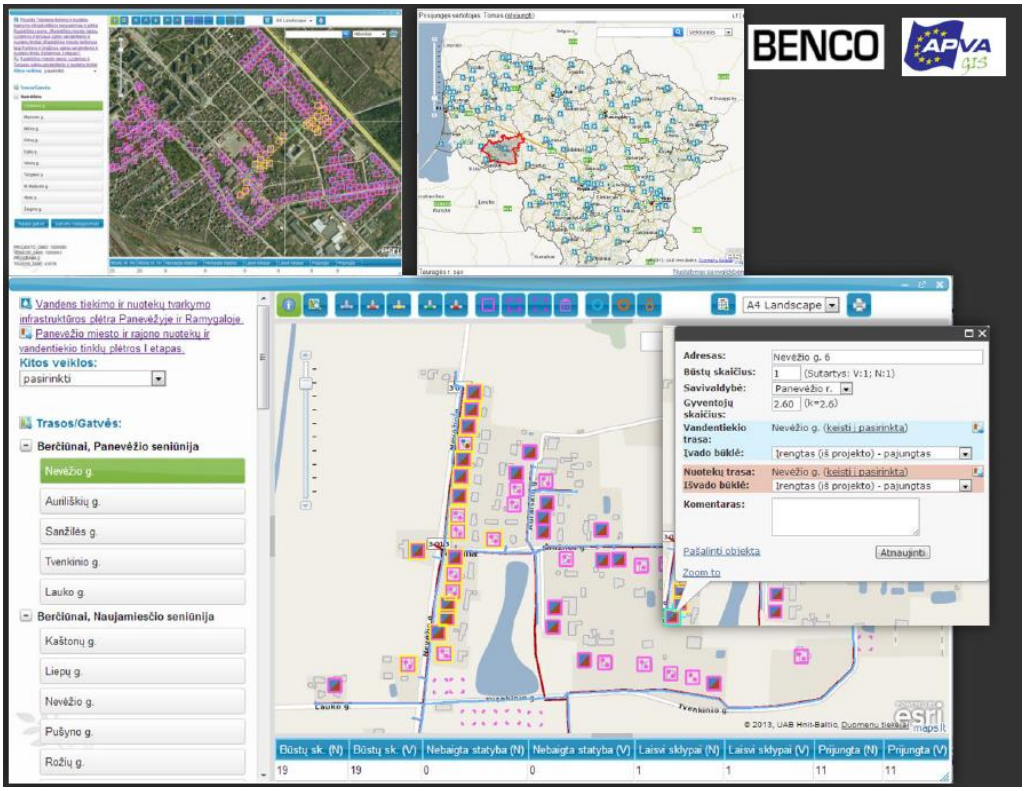
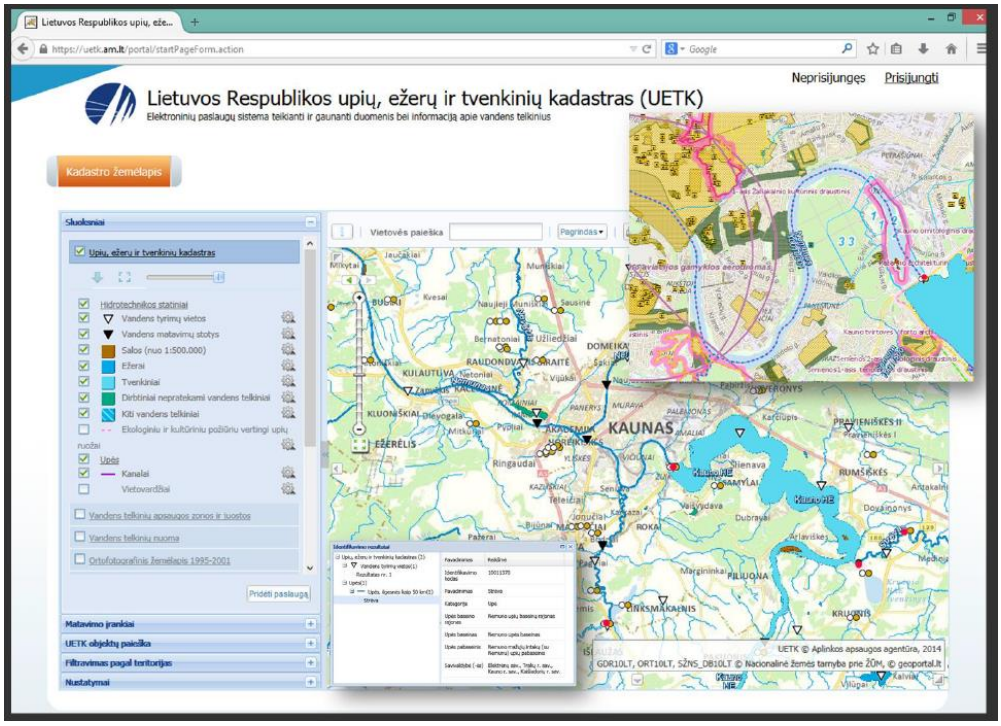


Figure 57 | Cadastre of Rivers, Lakes and Ponds, Environmental Protection Agency, Lithuania



4.2. Monitoring

4.2.1. Spain - Iberian Association of Riverside Municipalities of Duero River

In the field of monitoring, the use of ICT technologies is also a reality. The current network operations of observation of data hydrological and meteorological the Confederation Basin of the Duero results from the join of the network constituted by the river´s water quality stations and of the automatic hydrologic information system Information.

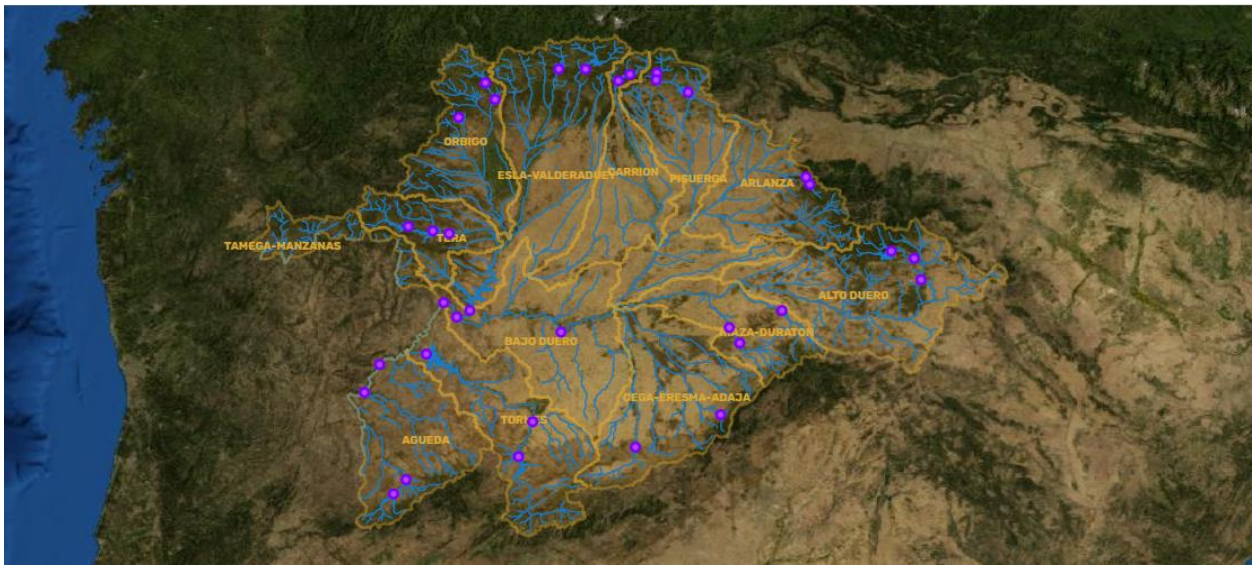
It's a network of hydrological and meteorological information in time real reliable and robust to account with consolidated basis of data of hydrological information and knowledge of the behaviour of the various rivers principal and tributaries that make up the basin catchment of the river Douro.

Is currently the main tool to observation and surveillance that allow the detection in real time of anomalous and this start the communication protocols between the various entities involved. This possibility is important in order to minimize the environmental, social and economic impacts of such situation.

The information is transmitted through VSTA, GPRS and GSM depending on the type of the station and is centralized in the control centre based at the Valladolid where is treated, analysed, distributed and record at different databases.

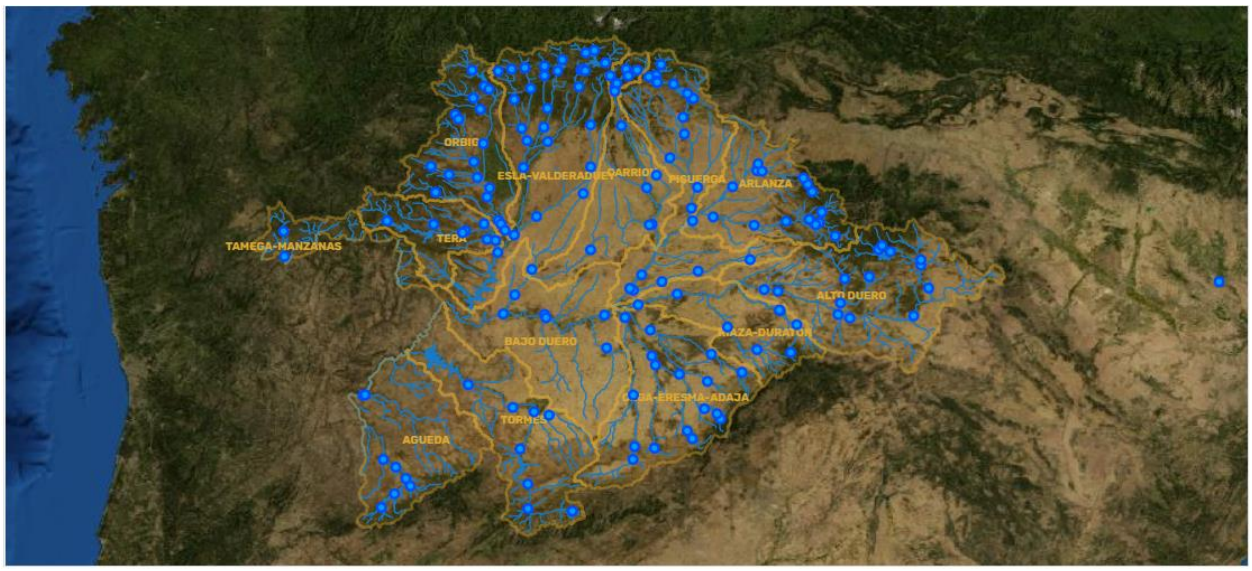
On the following figures several aspects of this system are presented.

Figure 58 | Geographical distribution of stations in reservoirs



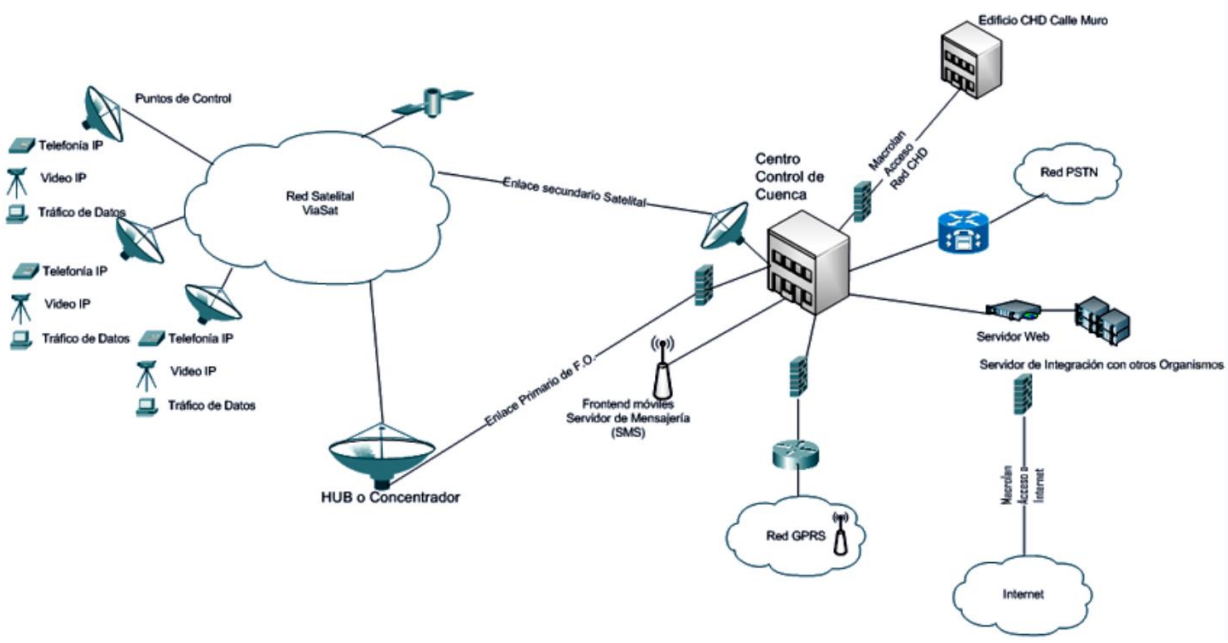
Source: SAIH Duero (www.saihdueros.es)

Figure 59 | Geographical distribution of stations at rivers and tributaries



Source: SAIH Duero (www.saihdueros.es)

Figure 60 | Schematic representation of the communications system



Source: SAIH Duero (www.saihdueros.es)

4.2.2. Greece - Regional Development Fund on Behalf of the Region of Attica

In this country, some good practices have been identified around this issue and can be consulted elsewhere in this document.

Here are some of the water monitoring needs identified by Greece:

- Autonomous and radio controlled equipment, run-off treatment technologies, etc, may also be used to identify sources of pollution and enable action.
- Inefficient, time dependent, costly and labour-intensive routine sampling and analysis procedures currently deployed to monitor the water quality may be complemented with ICT systems.
- Digital Transformation

4.2.3. Romania - The National Union of Romanian Entrepreneurs

One of the great solutions already developed, Sensors2Net water systems, developed by WaterScope Inc., offer innovative, intelligent solutions: data collection, interpretation, design, and implementation, by making both monitoring and water management. Whether in tight urban applications or over distances in rural and suburban communities: sensors remotely transfer data wirelessly to any dedicated server, where users perform Artificial Intelligence aided analysis and water management decisions regardless of space and time. The result is superior circulatory water planning across the entire spectrum of activities in the water cycle. Real-time monitoring, early error detection, water loss prevention, and implementation of predictive maintenance vs. preventive maintenance. All while fitting seamlessly into either existing or the latest planned water management processes.

SENSORS2NET IS THE ANSWER, WHEN

- design and monitoring of water solutions needs to be small, in tight populated areas.
- resource recovery, water reuse and aquaculture projects are being added to community planning.
- overall and real-time water quality information is needed.
- large number of sensors need to operate in one location but in great distances from each other.
- remote access to sensors' data is a must, but installation of cable network would require huge investments.
- GSM/internet connection is insufficient, not available, or not cost-effective.
- continuous and secure data flow is required together with low operation and maintenance cost.

SENSORS2NET SOLUTIONS, APPLICATIONS

- urban water circularity management
- urban waterways and canals (real estate valuation)
- water and sewage water monitoring
- wastewater pump shafts monitoring (predictive maintenance)
- water losses monitoring (Non-Revenue Water savings)
- water, wastewater and materials recovery facility design and maintenance
- urban and rural aquaculture
- urban vertical farms control & maintenance

HOW DOES IT WORK?

Figure 61 | Work SENSORS2NET

Sensors, measuring water parameters (pH, conductivity, dissolved oxygen, ORP, temperature, CO_2, flow, pressure, etc.) are connected to S2N Smart Node, developed by WaterScope International Inc.

S2N Smart Node handles up to 8 sensors and operates on batteries without the need of external energy source. The Smart Node transfers measurement data to a dedicated server with a frequency, required by the user. Data transfer is performed wirelessly, via LoRaWAN or NBIoT technology.

Wireless communication between S2N Smart Node and server is ensured by LoRaWAN gateway. One gateway is capable to handle thousands of S2N Smart Nodes. Distance between S2N Smart Node and LoraWAN gateway can be as far as 10-15 km (depending on terrains (mountainous or plain areas).

The data are transferred to a dedicated local or cloud server. The encrypted data are then visualized by customized and user-friendly dashboard and are ready to be analysed by Artificial Intelligence aided process for monitoring, service, or predictive maintenance.

SENSORSS2NET BENEFITS – URBAN

- superior accuracy and analysis for the design & build of smaller, more efficient, community-friendly, water facilities.
- allows for urban integration of all municipal and industrial water needs.
- allows for superior urban water quality in canals, ponds, creating maximum commercial real estate value.
- allows municipalities maximum water and financial savings through eliminating system water waste.
- provides even the largest communities with one, easy to use application to maximize circularity and accurate planning in all their water needs.

SENSORS2NET BENEFITS – RURAL AND SUBURBAN

- suburban and rural water value management integrated into one system;
- creates maximum yield and profitability in water reuse and aquaculture, including algae farming, fish farming and resource recovery;
- allows for previously unseen accuracy in quality and biological monitoring of large, rural water bodies such as rivers and lakes;
- creates a highly accurate and secure system of monitoring for maximum water security.

SENSORS2NET – INTEGRATION INTO SMART CITY PROGRAMME

How does S2N system work in Smart City project:

- ensures sustainable environment development;
- helps optimize city operations;
- provides enhanced quality of utility services;
- supports efficient management of assets, resources and services;
- enables unique integration of artificial intelligence into urban circularity.

SENSORS2NET SPECIAL APPLICATIONS

S2N Smart Hydrant:

Network pressure management is a challenge for network operators. Today still millions of m3 of water disappear between the wells and the faucets, causing significant losses and high operating costs for water suppliers. As traditional cost saving methods proved to be insufficient here, rationalisation of expenditure requires new solutions.

S2N Smart Hydrant monitors consumption data, network pressure, temporary water intake at

predetermined measurement points. The Artificial Intelligence aided data analysis gives real time, precise information on the condition of the distribution network. Value of the trend analysis helps define optimal pressure, discover changes of pressure or unauthorized water intake, even supports handle of customer claims.

S2N Water Pump Shafts Monitoring:

Wastewater pump shafts require continuous attention and quick action if malfunction occurs. S2N system monitors operation of the pumps, their energy consumption, pressure, delivered quantity of water, and transmits these data to the server. It can be installed in and used with already existing shafts as well. Through processing the data transmitted wirelessly by S2N system, the maintenance processes can be optimized and the former preventive maintenance – whether or not it was necessary – can be replaced by predictive, condition-based maintenance. Failures can be avoided, and maintenance works will be more efficient; balance of repairs and maintenance costs is improved, number of dysfunctions decreases, while operational safety increases.

S2N Wastewater Plant Monitoring:

Wastewater technology is a complex system, where each step requires precise measurements. They usually are located on a large area and the sensors must be installed in places, being far away from each other within the plant. Cost of cabling and software modification is high, not mentioning the need for PLC expansion.

Sensors2Net continuously collects and transfers data with its easy-to-install wireless communication system without costly cabling or GSM subscription. Being aware of the high security level, such plants are operating on, it is also possible to lead communication through the customer's own internal network. The process requires low cost but provides high efficiency. Users can see the results, diagrams and analyses on an interface customized to their needs.

S2N Smart Buoy:

Should it be industrial size aquacultures or recreational fishponds, water quality is key factor to ensure good quality fish and keep environmental standards. S2N Smart Buoy measures essential parameters of water: pH, temperature, dissolved oxygen, ORP, conductivity without any human interaction, and transfers them to the dedicated server. Environmental data like windspeed, sunlight intensity, humidity, air temperature can also be added, and the whole data base serves as source of real time information for fishpond managers and fishermen. By following physical and chemical parameters of the water, it is possible to forecast the appearance of algae bloom. The Artificial Intelligence supported trend analysis of the data enables users to make necessary preventive steps to avoid costly remediation of fish kills. It also helps maintain efficient operation of aquacultures' pumps and other technical equipments.

Another vendor is Libelium. They launched a Smart Water wireless sensor platform to simplify remote water quality monitoring. Equipped with multiple sensors that measure a dozen of the most relevant water quality parameters, Wasp mote Smart Water is the first water quality-sensing platform to feature autonomous nodes that connect to the Cloud for real-time water control. Wasp mote Smart Water is suitable for potable water monitoring, chemical leakage detection in rivers, remote measurement of swimming pools and spas, and levels of seawater pollution. The water quality parameters measured include pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), conductivity (salinity), turbidity, temperature and dissolved ions (Fluoride (Fluoride (F-), Calcium (Ca2+), Nitrate (NO3-), Chloride (Cl-), Iodide (I-), Cupric (Cu2+), Bromide (Br-), Silver (Ag+), Fluoroborate (BF4-), Ammonia (NH4), Lithium (Li+), Magnesium (Mg2+), Nitrite (NO2-), Perchlorate (ClO4), Potassium (K+), Sodium (Na+).

The Wasp mote Smart Water platform is an ultra-low-power sensor node designed for use in rugged environments and deployment in Smart Cities in hard-to-access locations to detect changes and potential risk to public health in real time.

Figure 62 | Libelium

Source Libelium Comunicaciones Distribuidas S.L. https://www.libelium.com/libeliumworld/comparing-professional-vs-maker-sensor-lines-for-agriculture-and-water-monitoring/

Waspmote may use cellular (3G, GPRS, WCDMA) and long range 802.15.4/ZigBee (868/900MHz) connectivity to send information to the Cloud and can accommodate solar panels that charge the battery to maintain autonomy. Smart Water nodes are ready to deploy out of the box and sensor probes can be recalibrated or changed in the field, with kits provided by Libelium.

“Smart Water is an improvement on existing water quality control in terms of accuracy, efficiency, and low operational costs. For municipalities, water quality detection and monitoring systems have to be reliable, autonomous, and flexible,” said David Gascón, CTO at Libelium. “With Waspmote, a full Smart Water solution is now available at a price point ten times less than current market solutions, for better management of water resources.”

Applications:

- drinking water monitoring: Common chemical parameters include pH, nitrates, and dissolved oxygen. Measuring O2 (or DO) is an important gauge of water quality. Changes in dissolved oxygen levels indicate the presence of microorganisms from sewage, urban or agriculture runoff or discharge from factories. A right level of ORP minimizes the presence of microorganisms such as E. coli, Salmonella, Listeria. Levels of Turbidity below 1 NTU indicates the right purity of drinking water.
- chemical leakage detection in rivers: Extreme pH or low DO values signal chemical spills

due to sewage treatment plant or supply pipe problems.

- swimming pool remote measurement: Measuring oxidation-reduction potential (ORP), pH and Chloride levels of water can determine if the water quality in swimming pools and spas is sufficient for recreational purposes.
- pollution levels in the sea: Measuring levels of temperature, salinity, pH, oxygen and nitrates gives feedback for quality-sensing systems in seawater.
- corrosion and limescale deposits prevention: By controlling the hardness of the water we can avoid the corrosion and limescale deposits in dishwashers and water treatment devices like heaters. Water hardness depends on: pH, temperature, conductivity, and Calcium (Ca+)/ Magnesium (Mg2+) concentrations.
- firsh Farming / Fish Tank Monitoring / Hatchery / Aquaculture / Aquaponics: Measuring the water conditions of aquatic animals such as snails, fish, crayfish, shrimps or prawns in tanks. Important values are pH, Dissolved Oxygen (DO), Ammonia (NH4), Nitrate (NO3-), Nitrite (NO2-) and water temperature.
- hydroponics: Plants that take the nutrients directly from the water need a precise pH and Oxygen in water (DO) levels to get the maximum growth.

Figure 63 | Smart Water Sensor Board + Probes for Wasp mote OEM

Source: Libelium Comunicaciones Distribuidas S.L. (https://www.libelium.com/)

***Specific Ion Monitoring Applications**:*

- Drinking water quality control: Calcium (Ca2+), Iodide (I-), Chloride (Cl-), Nitrate (NO3-), pH.
- Agriculture water monitoring: Calcium (Ca2+), Nitrate (NO3-), pH.
- Swimming pools: Bromide (Br), Chloride (Cl-), Fluoride (F-), pH.
- Wastewater treatment: Cupric (Cu2+), Silver/Sulfide (Ag+/S2-), Lead (Pb2+),

Fluoroborate (BF4-), pH.

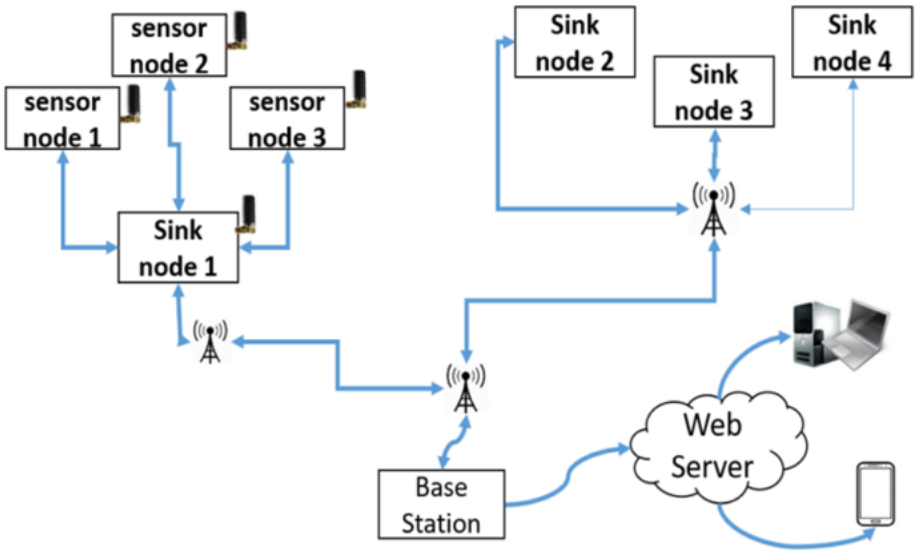
Waspmote Smart Water Technical Characteristics:

- Sensor probes measure more than 12 chemical and physical water quality parameters such as pH, nitrates (NO3), dissolved ions (Fluoride (F-), Calcium (Ca2+), Nitrate (NO3-), Chloride (Cl-), Iodide (I-), Cupric (Cu2+), Bromide (Br-), Silver (Ag+), Fluoroborate (BF4-), Ammonia (NH4), Lithium (Li+), Magnesium (Mg2+), Nitrite (NO2-), Perchlorate (ClO4), Potassium (K+), Sodium (Na+) dissolved oxygen (DO), conductivity (salinity), oxidation-reduction potential (ORP), turbidity, temperature, etc. Pollutants can be detected and treated in real-time, to ensure good water quality over an entire water supply network. Extreme pH values may indicate chemical spills, treatment plant issues, or problems in supply pipes. Low levels of DO may indicate the presence of microorganisms due to urban/agricultural runoff or sewage spills. ORP measures how well water sanitization is working.
- Waspmote transmits sensor readings to the Cloud via 3G, GPRS, or WCDMA cellular connections; in the case of several nodes located in the same zone, Waspmote sends values to the Meshlium Internet Gateway via long range RF bands 868MHz and 900MHz. Sensor data is available in real time, even from sensor nodes situated in remote locations.
- CE / FCC / IC certification and quad-band cellular connectivity (850/900/1900/2100MHz).Waspmote supports any cellular connection provider, and is ready for deployment in any country in the world.
- The new Smart Water sensors are available for both Waspmote lines:
  - Waspmote Plug & Sense!
  - Waspmote OEM

A system for monitoring water quality in a large aquatic area using wireless sensors network technology, a low cost, real-time water quality monitoring system which can be applied in remote rivers, lakes, coastal areas and other water bodies was installed using sensors for Atlas Scientific. The main hardware of the system consists of off-the-shelf electrochemical sensors, a microcontroller, a wireless communication system and the customized buoy. It detects water temperature, dissolved oxygen and pH in a pre-programmed time interval. The developed prototype disseminates the gathered information in graphical and tabular formats through a customized web-based portal and preregistered mobile phones to better serve relevant end-users. This Wireless Sensor Network (WSN) is suitable for monitoring physical and chemical water characteristics in remote areas at lower cost and reduce manpower requirements. It can be utilized for water quality monitoring which presents many advantages like its portability and near real-time data acquisition and data logging capability. WSN applications for the aquatic area are far more challenging activities compared to the land based WSN applications due to its electronic component which has zero tolerance to water or even moisture intrusion. WSN-based applications for environmental monitoring have been implemented for applications such as water quality monitoring, water chemical monitoring, hydrodynamic performance monitoring, irrigation, and agriculture. Other studies are focused on the enhancement of the transmission, power harvesting and management and environment adaptability in the past few years of applications. Dissolved Oxygen (DO), pH, and temperature are considered as the most common water quality parameters and are identified as one of the important water parameters that can be used to determine the actual physico-chemical status of a certain aquatic area. Measurement of how basic or acidic the water in a certain location can be done by measuring pH and that makes pH as one of the most important water quality indicators. The pH parameters are difficult to measure accurately as it deals with the very small amount of ionic concentration thus need a sensitive

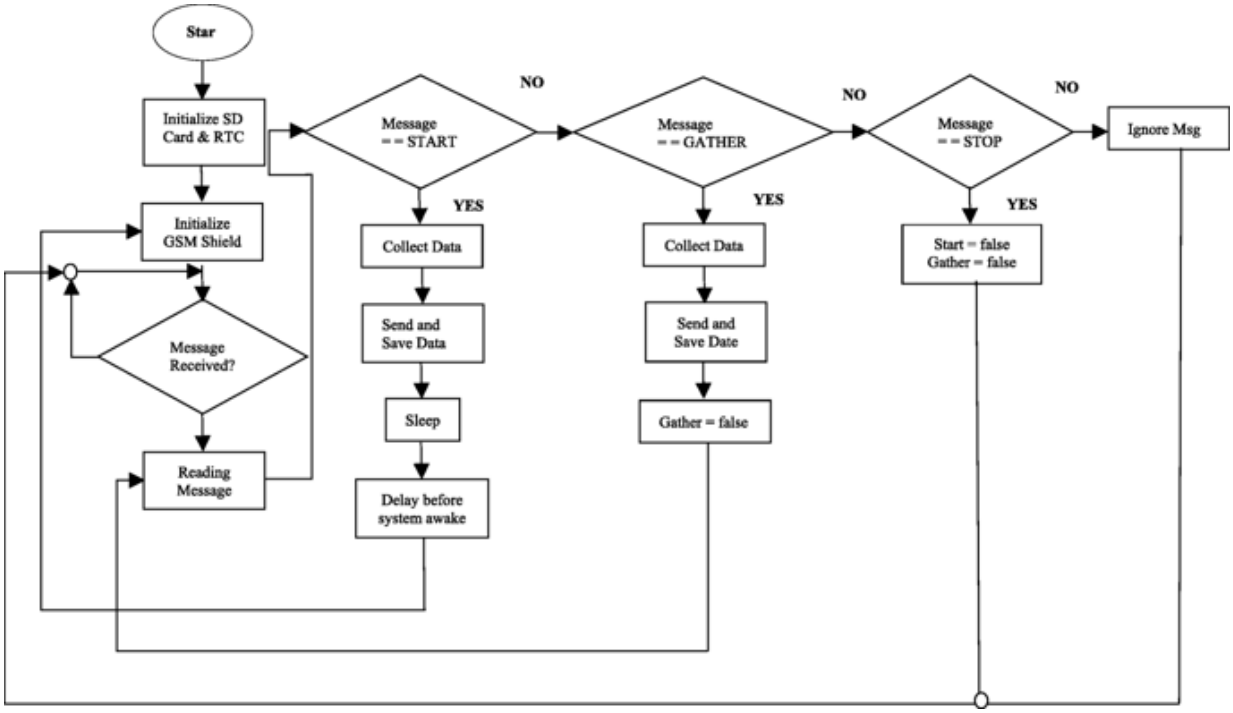
sensing device for its detection. Temperature is the most common physical assessment of water quality, as these parameters can have an effect on other parameters like photosynthesis of aquatic plants, the sensitivity of these organisms to pollution, parasites, and diseases. DO is an important parameter in assessing water quality because of its influence on the organisms living in a body of water. A DO level that is too high or too low can harm aquatic life and affect water quality. Hence, this study will particularly cover large aquatic area monitoring, focusing on DO, pH, and temperature as water quality indicators, using WSN technologies. Also, Global System for Mobile Communication (GSM) will be used to transmit sensed data from the sink node to the base station in the same method. The aim is to develop water quality monitoring systems deployment in order to provide a feasible solution for remote or distant places where a water quality laboratory is not present. Its main advantage will be its capability for real-time monitoring.

Figure 64 | System architecture



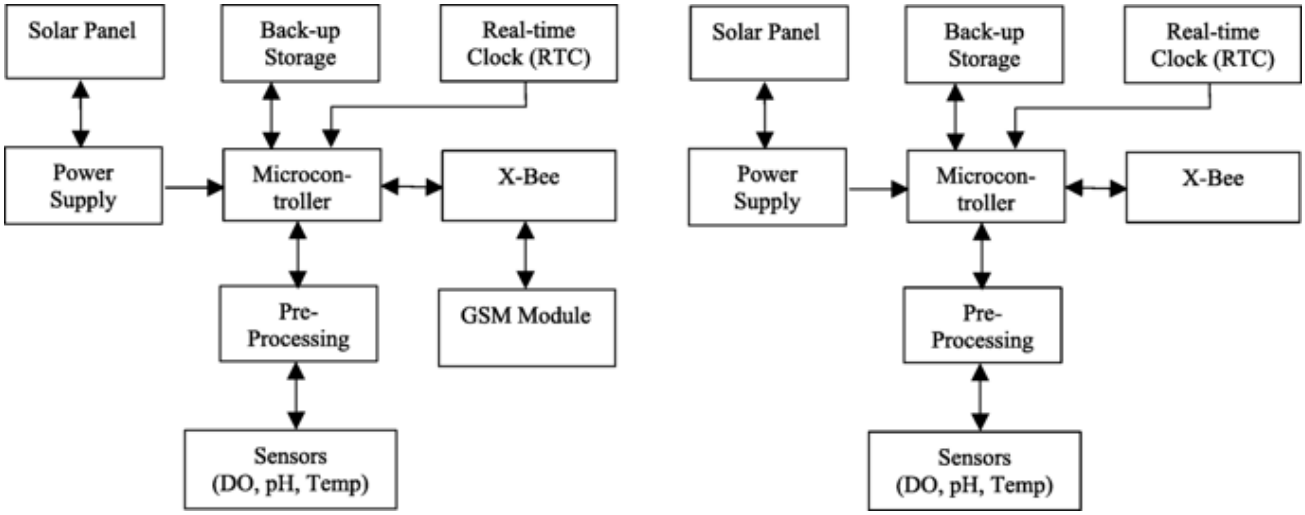
Source: Demetillo, A., Japitana, M. & Taboada, E. (2019). https://doi.org/10.1186/s42834-019-0009-4

Figure 65 | Systems flowchart for the operation of the proposed water quality monitoring system



Source: Demetillo, A., Japitana, M. & Taboada, E. (2019). https://doi.org/10.1186/s42834-019-0009-4

Figure 66 | Hardware architecture of a sensor node



Source: Demetillo, A., Japitana, M. & Taboada, E. (2019). https://doi.org/10.1186/s42834-019-0009-4

4.2.4. Sweden - The County Administrative Board of Östergötland

Information and communications technologies are used in Sweden in terms of monitoring water quality of drinking- and sewage systems to prevent major incidents related to the transfer of water in cities. Other fields of use are within the evaluation of water quality in lakes and streams in Sweden. However, further use of ICT could be developed in the future.

The main use of ICT in monitoring of water quality are operators at water plants who use ICT for online monitoring of microbial and pressurisation of sewage and water supply networks. The municipal operator in Östergötlands most densely populated city has tested techniques for smart water management measuring using four prototypes:

- Flow cytometer for detection of primary E.coli.
- Electronic tongue for detection of the presence of wastewater, chemical pollutants and microorganisms in water.
- Electronic nose for detection of diesel and other volatile gases.
- UVF sensor for detection of diesel and other hydrocarbon compounds using multispectral UV fluorescence.

Also, two sensor systems for industrial process water were developed:

- Impedance sensor for characterization of cutting fluids.
- SCGD (Solution Cathode Glow Discharge) sensor for detection of heavy metals in industrial wastewater.

In monitoring of biological factors there are several fish samplers in use that count the number of passages up and down stream constructed fauna passages, at waterpower plants. These monitoring stations show not only the frequency of fauna passage but also measures size and create video of the passage. The statistics can be accessed by anyone at the company that installs the technical equipment (Fiskdata.nu).

Monitoring in field which is managed by the County administrative board is so far limited to using ICTs in monitoring of nutrients and turbidity for collection of data in field at a few stations. Collection of process water and storm water have also been sampled with passive samplers, but online transfer has not yet found wide spread use but are on the rise in municipal areas. Sampling of environmental pollutants, nutrients, biological matrices (diatoms, fish and biota) in sediments and water is still performed manually by CAB or by hired consultants.

Figure 67 | Measuring station for turbidity, flow, temperature and pH in watercourse Svinstadssjön

Photo by: Tim Ekstam, CAB Östergötland

Depending on the type of environmental problem monitoring by applying different types of ICTs are used in Sweden. For example, in monitoring storm water and process water from different industries automated samplers to extract relevant samples over multiple hours are applied and monitoring of . Within the management of water in Sweden smart technologies such as satellite analysis of nutrients and water flow is common and it is applied in the status classification of water bodies during the management cycles of the WFD. During the last management cycle of 2016-2021 models for evaluation of nutrient loads were an essential part of the status classification. Model tools (software) used in the latest water management cycle included:

- Nutrient modelling
- Bioavailability of metals
- Stormwater modelling

In field use of ICTs in Sweden include inspection of watercourse by drones. During the last cycle inventory of watercourses by drones efficiently reduced the amount of work necessary for evaluating the hydro morphological status while also generating data for later use. Drones are widely used in Östergötland for developing measures such as wetlands and catchment dams for phosphorus providing information concerning areas which would have been difficult to attain otherwise.

To assess effects of pressures and suggested measures Geographical information systems (GIS) constitutes a powerful tool. Initiating the management cycle of 2016-2021 the pressure analysis used GIS-analysis of multiple data sources such as polluted areas, industries (IED- and No IED-industries), sewage treatment plants, agricultural areas, waterpower plants and migration obstacles. These were later used to connect identified pressures to observed effects in the water bodies and in the end resulted in suggested measures and EQS. Use of GIS is widely applied in Sweden in multiple areas in water management. It is widely used by authorities to display data and visualize monitoring, pressures and measures. However, GIS and application of the software could be of further use in visualizing results and

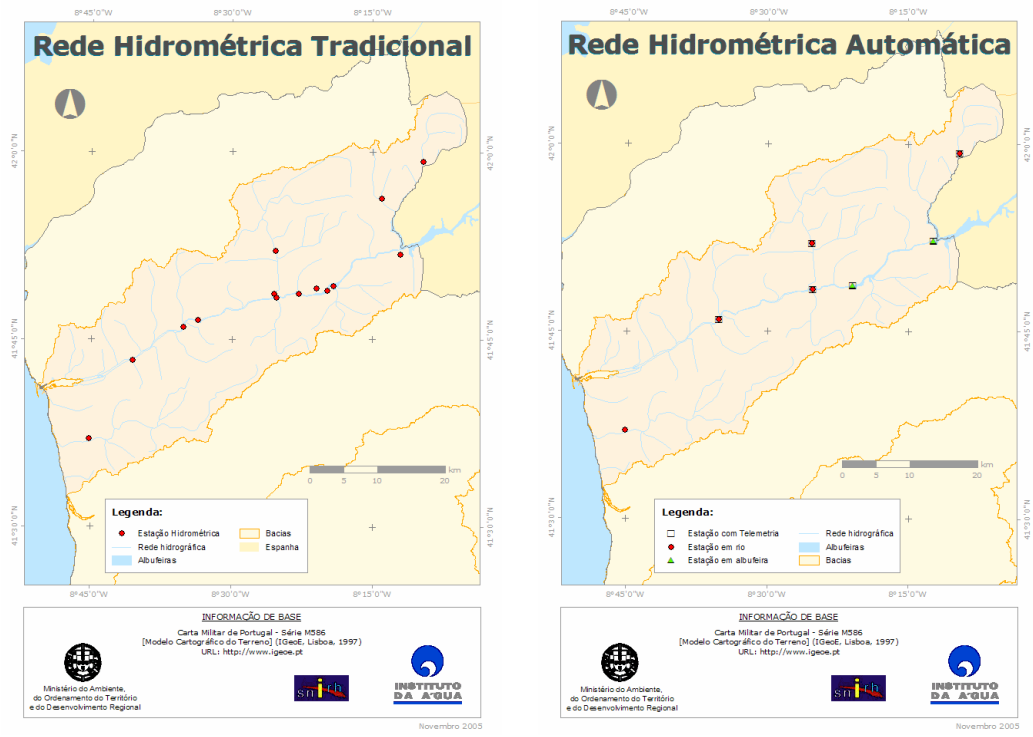
used in matters concerning permits.

4.2.5. Portugal - CIM Alto Minho

The application of information and communications technologies in the monitoring of the evaluation different aspects related to water use, throughout its cycle, is already a common practice in Portugal. In a more regional/local context, these technologies are widely used in water and wastewater treatment systems, allowing the correct operation and management of these infrastructures, ensuring the production of water or waste water of the desired quality. The use of these technologies allows not only a greater degree of automation of their functioning but a knowledge over time of the variation in the quality of treated water, as well as the identification of external factors that may influence the functioning of these systems and the quality of water or water residuals to be treated.

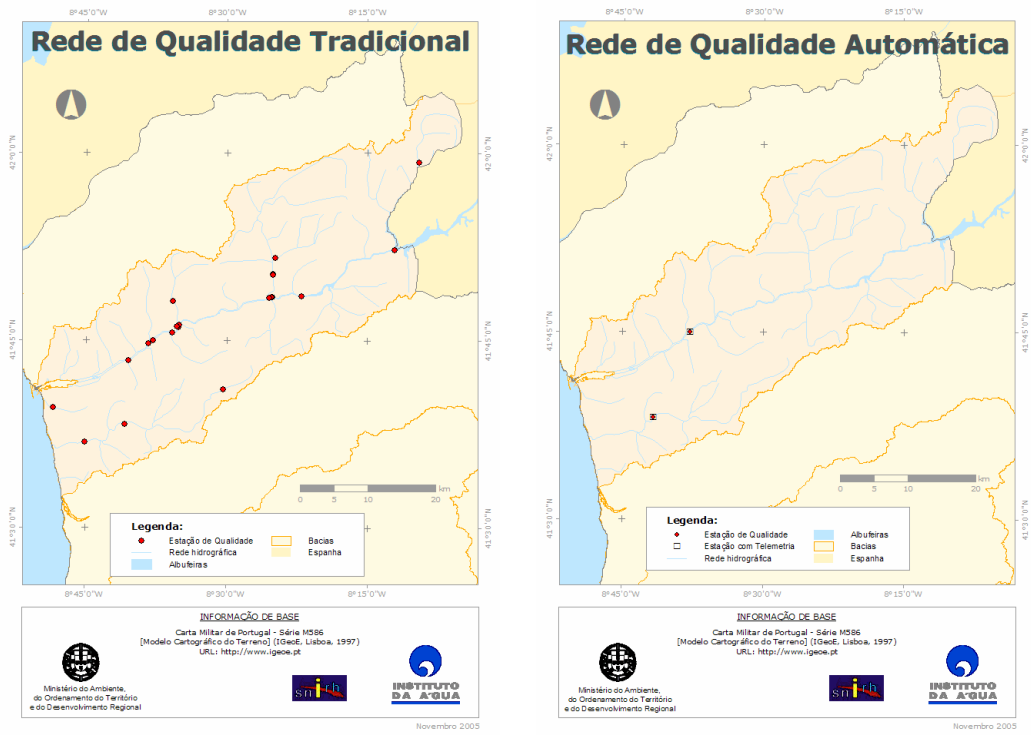
In the context of water resources monitoring, these technologies serve as the basis for a national tool, which monitors the quality of these resources in the different national hydrographic basins, which include the Lima River. This system, whose operation is the responsibility of the Portuguese Environment Agency, is called the National Water Resources Information System (SNIRH). Created in 1995 by the National Water Institute (INAG) in 1997 started to provide on the internet some information regarding the quality of surface and underground water. The monitoring network consists of automatic and conventional stations, some of which are equipped with tele-transmission. The system's portal also publishes thematic monthly summaries, aiming at characterizing national water availability, technical reports, cartography on water resources (for example flood zones), technical documents and photographs related to water resources. In addition to water quality data, this system provides meteorological, hydrometric and sedimentological data. The following figures refer to different types of graphic information provided by the system for the Lima River.

Figure 68 | Geographical distribution of traditional hydrometric stations (on the left) and automatic hydrometric stations (on the right)



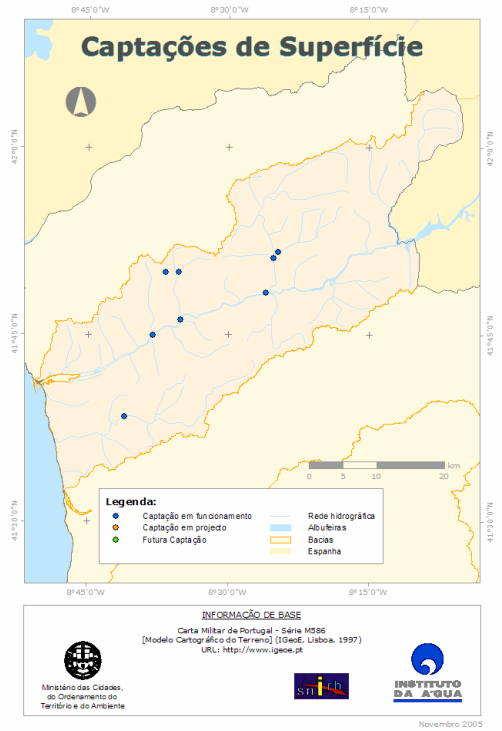
Source: SNIRH

Figure 69 | Geographical distribution of traditional quality stations (on the left) and automatic quality stations (on the right)



Source: SNIRH

Figure 70 | Geographical distribution of the water catchment stations



Source: SNIRH

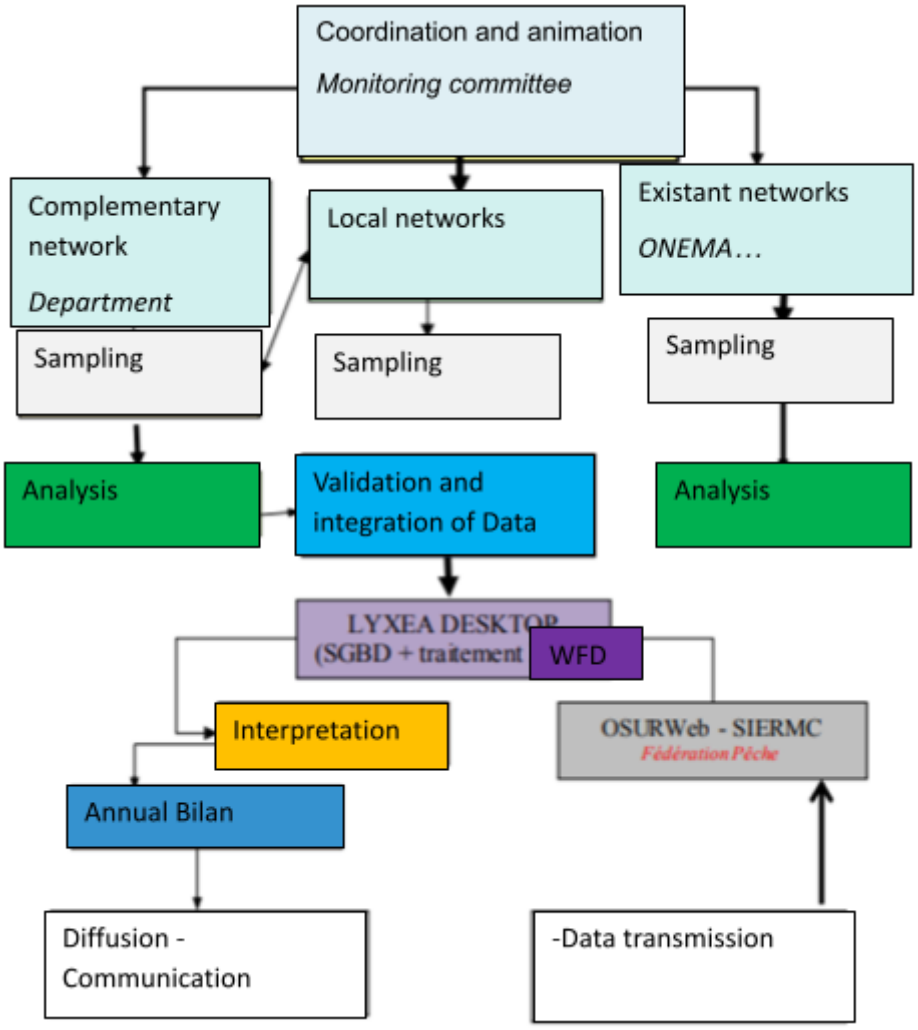
4.2.6. France - Cluster DREAM

The environmental monitoring process is generating more and more digital data. The thousands of stations managed by the Loire-Bretagne and Seine-Normandie water agencies generate an impressive amount of data for physical-chemical quality (usually 6 to 24 samples per station) and hydrobiology (biodiversity) cross-referenced with sensor data (hydrometry, piezometry). These two water agencies have had more than 70 000 000 data since the 2000s.

Based on this observation, private companies in the Central Region in partnership with these public entities developed several tools for centralizing, qualifying and structuring data on water bodies, such as:

- "Osur and Lyxea Water and Middle" tool: calculations of water quality assessment and other indicators by the water agency (Pierre 2020)

Figure 71 | Example of utilization of lyxea and Osur in Departmental network for monitoring the quality of the Loire rivers – 2015 assessment and development since 202



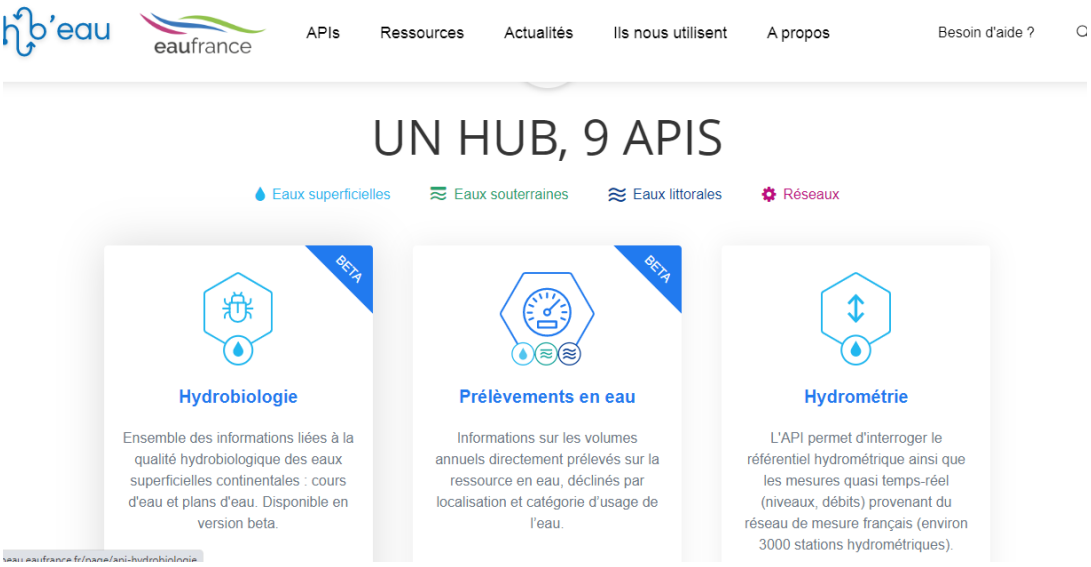
Source: Département de la Loire 2016

- Web services: Regarding the quantity and diversity of sources for water mass data, a goal of the region is to centralize data on the various chemical physical parameters in order to make them interoperable to have a clear and integrated view of the state of the environment and to develop reliable models. Most of the water data are available on the web: they are accessible “Open" (open data concept); but their re-use by the greatest

number proves technically complicated. In this context, a web service has been developed in Orleans called HUB'EAU (https://hubeau.eaufrance.fr/) and allows access to data on fish, water quality, hydrometry, temperature... (Porteneuve 2020) Led by BRGM, in partnership with the French biodiversity office and the Ministry of the Environment, Energy and the Sea, Hub'Eau offers an innovative open-data service, through simplified and functional access API-based, ensuring the best performance in terms of data availability on water;

- Tool for characterizing specific emissions: an example of the tool developed as part of the BEATRIX collaborative project, which aims to qualify and make a typology of certain pressures. In particular, by interviewing the "Search for Dangerous Substances for Water" database. This app identifies:
  - a predominant area of activity in terms of toxicity;
  - substances present in a specific release;
  - the distribution of a substance across all activities in a region and to make inter-regional comparisons.

Figure 72 | Hubeau platform



Source: Hub'eau platform web site

The project "Beatrix also provides access to a set of information on substances (formula, synonym, INERIS and other bibliography, internet link, status, contamination of the environment...) (Pierre 2020).

- Norrman project: this project aims at simulating the impacts of polluting emissions in rivers. This tool developed within this project assesses emission limits and thus determines the authorizations in accordance with the objectives of good condition. This project assesses the impact according to: the chemical status, the ecological status of the polluting macros, the specific pollutants of the ecological status. Thanks to this project, there is a possibility of defining scenarios/simulation for different geographical right-of-way under different specific conditions (stretch/module, rain/dry weather). The calculation is based on self-purification kinetics according to the types of parameters: hydrophilic

micropollutants. This tool used by local authorities' results in a certified database. This tool is linked to the water pollution problems encountered in the Central Val de Loire region (Pierre 2020).

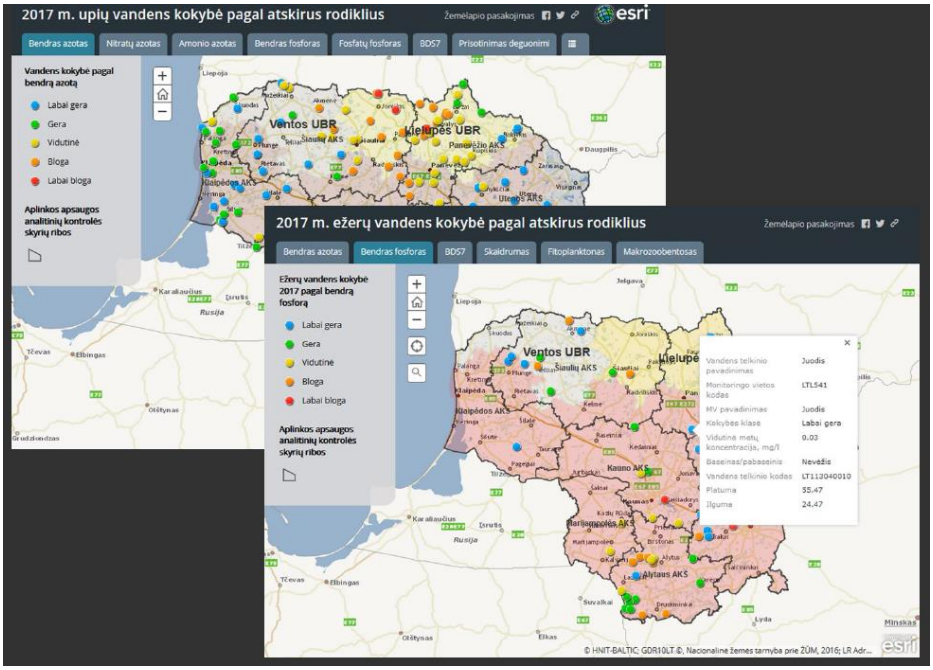
Figure 73 | Norman project

Source: Norman project (Pierre, 2020)

In addition, these tools make the data readable and understandable. For example, the emergence of ICTs in awareness and communication on micropolluants is indicative of the importance that these types of tools can have (Agence de l'eau Loire-Bretagne et DREAL de bassin Loire-Bretagne 2015).

4.2.7. Lithuania - Kaunas University of Technology (KTU)

Figure 74 | Water Ouality in Rivers and Lakes, Environmental Protection Agency, Lithuania



SMART ULTRASONIC WATER METER QALCOSONIC W1 WON AWARD

Axioma Metering finished the 2019 year with another recognition of its team's work – on 18 December, the smart ultrasonic water meter Qalcosonic W1 developed by the company was recognised as the best product in the competition Made in Kaunas District 2019 ("Sukurta Kauno rajone 2019").

The goal of this competition is to encourage the companies based in Kaunas district to develop innovative, high-quality and eco-friendly products that could successfully compete in the Lithuanian and international markets. The products and serves were evaluated by a commission comprising the representatives of the Kaunas district municipality, Kaunas Chamber of Commerce, Industry and Crafts, and the Kaunas district tourism and business information centre.

The smart water Qalcosonic W1 measures water flow with ultrasound, which makes the metering of water consumption very accurate. Extensive capabilities of transmitting data through radio waves, RFID, NFC, the Internet of Things (IoT) and the LoRa technology facilitate data collection, making it possible to analyse data and effectively meter the water.

Advanced detection algorithms are installed to identify faults in the water supply system (cracked pipe, leakage, freezing, backflow) – users and operators receive fault alerts, can react proactively and prevent losses due to water leakage. Another unique property of this meter is its small size and simplicity. Its structure and design symbolise a new evolution phase of the technology – it is probably the smallest smart ultrasonic water meter in the world.

Qalcosonic W1 is manufactured in Axioma Metering's automated factory in Kaunas FEZ where all the meter manufacturing operations are executed. This is still not very common in the Lithuanian industry, but it ensures the top quality of a product.

In 2019, 90% of the smart ultrasonic water meters were exported to more than 60 countries throughout the world.

This year the smart ultrasonic water meter Qalcosonic W1 was also recognised in the Baltic Assembly –

for the products it developed, Axioma Metering was announced the most innovative company of Lithuania. Furthermore, this year in the K.A.V.A. 2019 awards for quickly growing companies of Kaunas Qalcosonic W1 was named as the Innovation of 2019.

Also, there were identified and contacts received about the good practices implemented in Lithuania with using ICT or GIS, such as:

- Water network management, Real time Data from sensors (IoT);
- Public awareness, Data and App sharing about Water supply and Sever networks;
- Prevention of accidents in Water network, asset management;
- Flood hazards and risk maps;
- Cadastre of Rivers, Lakes and Ponds;
- Water Ouality in Rivers and Lakes;
- Water level monitoring and prediction;
- Monitoring of achievements in Environmental projects.

However, we still need time to contact the GP's owners if they will be interesting to share these GPs.

5. POLICY INSTRUMENTS ADDRESSED

A "*policy instrument is a means for public intervention. It refers to any policy, strategy, or law developed by public authorities and applied on the ground in order to improve a specific territorial situation*", according to the resolutions of the Interreg Europe Programme. In the following table the policy instruments addressed by the project partners are identify and described below.

Table 17 | Policy Instrument addressed by partner

POLICY INSTRUMENTS			
No.	**Name of Policy instrument**	**Responsible body name**	**Partner Country**
1.	ERDF Regional Operational Programme Castilla -León	General Directorate for Budget and Statistics, Regional Government of Castilla y León	Iberian Association of Riverside Municipalities of Duero River, Spain

POLICY INSTRUMENTS			
No.	**Name of Policy instrument**	**Responsible body name**	**Partner Country**
2.	Regional Operational Programme of Attica 2014-2020	Region of Attica	Regional Development Fund on Behalf of the Region of Attica, Greece
3.	Large Infrastructure Operational Program	Ministry of European Funds (Managing Authority for Large Infrastructure Operational Program)	The National Union of Romanian Entrepreneurs, Romania
4.	Regional environmental objectives of Östergötland	The County Administrative Board of Östergötland	The County Administrative Board of Östergötland, Sweden
5.	Centre-Val de Loire ERDF Operative Programme 2014-2020	Centre-Val de Loire Region	Cluster DREAM, France
6.	Operational Programme for the European Union Fund's Investments in 2014-2020 Republic of Lithuania	Ministry of Environment of the Republic of Lithuania	Kaunas University of Technology (KTU), Lithuania
7.	Alto Minho 2020 Strategy & Action Plan	Intermunicipal Community of Alto Minho	Intermunicipal Community of Alto Minho, Portugal

5.1 ERDF Regional Operational Programme Castilla – León (Spain)

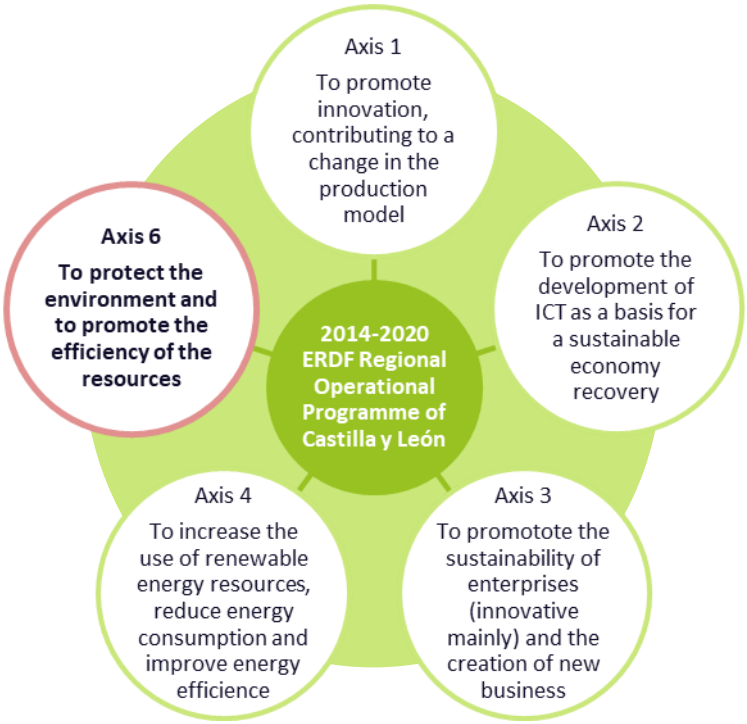
The policy instrument addressed by AIMRD in the BIGDATA 4RIVERS project is the ERDF Regional Operational Programme Castilla y León. It should be noted that AIMRD is not the body responsible for this policy instrument, the official responsible for it is Junta de Castilla y León, the regional government of Castilla y León.

The ERDF Operational Programme is a planning tool that establishes how and where to invest the funds of the European Cohesion Policy or Structural funds. The projects that receive grants of the ERDF Operational Programmes have to be placed in one of the 5 thematic objectives or priority axes of action and, in line with that principle, the 2014-2020 ROP Castilla y León is related to the following priority axis:

- Priority axis A: strengthening research, technological development and innovation;
- Priority axis B: strengthening the competitiveness of SMEs;
- Priority axis C: climate protection.

From this three priority axis six main strategic axis are developed in 2014-2020 ROP Castilla y Leónare. This strategic axis is presented in the next figure.

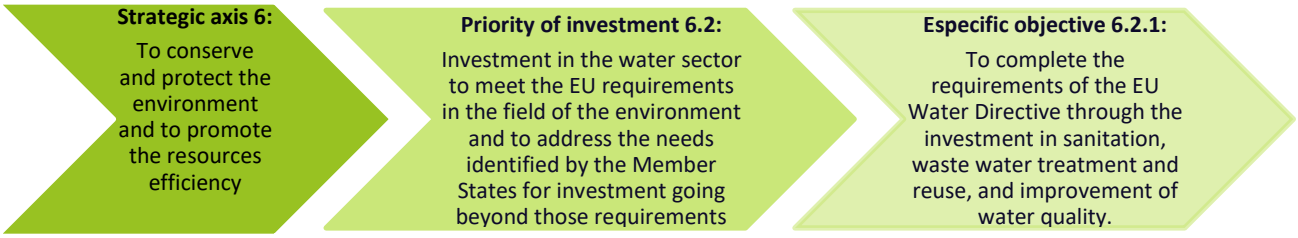
Figure 75 | Main axis of the AIMRD Policy Instrument



Source: 2014-2020 ERDF Regional Operational Programme of Castilla y León

The total budget settled is €628.8M and, although this operational programme concentrates more than 70 % of the available budget on research and innovation, ICTs, SMEs and the low-carbon economy, the Environmental protection (Axis 6 - Figure 64) is also a large priority, due to the need to accelerate and ensure compliance with the WFD in Castilla y León.

Figure 76 | Current Objective of the AIMRD Policy Instrument: Improvement of the efficiency of water treatment



Source: 2014-2020 ERDF Regional Operational Programme of Castilla y León

The results obtained are quantitatively measured through productivity and result indicators, in 2018 (milestone) and in 2023 (last milestone), which expected outcome related with axis 6 is 136.662 additional population served by improved wastewater treatment. The preparation and implementation of the operative programme also takes into account sustainable development, equal opportunities and no discrimination and gender equality.

The ROP Castilla y León agrees with the scope of the BIGDATA 4RIVERS project, having the same goal,

to improve the quality, service, integration and efficiency of water supply systems and wastewater collection and treatment stations as well the drainage of this type of water.

5.1.1. Opportunities and needs for improvement of policy instruments addressed

Castilla y León Region still doesn´t fully accomplish the objectives of the european WFD and through its ROP the regional government is fostering the implementation of water treatment systems according with discharges characteristics as well as the characteristics of the receptive riverbed improving the existing systems and installing new ones when necessary. Analysing this policy instrument, it is possible to underline some constraints, as some opportunities, to improve the policy instrument and to facilitate the search for conceivable solutions to the problems identified between the good practices shared by the other partners in the context of the BIGDATA 4RIVERS project (see Table 18).

Table 18 | AIMRD Policy Instrument: Constraints and opportunities

ERDF REGIONAL OPERATIONAL PROGRAMME CASTILLA Y LEÓN	
MAIN CONSTRAINTS	**OPPORTUNITIES**
Management, maintenance and monitoring of water treatment/purification systems (new or existing) are almost inexistent **b**ecause the policy instrument is only focused on building those systems.	Good percentage of funding for water treatment and management as also for innovative solutions.
Approach to the end of the programming cycle without completing the specific objectives defined – ambitious indicators.	Approach to the next programming cycle of ERDF ROP 2021 – 2027.

5.1.2. Other policy instruments in the specific context of water and river management

Complementing the policy instrument addressed by AIMRD in the project, other instruments should also be mentioned because of their relevance to the territory, in the specific context of water and river management. The water, rivers and rivers basins of Castilla y León are managed by four Confederations: the CHDuero, the CH Norte de España, the CHEbro and the CHTajo.

Note that in this document the Duero basin will be prioritize because of the straight relation with the AIMRD scope. Its responsible, the CHDuero, is a public organization with legal personality within the framework of the Ministry of Agriculture, Fisheries, Food and Environment with functional autonomy. The CHDuero has a main part and experience in applying the various instruments, and in parallel to a large number of entities in charge of managing the rivers and of the planning and management of river basins, is the main responsible of some of the following policy instruments

Some relevant examples of others policy instruments, at regional level, in the specific context of river and water management of the Duero basin are:

- the Hydrological Plan of the Spanish part of the Duero river basin district (2015-2021);
- flood Risk Management Plan of the Spanish part of the Duero river basin district;
- the Special Drought Plan for the Spanish part of the Duero hydrographic demarcation;
- Castilla y León Regional Sanitation and Purification Plan (2007-2015);
- Castilla y León Regional Hydraulic Infrastructure Master Plan.

The first result from the transposition of the WFD, the Duero Hydrological Plan is the instrument that allows to achieve the objectives of national hydrological planning.

The second one represents an element of an integrated management of the basin and that hence the importance of coordination between both processes guided by the Flood Directive and the WFD, respectively. Its scope is related with interventions based on green infrastructures and has associated measures, such as those of natural water retention (NWRM) or reducing risk and vulnerability of assets exposed to flood.

The third drives from the European recommendations for “Facing the challenge of water scarcity and drought in the European Union” (European Commission, 2007). Its general objective is to minimize the environmental, economic and social impacts of eventual episodes of droughts and one of the three specific objectives recognized in the policy instrument is to guarantee the availability of water required to ensure the health and life of the population, minimizing the negative effects of drought and scarcity on the urban supply.

The fourth respects to a regulation on water of the JCYL and relates to a general protocol of collaboration between the Ministry of the Environment, and Rural and Marine Affairs and the JCYL, which established the general framework of collaboration in the field of sanitation and purification to guarantee the execution of the National Quality Plan, specifically related to the guidelines of water sanitation and treatment.

The fifth also respects to a regulation on water of the JCYL and comprises the strategic implementation of suitable systems of Urban Hydraulic Infrastructure, necessary both for satisfy the demands consonant with a modern conception of the quality of life of the inhabitants of Castilla y León, such as to achieve a correct use of natural resources, without undesirable environmental impacts.

The main problem related to the Duero basin nowadays is the lack of efficient wastewater facilities in most of the municipalities of the Castilla y León region to the levels required by the relevant EU directives, as well as to address public health and environmental threats related to the use of the water by industries and for agriculture activities. According to the EU legislation, municipalities with more than 2000 inhabitants are obliged to properly treat their wastewaters before dumping them into the receiving environment.

The issues of wastewater treatment and the reuse of water are of great importance, especially in areas where the shortage of conventional resources is a structural problem, as it is in the case of Spain. Wastewater reuse is an important mechanism to avoid problems derived from droughts and water scarcity.

Despite the current situation of Castilla y León Region, it should be noted that this country presents one of the greatest rates of wastewater reuse in Europe and globally. According with different sources of information, the annual total volume of wastewaters reused in Spain currently varies between 493 hm3/year and 268 hm3/year. Regarding its main uses, around 40–70% of this volume is used in the agricultural sector, followed by 36% used in the irrigation of parks and recreational areas. Industrial uses present 10% and 7% is involved in several uses of reclaimed waters such as activities related with urban and residential purposes, discharges since sanitary installations, etc. Finally, a 2% is used in the cleaning of sewage systems and/or street cleaning (Jodar-Abellan, et al., July 2019).

5.2. Regional Operational Programme of Attica 2014-2020 (Greece)

The Region of Attica, represented by the Regional Development Fund, as entity is responsible for the design, management and monitoring of the Regional Operational Programme for 2014-2020. It is the owner of the policy instrument Regional Operational Programme of Attica and it has the overall control over programme specification and the allocation of financial resources, taking into consideration the provisions of European and national legislation. Regional Operational Programme for 2014-2020 consists of priority axes associated with the actions that Region of Attica wants to implement.

More specifically, for BD4R Programme the priority axis which is connected with actions that Region wants to implement is axis number 06:

- Priority Axis 06 - Improving the Quality of Life in the Urban Environment
  - *Thematic Objective 06:* Preservation and protection of the environment and promotion of resource efficiency.
    - *Investment Priority 6b:* Investments in the water sector in order to meet the requirements of the Union's environmental acquis and address the needs identified by Member States for investments that exceed those requirements.
      - *Specific objective 6.b.1:* Expansion of water supply networks in settlements that do not have access to high quality drinking water.

The main objective of the Regional Operational Program Investment priority 6.b is to fund and to implement projects following the European Environmental Acquisition and the National Strategies in the Sector of Waters (Directives 2000/60 and 91/271, other Special Instructions Issues, River Basin Management Plan Runoff, as well as Susceptibility associated with Water).

The actions are aiming at compliance with the requirements of Directive 98/83/EC on water for human consumption and the sustainable management of the water resources of the Region, such as the completion of water infrastructure, mainly on islands and remote settlements of the Region, etc. In the water sector there is a great need to implement targeted infrastructure water supply mainly to the islands of the Region in order to meet the requirements of Directive 98/83 /EC.

5.2.1. Opportunities and needs for improvement of policy instruments addressed

The priority for the ROP of Attica (RoA) is very high and critical. There are urgent targeted actions to be implemented through new projects supported, from the Management Plan for the River Basin and following national and European legislation on the protection and management of water resources. One very important reason why the concerned policy instrument should be improved also in governance terms, regards the fact that Region of Attica needs to follow alternative development steps and measures for the quality of life of the citizens. Region of Attica faces many, difficult and different challenges being the most populated region of Greece (almost half of the country's population is situated in Attica), hosting also a big number of refugees.

The improvement of the policy instrument addressed will be achieved mostly through new projects supported and through improved governance. Region of Attica wants to implement new projects such as:

- Facilities - Infrastructure for the supply of islands and small agglomerations to meet the requirements of Directive 98/83 /EC
- Modernization - upgrade of existing water supply systems (remote control etc.)
- Development of leakage control systems in treatment facilities and abstraction systems as well as in transport and distribution networks.

The project will also help RoA to improve its governance results with special focus in the impact of the efficiency of the water treatment systems in the rivers quality of water (to ensure that the water used is returned to the flow system in adequate sanitary conditions and quality).

As a result of the improvement new-targeted actions for the implementation of the Management Plan for the River Basin and national - EU legislation on the protection and management of water resources will implement. RoA envisages also the improvement of the policy tool because improvements expected are linked to a desired improved governance managing ERDF funds related to an increased technical know-

how concerning best practices and successful case studies on water treatment.

In addition, RoA needs to initiate an “updating” and “upgrading” process in terms of acquisition and implementation of new methods and approaches related natural resources, arising thanks to cooperation with EU partners.

The basic principles that will govern the formulation of the methodology and criteria for the selection of Actions are the evaluation of their feasibility, efficiency and effectiveness in order to ensure their contribution to the achievement of Specific objective 6.b.1 and the results provided for each investment priority of the program.

Also, the improvement of the policy instrument will be achieved by the selection of Actions that are compliant with Directive 98/83 / EC and 2000/60 / EC, Flood Risk Management Plan and River Basin Management Plan. Finally, in the case of financing actions with potential effects on the coastal and / or marine ecosystem (eg tourism), support will be provided by the environmental balance and sustainability assurance. This assurance will be provided through the process of environmental licensing and / or environmental assessment of the relevant actions.

Region of Attica emphasizes to the promotion of actions for the preservation and promotion of the ecological and cultural reserve and already implements actions with special focus in the impact of the efficiency of the water treatment systems such as:

- implementation of portable water treatment systems and new water supply networks to meet needs in Attica islands region with problems (qualitative and quantitative) in potable water - water network projects;
- water treatment systems and Implementation of potable water treatment systems and new water supply networks for the needs of Attica's special local and climate conditions, on islands or coastal areas and (qualitative and quantitative) problems in potable water - projects of water supply networks and water treatment systems.

The shortcomings in the infrastructure for wastewater collection and treatment to meet the environmental acquis remain significant. In this case, too, encouraging policies for the circular economy is an important opportunity, as are alternative methods of generating energy by utilizing municipal waste. BigData4Rivers, should provide inspiration regarding new funding schemes and effective projects that will assist the improvement of the policy instrument.

5.3. Large Infrastructure Operational Program (Romania)

The financing of water protection measures is mainly covered as follows:

- 45.63% European structural and investment funds:
  - Cohesion Funds,
  - European Agricultural Fund for Rural Development (EAFRD),
  - European Regional Development Funds (ERDF)
  - European Fisheries Fund (EFF)
  - LIFE Funds
  - Other funds.
- 24.68% from national government and local governments funds (state budget, local budget, royalties from contributions, etc.);
- 3.39% Own sources of business enterprises;

- 0.89% "Romanian Waters" National Administration financial resources;
- 2.2% Other sources;
- 23.21% Uncharted funding resources.

In Romania, in the water supply system has been implemented by a series of externally funded programmes that allowed the development of institutional capacity and the expansion of water supply networks or the replacement thereof, especially in urban areas with the subsequent expansion of networks in rural areas.

Most non-compliant agglomerations larger than 10,000 PE were included in the financing applications from non-reimbursable European funds, under the Environment Sectoral Operational Programme 2007-2013, continued by the Large Infrastructure Operational Programme 2014-2020. Human agglomerations with a population between 2,000 and 10,000 PE and for which a lower level of compliance has been achieved are included in the EU financial framework related operational programmes for the 2021-2027 timeframe.

5.3.1. Opportunities and needs for improvement of policy instruments addressed

Some important issues related to water resources management are the following ones:

- maintaining the social and ecological parameters of water and aquatic resources, which are defining but sensitive elements for the whole society, both in terms of maintaining living conditions and for economic development;
- supporting a water management long-term approach as an integral part of the system of key- areas for sustainable development;
- adopting a sustainable management to ensure the maintenance of biological diversity and ecological balances.

5.4. Regional environmental objectives of Östergötland (Sweden)

The Regional Environmental Objectives of Östergötland have not been reached yet and new approaches and actions are needed. This policy instrument is also in close coherence with the River Basin Management Plans (RBMPs) and the accompanying Programmes of Measures (PoM). The policy instrument recognizes that actions need to be taken to reach ecologically sustainable rivers, lakes and coastal waters once the characterization shows that only 10% of the lakes and rivers in our region presently achieve good ecological status. The main challenges are related to eutrophication, toxic substances and physical impact activities like hydropower plant dams.

New approaches and instruments are thus needed to increase the level of action and a larger acceptance for taking actions in the region. One way to try to achieve this is through:

- develop sustainable local action plans where knowledge from the project, suitable for the selected area, will be implemented. Knowledge and experience of how to cope with the problem and visualize how local action plans can be successfully implemented will improve our management and actions included in the policy instrument.

To be able to develop local action plans and to make them accepted we also need to:

- involve more stakeholders and improve the communication between them;
- improve the efficiency of environmental monitoring.

5.4.1. *Opportunities and needs for improvement of policy instruments addressed*

The aim is to develop new approaches to use the policy instrument and achieve the target stipulated in the regional environmental objectives. One of these approaches is to create more administrative indicators that are showing the progress in reaching the goals.

Carrying out more local action plans and incorporating these in management of water and city development could improve the handling of water quality in municipal spatial planning processes. This will also establish new ways of cooperation between the different levels in water management in Sweden. Improving the handling of water in spatial planning would greatly improve the chances of reaching sub indicators of each goal related to water. Action plans could also pose as a more detailed description of possible measures for municipalities and other water organizations or stakeholders, increasing the possibility of achieving the environmental objectives related to water management.

Along with the local plans several other areas will have to be developed to support the plans and make the plans more accurate and concrete:

- Local water management;
- More extensive monitoring and development of sensor technique.Data management, to sort and transform large amounts of data and make them more readily available to the different levels of water management entities.

A major issue in water management is monitoring of water body status. Monitoring by analysis of water, sediment and biota samples in labs is expensive while the national budget allocated for monitoring in water for all regions has remained at the same level during the last decade despite the need for monitoring data has increased. During 2019-2022 an increase in available financial means for regional monitoring have been introduced, the situation following 2022 is currently unknown. An increased amount of financial means has enabled an increased number of waterbodies to be investigated and in more detail than previously.

Data generated from increased monitoring also must be utilized by entities both within and outside the County administrative boards. This poses the need for improved management of data which has been identified at CAB Östergötland. Spreading data generated by CAB to municipalities poses a major field where improvement is necessary. This process has been initiated but still needs further development.

5.5. Centre-Val de Loire ERDF Operative Programme 2014-2020 (France)

The policy instrument identified by the DREAM Cluster is axis 1 of the Centre Val de Loire Operative Programme 2014-2020. The total budget of this instrument is 259.94 million euros. With the help of the ERDF, the ESF and the IEJ, the Centre-Val de Loire Operative Programme supports project owners whose actions are part of 6 axes. This programme covers 39,000 km2, or 7% of the French national territory. As part of the PO, the ERDF will be mobilized through 5 axes and 5 thematic objectives (OT); ESF on 2 axes and 2 OT (Région Centre Val de Loire 2019).

- **Axe1: A Society of Knowledge**

The objective 1 "increase investment and skills in 5 potential areas of specialization" is directly related to the subject of the BigData4rivers project. The projects should strengthen the five potential areas of specialization (DPS) identified in the regional innovation strategy, one of them relates to "Environmental Engineering and Metrology for Resource-Intensive Activities" projects (Région Centre Val de Loire 2019). Within Axis 1 Objective 1, the BIGDATA 4RIVERS project aims to improve action 2.

Action 2: Programs and research projects in potential areas of specialization (DPS)[3] on basic research, industrial research, experimental development and feasibility studies involving one or more research operators and/or one or more companies. The objectives are: to increase the critical mass, visibility and attractiveness of the Potential Specialization Domains selected in the regional strategy innovation (SRI-SI), to develop partnerships between public research operators and companies, to contribute to the acquisition of new knowledge and skills, accessible to companies in their approach to innovation and the development of new products and services (Martry 2020).

The aim is to improve partnerships between public research operators and industry. DPS1: "Environmental engineering and metrology for resource-intensive activities" is directly related to the objective of improving water quality while associating public and private actors.

The sector identified are the following:

- continuous measurement of the quantity and quality of water resources and environments;
- digital simulation and information systems engineering;
- smart water resource management;
- the management of agro-resources and forestry;
- energy recovery of water and control of processes and impacts.

Table 19 | Analyse SWOT of Axis 1 of the Centre Val de Loire Operative Programme 2014-2020

STRENGTHS	WEAKNESSES
1. Smart specialization strategy: enough precise to constitute relevant potential areas of specialization (DPS) and also enough large not to "close the door" to projects that structure the territory, but that would be slightly outside of these DPS. **2.** Partnership relationship between the operational directorates of research and technology transfers (DESRTT) and that of the economy (DE) and the European and International Directorate (DEI). Operational directorates are primarily involved in detecting co-financing projects, conducting an analysis of their operational eligibility and then requesting the IED for administrative, financial and legal training. The partnership is shared between operational branches and DEI. This leads to a high rate of programming (nearly 90% of the 66-million-euro model) and has the creation of a robust project review **3.** Territorial animation on economic development led by the regional agency of economic development (called DEV'UP). This agency is cited as an example in national good practice.	**4.** State aid: Projects are very often regulated by the SA.40391 notification-free scheme relating to RDI aid and in particular its annex V "non-state aid funding" allowing financing by public funds up to 100% of the project costs. This regime leaves a large part of interpretation (no list of structures considered by default as research and dissemination organizations of knowledge, no operational variation of the methodology of accounting for private public inputs of research platform projects in the scheme...). In addition, state aid schemes are often published after the start of programming (e.g., current regimes are extended until 31/12/2022 and the next programme starts on 01/01/2021). **5.** Reducing controls: the post-certification and inter-ministerial control coordination commission (ICCC) are sometimes multiple for the same carrier. This can discourage project owners as the rules evolve as the programming progresses **6.** Support for porters: it is necessary to have sufficient administrative, legal and financial capacity for using European funds. It is the role of the local authorities as a management authority to properly alert project owners for setting-up a project financed by European funds and to

[3] A potential area of specialisation preferentially concentrates measures to support projects that will generate the greatest economic and social impact for the territory of the Centre-Val de Loire region.

	continue to support porters in risk zone.
OPPORTUNITIES	**THREATS**
7. Improve the articulation with other European funds (Horizon Europe, InvestEU in particular) and local projects	**8.** Differences in interpretation of certain regulatory aspects and the weight of controls **9.** The human resources allocated to program management **10.** Long processing and payment times

Source:(Agence Nationale de la Cohésion des Territoires 2020)

5.5.1. Opportunities and needs for improvement of policy instruments addressed

Despite a local rich ecosystem, the operational program fails to stimulate the development of water projects in the territory aiming at achieving the good status of the water bodies. However, one of the objectives of the OP is to set up new projects (new innovative measurement processes, digital water networks, etc.).

One of the main reasons why the Policy Instrument should be improved in terms of governance is that the multi-partner approach is not sufficiently integrated into PO-funded water projects. The PI is disconnected from existing projects and multi-actor partnerships do not rely on the PO. At the same time, the region needs to strengthen the water management skills of public and private actors in its territory in order, in particular, to meet the regulatory requirements of the European directives on the ecological and chemical status of water. The strategy within Axis 1 of the CVL FEDER could be improved by better integrating the needs of stakeholders including businesses into public discussions (work on water reuse, industrial water treatment, environmental metrology, urban water purification, etc). To increase the number of projects, specific support for the partnership on the subject and particularly with companies would be needed.

5.6. Operational Programme for the European Union Fund's Investments in 2014-2020 Republic of Lithuania (Lithuania)

The Operational Programme (OP) has a priority axis (5-environment, sustainable use of natural resources & adaptation to climate change) that includes as investment priority (5.3) to investment in the water sector to meet the requirements of the EU environmental acquis & to address the needs for investments going beyond those requirements, improving the status of the Baltic Sea & other surface waters.

Under the specific objective 5.3.1 -Improve the status of the Baltic Sea & other surface waters – & 5.3.2 – Enhance accessibility of water supply & wastewater treatment services & improve the efficiency of the system – the programme envisages, among others: to update river basin area management plans, strategic documents on the protection & management of the environment seeking to implement water protection objectives & to strengthen the system of the water monitoring of the status

In order to improve the efficiency of the actual ROP, it’s important not only learn from other EU regions how they had developed their river basin area management plans & strategic documents but also to contribute to the usage of ICT as a supporting tool for the management, maintenance & monitoring of water

This axis has another investment priority that is never taken in to account within the projects financed by the priorities 5.3.1 & 5.3.2, the priority 5.1.1 -Minimise climate change-induced damage - & to which all the measures regarding the improvement of the water quality & sustainability are contributing.

The quality of water in Lithuania's rivers has improved significantly over the past decade thanks to large investments in wastewater management system; however, the Curonian Lagoon, the Baltic Sea shore, about two-thirds of Lithuania's rivers and about one-third of lakes do not meet yet the requirements for a good status of water (in 2012, the share of water bodies of good water status accounted for 54%). The main factors of human economic activities having an impact on the status of surface water bodies are the diffuse pollution and point source pollution (municipal and industrial wastewater discharged from a specific source of pollution), and on the biodiversity of the Baltic Sea – human activities at sea and pollution accidents.

In Lithuania, there are 1267 settlements with a population of between 200 and 2000. Inhabitants of these settlements account for 20% of the Lithuanian population. Their drinking water supply and wastewater treatment systems do not meet requirements of EU Water Framework Directive 2000/60/EC and EU Urban Waste Water Treatment Directive 91/271/EEC.

Some of these settlements discharge wastewater to surface water bodies partially treated or untreated, thus making an adverse impact on the state of surface water bodies. The status of 45% of the Lithuanian surface water bodies is satisfactory or poor. To improve the status of these water bodies, it is crucial to set a priority of investing not only into large settlements, but also into settlements with the population below 2,000. It will ensure the compliance of services provided to consumer with health, environmental and quality requirements as well as public supply of drinking water and the provision of wastewater treatment services, in optimal conditions and at optimal prices, to a maximum number of people and other potential users (reaching a long-term target of 95% of the population), which will also contribute to the implementation of IT development programmes.

5.6.1. Opportunities and needs for improvement of policy instruments addressed

Our priority in the future will be;

- to upgrade the wastewater treatment plants regarding reduction of the Priority substances, Emerging substances and other SVHC's;
- to reduce the pollution by N and P from agricultural areas and the same to the Baltic Sea;
- to install wastewater treatment in small communities, which are mostly beset with wastewater management issues.

In some, we hope, it will be possible to create autonomous sewage treatment systems; the rest will have to be connected to the centralized network. Wastewater treatment in communities with 2,000 and less inhabitants is currently the biggest issue for Lithuania. These communities were not entitled to EU financial support under the current financial framework and therefore will be prioritized in the EU Multiannual Financial Plan 2014-2020.

The growth of economic activity is putting inevitable pressure on natural resources. Investment into resource-efficiency under thematic objective 6 aims to considerably increase the scope of share of properly treated surface wastewater and the share of the population which can benefit from wastewater treatment services and the provision of drinking by public utilities.

Several questions were discussed regarding the opportunities and needs for improvement of Policy instrument addressed. There are main questions:

- what are good practices from other EU regions for implementation of the green infrastructure measures for pollution reduction?
- what are the Best available techniques or economically feasible technologies for the reduction or treatment of the Priority Substances or Substances of very High Concern

(SVHC) and Emerging pollutants?

- what are other countries 'practices for reduction of the Priority substances, SVHC or Emerging pollutants in wastewater treatment plants and as well as in surface waters?
- how other countries solve the N and P problems and the Eutrophication of surface waters?
- what could be the most effective involvement of local communities/municipalities in water resources management?

5.7. Alto Minho 2020 Strategy & Action Plan

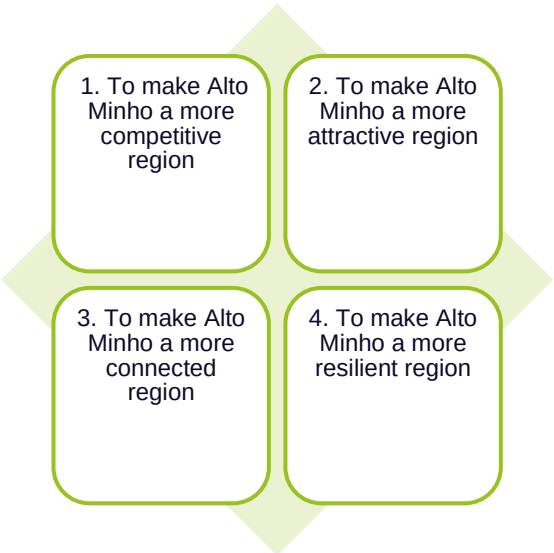
According to the assumptions of the Interreg Europe Programme a "policy instrument is a means for public intervention. It refers to any policy, strategy, or law developed by public authorities and applied on the ground in order to improve a specific territorial situation". In most cases, financial resources are associated with a policy instrument. However, an instrument can also sometimes refer to a strategy or legislative framework with no specific funding.

The policy instrument addressed by CIM Alto Minho in the BIGDATA 4RIVERS project is the "Alto Minho 2020 Strategy & Action Plan". It should be noted that CIM Alto Minho is the body responsible for this policy instrument.

The "Alto Minho 2020 Strategy & Action Plan" is an initiative of the Alto Minho Intermunicipal Community that aimed to establish a diagnosis, vision, strategy and action plan for the programming period of the Structural Funds (2014 – 2020). The Alto Minho 2020 is focused in preparing a "desirable future" respecting the past identity of the region. For this "desirable future" the sustainability of the Alto Minho region is an important vector of development. In this strategy is assumed is regional feature based on the promotion of the transmunicipality through the coordination, cooperation and concertation partnerships.

This plan covers four thematic axes as can be observed in the next figure.

Figure 77 | Thematic Axes of the Action Plan



The Action Plan is a strategic reference for the development of the region, open to all actions that fall within the priorities of the "Alto Minho 2020 Strategy".

From a strategic and operation point of view this plan is implemented through a set of nine actions plans being that two of them are related to the object of the BIGDATA4RIVERS project. They are:

- the action plan number 4 – Alto Minho Sustainable;
- the action plan number 7 – Alto Minho Intelligent.

The highlight is to the project that have as goals the Improvement of quality, service, integration and efficiency of water supply systems and wastewater collection and treatment plants as well the drainage of this type of water.

5.7.1. Opportunities and needs for improvement of policy instruments addressed

At the regional level, the Alto Minho 2020 Strategy represents an opportunity to strengthen the role of water resources as an essential value to the development of the region in its various aspects (economic, social, environmental and ecological) and as an strategic asset to be consider at the planning region process.

On the other hand, it will allow the definition of actions of regional nature that promote greater knowledge of the various factors associated with the use of this resource and assure a better response. This project, by emphasizing the use of information and communication technologies in water management as a resource since will make possible to identify good practices from other regions in this context represents an important contribution to the pursuit of the current strategy in the Alto Minho Intelligent axis (action plan number 7).

As mentioned, due to the institutional framework in this domain, resulting from the transposition of the European water directive, the number of state institutions involved in the management of the water resource is very high, sometimes leading to great difficulties in the implementation of various measures. The creation of governance instruments among the different stakeholders that may constitute an improvement in the implementation of that type of measures, constitutes a need that this project can help to fill.

5.7.2. Other policy instruments in the specific context of water and river management

In addition to the policy instrument addressed by CIM Alto Minho in the project, mention should also be made of other instruments applicable to its territory in the specific context of water and river management.

So, in the region corresponding to the CIM Alto Minho, others policy instruments in the specific context of river and water management are as follows:

- Regulatory Decree No. 11/2002, of 8 March - Approves the Lima River Basin Plan;
- Management Plan for the Hydrographic Region of Minho-Lima 2016-2021, from APA;
- Intermunicipal Plan for Adaptation to Climate Change in Alto Minho;
- Flood Risk Management Plans (PGRI).

The first and the second result from the transposition of the Water Framework Directive, and in Portugal the hydrographic region is considered as the management unit for rivers and waters. The third is a policy instrument developed by the Intermunicipal Community itself, having a wider and transversal scope of application to the various sectors of activity.

The main experienced in applying the various instruments, and parallel to the existence of a large number of entities in charge of managing the rivers and in the planning and management of river basins, can m -If highlight three points for which it has been hard to watch results that are compatible with maintaining

adequate levels of socioeconomic and environmental performance of rivers:

- flow management, both in times of floods and in summer seasons. This is a situation that, in the case of the Minho and Lima hydrographic basin, involves several actors, such as the national and Spanish entities with responsibilities in the matter, but also the managing entities of the hydroelectric plants. Hence there have been several problems that reveal some difficulty in ensuring that the flows drained in autumn / winter do not, above all, raise problems from the point of view of risk to human life, being certain that the phenomena of margin erosion are more and more frequent and, for flows drained in the spring / summer, which are compatible with environmental, economic and leisure needs;
- defence of the margins through maintenance, reinforcement of riparian galleries. In spite of the legislation foreseeing its conservation and even valorisation, riparian galleries are reduced in a very high number to the minimum and, at times, non-existent. This fact, in addition to reducing its impact on improving water quality, local fauna and flora, often results in the instability of the margins, which leads to its continuous exposure to degradation factors and therefore to phenomena more or less severe erosion, with all the resulting implications;
- quantity and Quality of the water that flows through surface and underground runoff to water courses. One of the issues that is of the utmost importance so that the objectives of river management can be achieved, in terms of quantity and quality of water.

As is well known, many of the current problems related to the quality and quantity of water that flows into water courses are related, and in the hydrographic region of Minho and Lima, this reality is very present, with the problems that are systematically revealed by virtue of the inability to promote the correct ordering of the most declining slopes of the hydrographic basins, with a view to ensuring the maintenance of an adequate vegetation cover. Thus, these aspects, have been subject to a considerable percentage, by virtue of the forest fires that are happening cyclically, erosion phenomena, with place to soil loss, as time passes, it will reduce its capacity to cushion the impact of falling water droplets and seepage. As consequences, among others, the following stand out:

- the increase in surface runoff, with a greater solid load, which reaches the water lines;
- the decrease in infiltrated water, with effects on the decrease in availability for recharging rivers in the summer period;
- by virtue of i) and ii) the significant decrease in the time the water remains in the system;
- a decrease in water quality in waterways and increasing its capacity of erosion;
- the change in dynamics.

6. GOOD PRACTICE PROPOSED BY EACH PARTNER

One of the objectives of the Joint Analytical Report focuses on the identification of good practices in the context of water management, in the different partner regions, including in order to facilitate the exchange of knowledge between partners and the adoption of good practices.

6.1 Iberian Association of Riverside Municipalities of Duero River

Next the good practices identify by AIMRD are described. This identification is a result from the collaboration and contributions of the Local Stakeholders Group. Due this process resulted in a pre-selection of four possible good practices. Work is underway to identify and characterize other potential good practices.

Good Practice 01: Cross-border collaboration in the implementation of projects and signed conventions related to water management

Designation of the good practice

Cross-border collaboration in the implementation of projects and signed conventions related to water management.

Context of application

Shared management of the Duero international hydrographic basin, taking in consideration the evolution of water conventions signed between Spain and Portugal, projects in collaboration and also the resolutions about shared needs, such as:

- Settlement of border disputes;
- Hydroelectric use in international river sections;
- Consumptive uses of water;
- Prevention of floods and droughts;
- Good quality state of water.

Brief description of the technology developed/apply

The technologies developed / applied vary depending on the type of project in collaboration.

State of the good practice

Cross-border collaboration is carried out continuously in the qualitative and quantitative management of water resources, being essential to achieve the environmental objectives imposed by the WFD.

The Convention on the Cooperation for the Protection and Sustainable Use of Luso-Spanish Hydrographic Basin waters, commonly known as the Albufeira Convention, in 1998, was a big step for this achievement. Since then, both parties have been constantly learning and adapting. There has been a need to invest in joint studies and projects with a view to better understanding the problems that occur in these basins, allowing the implementation of new tools and methodologies capable of harmonizing

planning, monitoring and responding to current and future situations, such as those that will result from climate change, with regard to the management of water resources.Highlighting the following joint projects:

- The joint assessment program of Water Bodies in Portuguese-Spanish hydrographic basins;
- Aquamundam – Solutions for sustainable and integrated water management in the POCTEP space (Interreg España – Portugal);
- Flumen Durius – Promotion and appreciation of two tourist resources of the Douro river (POCTEP 2014-2020);
- Discover Duero/Douro – Cooperation for the consolidation of the cross-border space Duero - Douro as a tourist destination of excellence (POCTEP 2014-2020);
- FLUVIAL - New river cities of the 21st century (POCTEP 2007-2013);
- MARCADUERO - Durable Duero Brand: Sustainability, Quality and Promotion (POCTEP 2007-2013).

Major difficulties during the implementation

Resulting from a good articulation between the two Member States, the management of the Douro basins, with regard to shared water bodies, has not presented any relevant difficulties.

Implementation time

Collaboration occurs continuously, with moments when it is more intense, as a result of the development of joint projects.

Results obtained / expected

Although the responsibility for the management of water resources is clearly separated between the two Member States, they are consulted during the elaboration of the main planning instruments, namely in the elaboration of national plans, such as the Hydrographic Region Management Plans (PGRH) and Flood Risk Management Plans (PGRI). Collaboration is also present in cross-border monitoring and information sharing.

Cost and profits obtained / expected

The costs of this collaboration are not measurable. However, the costs associated with ongoing joint projects can be estimated.

Other possibilities of application

Applies to all water bodies shared across borders by two or more countries.

Likewise, current cross-border cooperation is a good example of shared river basin management and can be expanded to other areas of natural resource management.

Good Practice 02: Automatic Information System in real time of the Duero Hydrographic Confederation, O.A.

Designation of the good practice

Automatic Information System in real time of the Duero Hydrographic Confederation, O.A.

Context of application

The current network of observation of hydrological and meteorological data of the Confederación Hidrográfica del Duero, OA, is configured from the Red Oficial de Estaciones de Aforo (R.O.E.A.) of the Duero river basin and the Automatic Hydrological Information System (S.A.I.H.).

In this way, a network of hydrological and meteorological information is available in real time, which includes the powerful technology of the S.A.I.H. with the historical experience and reliability of the red R.O.E.A. resulting in a unique, reliable and robust hydrological information system that supports consolidated databases of hydrological information and knowledge of the behaviour of the different main and affluent rivers that make up the Duero river basin.

Brief description of the technology developed/apply

The so-called Red Integrated SAIH-ROEA it is currently the main tool for observing hydrological data in real time, both for the control and monitoring of rivers in the fields, as well as for the detection of possible extraordinary situations, which allows us to initiate the communication protocols of situations extraordinaries there were the different entities involved in the management of episodes of the avenue or the sequel.

The information is transmitted through VSAT, GPRS and GSM communications based on the typology of the station following the communication, and it goes directly to the Center of Control of Cuenca located in the number 42 of the Channel of Castilla in Valladolid, where it is supervised, consolidates and distributes the different applications and databases of the information system for its use and distribution.

State of the good practice

This system improves the management of water, as well as the detection of extraordinary avenue situations, following the anomalies in water quality, fundamentally improving on the following aspects:

- Centralization and unicity of information and its distribution;
- Supervision, validation and availability of public information;
- Improved hydrological, meteorological and water quality data bases;
- Effective and efficient management of extraordinary situations (avenues, sequences and water quality);
- Efficient management of ordinary situations;
- Management of the knowledge of the river, improving it and optimizing the planning and exploitation of the water resource development;
- Monitoring of compliance with International Agreements (like Albufeira Convention);
- Citizen information and participation.

Major difficulties during the implementation

No information.

Implementation time

On implementation with no known date to end.

Results obtained / expected

The Integrated Red SAIH-ROEA provides information regarding the levels and flows flowing through the main rivers and tributaries, the level and the volume packed in the different prey, the flow unpacked by the relievers, valves and made up of the same, the numerous floods points of all the geography of the river, as well as the flows discouraged by the main uses of the water in the river.

Cost and profits obtained / expected

Definitely, the Integrated Red SAIH-ROEA was a boost in the management of water, as well as in the detection of extraordinary situations of avenue or next.

Other possibilities of application

The detection of possible abnormal situations is a fundamental factor in order to minimize the social, economic, material and medio environmental impact of this type of situation.

Good Practice 03: ALBUFEIRA - Joint evaluation program of the water bodies of the Spanish-Portuguese hydrographic basins

Designation of the good practice

ALBUFEIRA - Joint evaluation program of the water bodies of the Spanish-Portuguese hydrographic basins.

Context of application

The general objective of the project is to advance in the joint coordinated implementation of the Marco del Agua Directive between Spain and Portugal, especially with regard to the follow-up of the status of the Hispano - Portuguese Hydrographic Water masses and the impact assessment of the measures that have been developed to achieve the environmental objectives.

Generally speaking, hydrological plans only include a geographical reference of protected areas within the Habitats Directive, without further details about the state and / or specific conservation objectives. As mentioned in the Report of the European Commission, it is necessary to continue working to guarantee the protection of emblematic protected habitats that depend on the water. Quantitative and qualitative requirements for water in protected areas should be assessed and included as additional objectives on hydrological plains. It is necessary to take measures to ensure that habitats and species dependent on water can reach a favourable conservation status.

Brief description of the technology developed / apply

Not applied.

State of the good practice

Actions to develop:

- Common methodology for monitoring and monitoring the state of the ecological potential of rivers and shared water bodies that will be tested and validated through a joint experimental program.
- Hispano-Portuguese technical team that will coordinate and work together on the survey, calculation of indexes, assessment of potential ecological status, this way the evaluation methodology designed and agreed by both countries will be validated - Indexes, protocols and y joint procedures for the assessment of the state the potential of water masses categorize rivers and trans frontiers and trans frontiers.
- Sensitization to bordering communities on the importance of water resources in the transboundary space as a joint wealth that needs to be protected and endured in a sustainable way.

As a final result, once these tools have been tested, they will be integrated into the joint tools and procedures by the Spanish and Portuguese administrations as part of the International Convention of Albufeira and in the planning procedure 2021-2027 as well as in the DMA follow-up programs. both countries.

Major difficulties during the implementation

No information.

Implementation time

This project occurred between October 2017 and December 2019.

Results obtained / expected

The project results will contribute to implementing coordinated and effective management methodologies that redefine the ecological potential of the shared rivers in a better way of knowing and valuing the state. By means of these activities, the indicator of improvement in the conservation status of the habitats in the trans frontier space is contributed, indicator of the result of the program corresponding to the priority of investment.

Cost and profits obtained / expected

As a specific area of action, a wide range of activities will be carried out, covering 58,000 hectares of protected spaces integrated in the Red Natura 2000 of Spain and Portugal across the border, in the same areas as the water masses that will be designed and will prove the joint methodology for assessing ecological status.

Other possibilities of application

To improve the knowledge of the degree of conservation of species and types of habitats in the natural spaces of the border connected to the rivers that allow a coordinated management and protection, and their relationship with the state of the water masses, evaluating the need to define a complementary assessment to guarantee the protection of habitats and protected species.

Good Practice 04: Reduction of the impact generated by odors typical of the WWTP in Herrera de Duero installation

Designation of the good practice

Reduction of the impact generated by odors typical of the WWTP in Herrera de Duero installation.

Context of application

Reduction of the impact generated by odors, typical of the WWTP in Herrera de Duero installation, which can occasionally be detected in houses near the facilities.

Brief description of the technology developed/apply

Installation of deodorization tower of active carbon in the WWTP of Herrera de Duero, in which all the gaseous streams of the process are treated. For this purpose, the points that generate odour have been confined in the facilities in pre-treatment, homogenization tank, biological reactors, secondary decanter and sludge storage. The deodorization tower treats the air of these areas, which arrive to the tower by means of a fan which makes air pass through a bed of active carbon prior to the exit to the atmosphere, decreasing the concentration of volatile organic compounds which cause the presence of smell in the installations.

State of the good practice

The installation is in operation.

Major difficulties during the implementation

Coordination between the installation works and the normal operation of the WWTP.

Implementation time

3 months.

Results obtained / expected

Reduction of odours in areas around the installations.

Cost and profits obtained / expected

Investment of 68,207.32 € financed through Diputación de Valladolid.

Benefit obtained: social benefit with the decrease of odours in the houses near the facilities

Other possibilities of application

Application in small WWTP where the presence of houses is near to the facilities.

6.2 Greece - Regional Development Fund on Behalf of the Region of Attica

Good Practice 01: Monitoring of Asopos river basin waters – assessment of pollution/contamination and qualitative and quantitative investigation of contamination levels and possible sources of pollution

Designation of the good practice

Monitoring of Asopos river basin waters – assessment of pollution / contamination and qualitative and quantitative investigation of contamination levels and possible sources of pollution, Research in progress (Apr.'18-Oct.'20) funded by Region of Attica elaborated by National and Kapodistrian University of Athens (NKUA)

Context of application (problems that were on the source of the good practice)

Asopos river is located in Central Greece (specifically in Boeotia prefecture) and northern Attica. Its total length is 57 km and its basin is 718 km^2. The river passes through areas in Boeotia, where 20% of total Greece industrial production takes place, and flows into the sea in north-east Attica (municipality of Oropos).

The extensive installation of industries in the area near the river, and the uncontrolled disposal of industrial and agricultural wastes into the river, make the water quality of Asopos questionable. The environmental problem of Asopos river basin is known since 1969. Pollution of the wider area of the Asopos river with heavy metals, hexavalent chromium, Cr (VI), and nitrates detected in the aquifer of the region, became known in August 2007, on the publication of measurements of the Hellenic General Chemical State Laboratory, and other accredited laboratories.

The area of Asopos river was declared a case of "Special National Intervention" and the Hellenic Environmental Inspectorate (HEI) was instructed to intensify the inspection and control activities in the area. During the 2004-2012 period there have been in total more than 250 checks and rechecks of works and activities in the area. In February 2010, the "*Programme of Integrated Management of the Environmental Crisis in the Asopos River*" was presented, which took into account the constant demands of the Local Community, and which was formed following systematic cooperation with all stakeholders and agencies. The coordination of action was undertaken by the Special Secretariat for the Environment and Energy Inspectorate (SSEEI), its coordinating role according to Law 3818/2011, and the Special Secretariat for Water of the Ministry of Environment, Energy and Climate Change. The program consists of measures for immediate implementation and measures of medium- and long-term effect, including the establishing of rules, guidelines and procedures governing the control of sources of pollution and the way that industry operates, the clarification of responsibilities between agencies, informing the citizens and all stakeholders, etc., and measures which are implemented gradually, with main objectives: (a) the protection of public health; (b) the containment and eradication of pollution; (c) the planning of the industrial area of Inofita, Schimatari; (d) ensuring the implementation of the measures.[4]

However, the probable occurrence of industrial and agricultural organic chemicals with unknown toxic effects has not been studied so far. Until recently, in addition to the analysis of physicochemical parameters of water, it was possible to monitor only conventional pollutants and priority pollutants in accordance with Directives 2006/118/EC and 2013/39/EU, respectively. The development and implementation of modern methods in combination with the use of state-of-the-art technology make it possible to detect and monitor pollutants with unknown toxicological activity, which to date are not included in routine monitoring and therefore their contribution to water quality has not been studied and

[4] Report on the implementation of Directive 2004/35/EC "*On environmental liability with regard to the prevention and remedy of environmental damage*", Ministry of Environment & Energy of Hellenic Republic, October 2013

evaluated.

RoA administration decided to fund NKUA to elaborate the first extended environmental monitoring study in Greece including not only the determination of legislated compounds but also the wide-scope screening of organic chemicals for which no occurrence data exist, namely, target analysis, suspect and non-target screening of **Priority Pollutants** and **Emerging Contaminants**

The overall aim is to obtain a database for the qualitative and quantitative assessment of the levels and the origin of the pollution / degradation of the waters of the Asopos basin (in the territorial jurisdiction of RoA), the environmental risk assessment and the proposed actions to improve water quality.

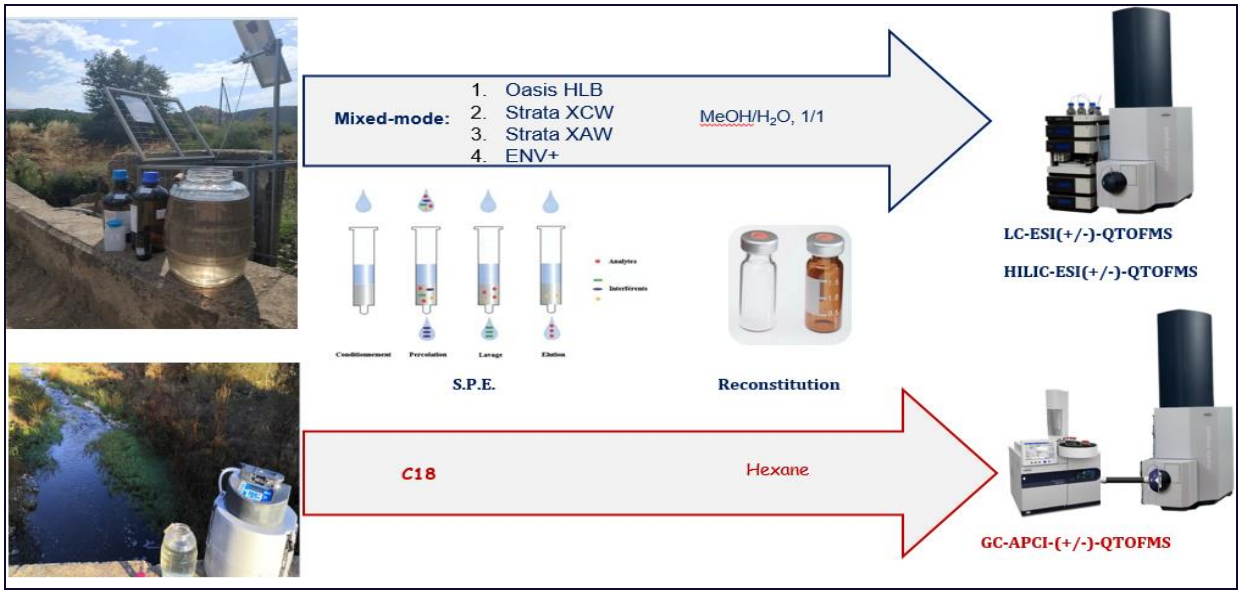
The objective comprises the extended monitoring of water quality of:

- Asopos river's basin and its underground aquifer at the borders of Attica - physicochemical parameters and conventional pollutants (Directive 2006/118/EC), priority pollutants (Directive 2013/39/EU) and emerging pollutants;
- Mavrosouvala spring (drinking water) - monitoring drinking water under the Joint Ministerial Decision Y2/2600/2001 (compliance with Directive 98/83/EC) and emerging pollutants.

Brief description of the technology developed/apply (is applicable)

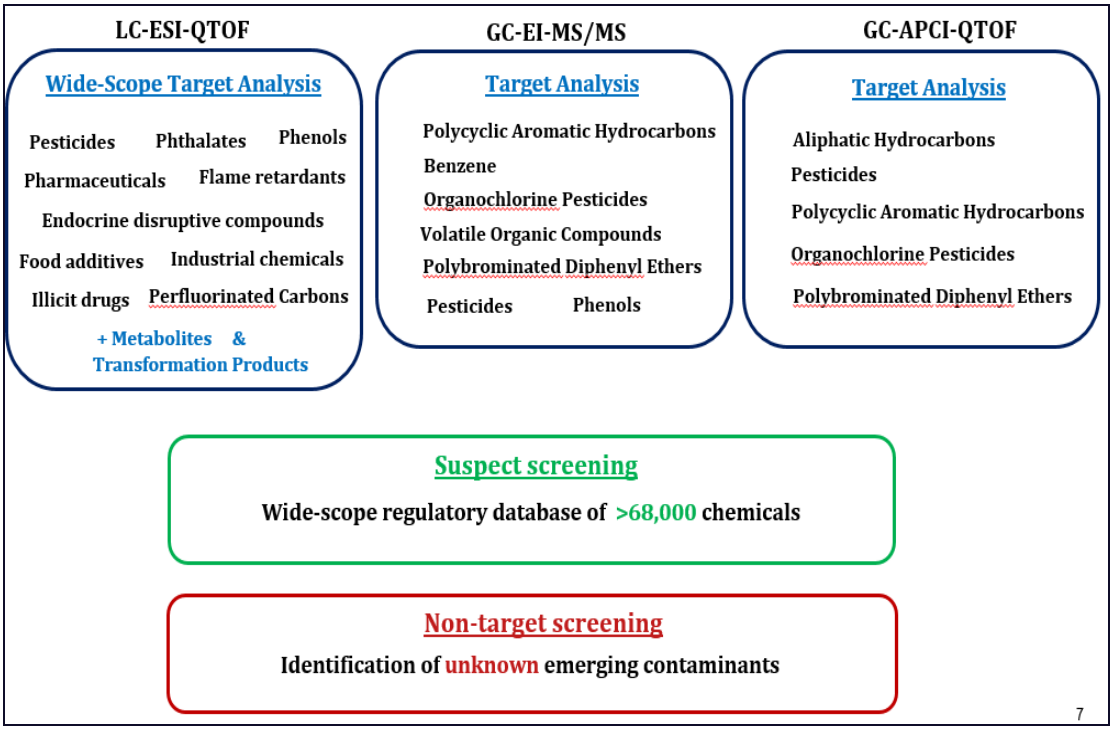
The general sample preparation methods and **High-Resolution Mass Spectrometric Analysis** as well as the **analysis with mass spectrometric techniques** are illustrated in the pictures. Two portable autosamplers were used in order to collect 24-hour samples from the river for 30 consecutive days.

Figure 78 | Autosamplers' preparation



Source: Presentation under the title "Advanced Monitoring of Asopos river basin" by Prof. Nikolaos S. Thomaidis, 1st Technical Committee meeting, Athens, 23/01/2020

Figure 79 | Sample analysis



Source: Presentation under the title "Advanced Monitoring of Asopos river basin" by Prof. Nikolaos S. Thomaidis, 1st Technical Committee meeting, Athens, 23/01/2020

State of the good practice (proven/test phase/concept validation)

Development of methods for:

- monitoring physicochemical parameters and conventional pollutants;
- determination of priority pollutants and emerging contaminants and advanced monitoring of emerging contaminants in water samples of Asopos river, as well as, monitoring drinking water and emerging pollutants in Mavrosouvala spring.

Major difficulties during the implementation

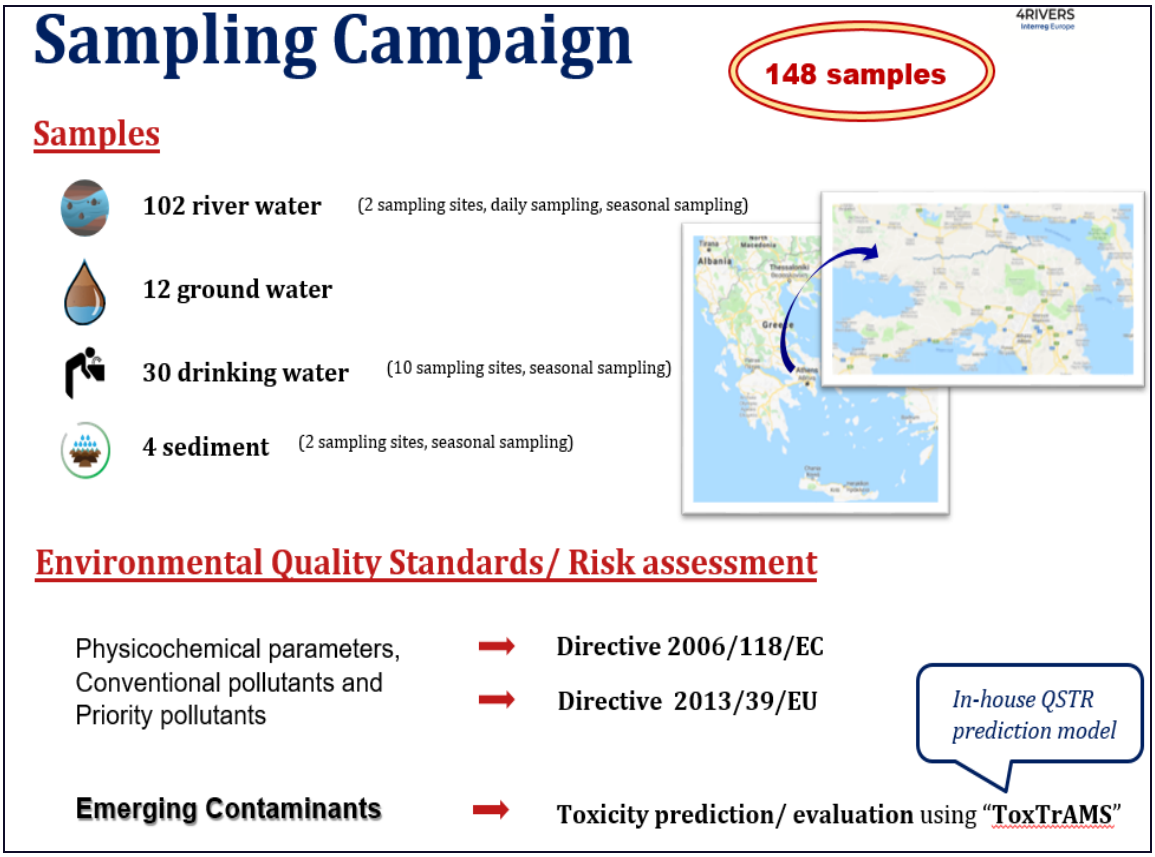
Once the sampling stations are determined, good conditions related to the safety and good operation of the portable autosamplers and the samples' collection and transfer to the laboratory need to be met. Good co-operation with local people is also vital to sustain the operation of the autosamplers as well as to collect information on land use, enterprises and activities, etc, taking place in the area of interest.

The methods developed need high expertise.

Implementation time

The study started on April 2018 and concludes in October 2020. The sampling campaign is illustrated in the following picture:

Figure 80 | Sampling campaign for monitoring Asopos river



Source: Presentation under the title "*Advanced Monitoring of Asopos river basin*" by Prof. Nikolaos S. Thomaidis, 1st Technical Committee meeting, Athens, 23/01/2020

Results obtained/expected

The results indicate the pollution/contamination degree of Asopos river basin:

- Plant protection products (herbicides and fungicides, transformation products)
- How the weather affects the daily detection trend
- Distribution of pharmaceuticals
- Industrial chemicals
- Seasonal trends of the pollutants/contaminants
- Suspect screening
- Detection of spills including trend analysis

Cost and profits obtained/expected

Total budget for the research, including the supply of the two autosamplers, is 268.100 euros plus VAT.

Monitoring water quality, protecting of public health and eradicating pollution are, amongst others, obligations by law of public bodies such as Regions.

Moreover, the good ecological status of water bodies could relate to benefits in the following:

- avoided costs for treatment of drinking water;
- reduction of disposal costs for contaminated dredging material;
- more and better opportunities for informal recreation (walking, cycling) and water sports;
- improved health and living environments; also
- benefits associated with an improved protection of nature and biodiversity.

Other possibilities of application.

Not applied.

Good Practice 02: Development and application of Novel, Integrated Tools for monitoring and managing Catchments (INTCATCH), HORIZON 2020 project (Good practice of Stakeholder: EYDAP)

Designation of the good practice

Development and implementation of innovative tools and services for monitoring surface water quality and integrated water resources management.

Context of application (problems that were on the source of the good practice)

INCATH project focuses on the development and implementation of innovative tools and services for monitoring surface water quality and integrated water resources management. Specifically, robotic boats are equipped with appropriate sensors to measure and record important parameters in real time. The monitoring techniques that are developing aim to supersede the inefficient, time dependent, costly and labour-intensive routine sampling and analysis procedures currently deployed to understand the quality of receiving waters. It will compliment routine monitoring that is required for baseline datasets, but also enable cost-effective impact and management investigations.

A business model will transform water governance by facilitating sustainable water quality management by community groups and NGOs using a clouds data linked to a decision support system and eco-innovative technologies.

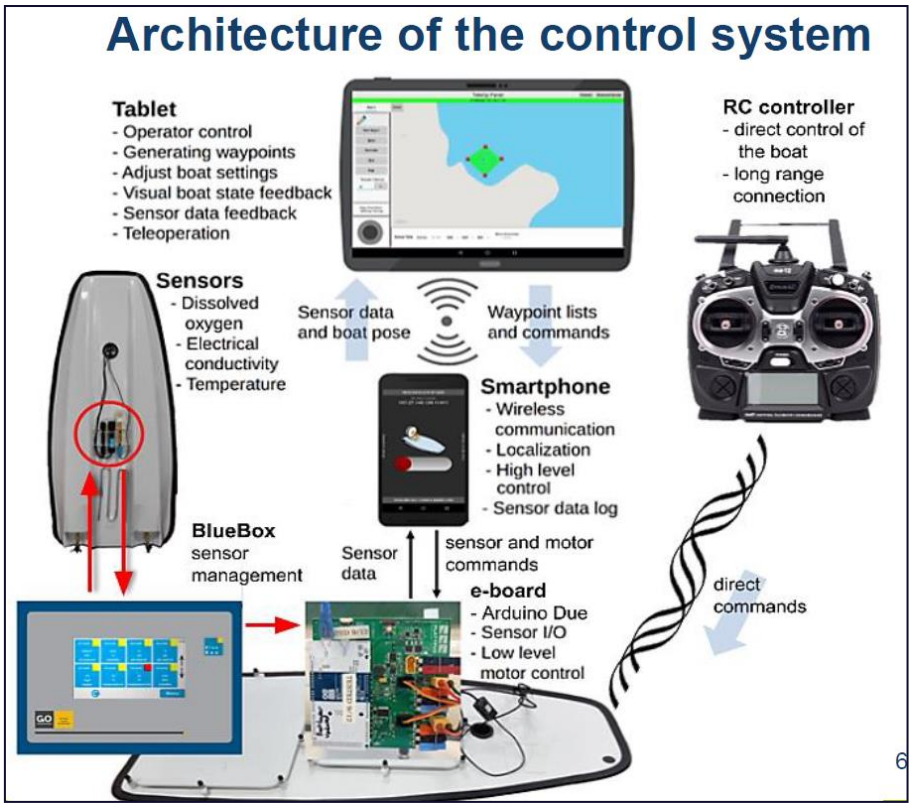
Brief description of the technology developed/apply (is applicable)

Robotic boats are equipped with appropriate sensors to measure and record important parameters in real time.

Figure 81 | Robotic boats (sensors and control system)

Basic set of sensors
•Conductivity
•Dissolved Oxygen
•pH

Innovative sensors
•Chlorophyll -a
•ISA (In Situ Spectral Analyzer)
•Hydrocarbons and Refined oils
•On-board metals analyzer (Cu, Pb) using ASV
•On-board sampler (4*500ml)
•On-site systems for the determination of E. Coli, Genomics/ DNA-analysis



Source: Presentation under the title "*Water quality monitoring with the use of robotic boats*" by Dr. Efthymios Lytras, 1st Technical Committee meeting, Athens, 23/01/2020

State of the good practice (proven/test phase/concept validation)

Monitoring using the robotic boats and the sensors have been performed on lake Yliki, lake Pamvotis, lake Koumoundourou and Dam of Thermi.

Major difficulties during the implementation

Not applied.

Implementation time

Project duration: June 2016 – January 2020

Results obtained/expected

- Autonomous and radio-controlled boats to provide better access and coverage of waterbodies
- Innovative Sensors make monitoring easier and cheaper for 'non-experts' to do, and do 'more effective monitoring for less'
- Decision Support System optimizes the water quality monitoring strategies and, ultimately, the management of the water bodies via measures in River Basin Plans
- Cloud based geo referenced data management solutions to support sharing with whole community and raising alerts in time to take action to protect end users/uses.

Cost and profits obtained/expected

HORIZON 2020 funded the research project. Costs for good maintenance and operation of the robotic boats, sensors, and the other equipment, as well as costs related to operators and transporting the equipment to water bodies of interest should be taken into consideration.

Profits/Benefits involve:

- Better access to critical points and large area coverage
- Real time monitoring
- Spot pollution sources revealing
- Cloud based data available
- Decisions support for targeted sampling and monitoring

Other possibilities of application

Not applied.

6.3 Romania - The National Union of Romanian Entrepreneurs

Good Practice 01

WATMAN is a project that will implement the national water management strategy in case disaster developed by MMGA. This project will set the prerequisites for the achievement of the Integrated Information-Decision making system in case of disasters.

Through this project, the following goals are achievable:

- Optimal use of water resources both at river basin and national level;
- Providing / optimal allocation of water resources both at river basin and national level in terms of quantity and quality;
- Optimal management of water management infrastructure in case of disasters;
- Optimizing the operation of hydro-technical works;
- Harmonization of the operation of hydro-technical works and water resources in accordance with the EU Water Framework Directive;
- Development of a fast response alarm system for the population in case of disasters;
- Decreasing of material damage and loss of human life in case of disasters;
- Rapid assessment of damage caused by disasters;
- Improving Romania's bilateral relations by respecting bilateral agreements in the field of water.

In Romania, the economic mechanism in the field of water management has been streamlined based on the following principles:

- The beneficiary pays;
- The polluter pays;
- Cost recovery for water management;
- Protection and sustainable use of water resources;
- Saving and reusing water by applying economic incentives and sanctions;
- Ensuring raw water at source in accordance with water permits;
- Qualitative and quantitative monitoring of surface and groundwater resources;
- Research in the field of water, operational hydrology and hydrological forecasting;
- Capture of wastewater transformed into water resources, according to water permits;
- Protection against dangerous hydro-meteorological phenomena, including drought;

The agro-meteorological measurement programme aims at monitoring the daily agro-meteorological parameters and the changes occurred in the soil moisture content in case of crops.

Agro-meteorological forecasts include specific information (air temperature, precipitation, ETP, soil moisture, water need of crops) needed to assess extreme events (drought or excess moisture). These data collected by the National Observation Network are analysed and compared with the critical thresholds, in order to assess the risks and make adequate recommendations for decision makers and farmers. The meteorological data processing and interpretation of (from the synoptic meteorological database/ ORACLE) are performed using specific applications such as AGRO-SYNOP, AGROSERV and AGROTEMPSOL. Soil moisture dynamics throughout active crop vegetation (March-November) is monitored using specialized equipment such as 55 portable soil moisture measuring systems (Delta-T). The amount of water available in the soil is determined directly through sensors placed at different observation points (agro-meteorological platforms), which are representative for agriculture. The data collection is carried out every 10 days in the Meteorological Services, by the agro-meteorological specialists activating in the network; then data and information are transmitted electronically via computers to the Agro-meteorology Laboratory of National Meteorological Administration (ANM), to map the soil moisture reserve (m^3/ha) accessible to plants (autumn wheat and corn), by calendar dates of agricultural interest and at various depths (i.e. 0-20 cm, 0-50 cm and 0-100 cm). The entire agro-monitoring system is supported by the development and improvement of the demand for the collection and transmission of agro-meteorological data in fast flow, and the making of statistical data series - databases and the calculation of agro-meteorological indices. The opportunities provided by GIS remote sensing techniques (software products for tracing the area of the main agro-meteorological parameters / precipitation, drought indices, etc.), have increased the accuracy of spatial coverage using the normalized difference vegetation index (NDVI) obtained from satellite images made by SPOT VEGETATION.

In order to maintain and improve the quality of surface and groundwater in terms of nutrient concentration and eutrophication processes, measures to prevent pollution with nutrient are supported by the National Rural Development Programme (PNDR). An important component in the implementation of the EU Nitrates Directive in Romania consists in the Integrated Nutrient Pollution Control Project (CIPN) 4 managed by the Ministry of Environment, Water and Forests, which started in 2002 with a pilot-project and has being implemented at national scale until 2022. The specific objective of the project is the long-term reduction of nutrient emissions in water bodies by applying an integrated soil and water management (see: http://apepaduri.gov.ro/controlul-integrat-al-poluarii-cu-nutrienti/)

Thus, through the additional financing of the project, there are provisioned collection platforms and

manure management at the community level where a large livestock is raised in traditional households, small and medium farms, but also the building of rapid composting stations of manure and organic waste.

To reduce nutrient pollution of water, in addition to technical measures to improve the quality of effluent discharged from sewage treatment plants, industrial plants and agro-zootechnical farms and the application of the Code of Good Agricultural Practice, another effective measure consists in the introduction and marketing of specific detergents with zero phosphate content. For human agglomerations of less than 10,000 PE, there is no obligation in the national legislation for the advanced removal of phosphorus. Therefore, the reduction of phosphate in detergents can have an important impact on the reduction of phosphorus loads from human agglomerations of less than 10,000 PE, in a shorter time than for the construction/ modernization of water collection systems and treatment plants. Thus, Romania is implementing the requirements of Regulation (EU) No 259/2012 of the European Parliament and of the Council of 14 March 2012 amending Regulation (EC) No 648/2004 as regards the use of phosphates and other phosphorus compounds in consumer laundry detergents and consumer automatic dishwasher detergents.

Good Practice 02: Research and Development of the Wind Device for Irrigation in climate deficient agricultural lands. Experiments, certification and manufacturing. Acronym: INISA Project, Romania (https://www.incas.ro/images/stories/Proiecte_CEEX/C61/index.html)

The proposed project has as major orientation the irrigation of agricultural areas located both in the hilly areas and in plain areas, areas where the frequency and intensity of air currents is low. Unlike the high-power installations used in the regions with high wind potential (mountainous and coastal areas), the project aims to capitalize on the lower wind potential, specific to the plain areas, these being the main agri-food sources.

The widespread use of non-polluting technologies, production and sustainable management of biological resources of soil, forests and aquatic environments, the capitalization of these sources (water for the irrigation of crops, fruit growing, livestock farms and other needs of small and medium agricultural producers) are included. in the national effort to bring the agro-climatically deficient areas to the level of the requirements of a competitive production both at national and international level.

The wind installation for irrigation ensures the extraction of water from depths up to 30m by efficient use of unconventional wind energy, in areas where the intensity of the currents is low and has large fluctuations of their direction.

The solution adopted for the wind installation ensures the conservation of natural and artificial biological resources by two directions: extraction of water from the ground, for irrigation during periods when the agro-climatic conditions are deficient and storage of extracted water in the buffer tank of the wind installation.

The sustainable management is ensured by the consortium consisting of the partners participating in the project, a consortium that through the executed specialized works allows the realization of a complex research base for the permanent collection of experimental data for further developments. The sustainable management is also supported by the creation of a national Science / Technology Park for the development of wind turbines and wind installations.

The project proposes a system that uses wind energy potential for regions with low average wind speed and high risk of plants' water demands. Major research and engineering efforts are focused on designing systems that efficiently convert wind energy into electricity or mechanical energy in regions with high wind potential (high and constant wind speeds, and constant directions). However, few have been achieved for the use of wind energy if the conditions mentioned above do not occur and if wind turbines with electric adjustment are not economically feasible. The wind-powered device proposed for implementation in this

project was designed to take advantage of the reduced wind energy at the irrigation water pump in agricultural regions with depths of up to 30 meters. The low technical requirements of the new device and the particularities of the land for which it is intended (irrigation) can ensure a successful implementation. The device was invented by a research team from the National Institute of Aerospace Research and was patented in Romania (patent no. 119966/2005).

Success Factors

- The novelty of this device is the combination of the technical aspects of small turbines easily adaptable to the change of rather inefficient wind direction, with elements from large turbines extremely efficient, but which have the disadvantage of increasing production and maintenance costs.
- Small and medium farms, especially those with limited access to power lines or fuel, are ideal for the end-users of the wind irrigation system, if the agro-climatic conditions are suitable for such an investment.
- The successful implementation of the system is conditioned by the simultaneous presence of four agro-climatic criteria: the large water deficit, the wind potential, the groundwater and the economic importance of the crop. In addition, the study will reveal the economic feasibility of the irrigation device through cost / benefit analysis in a pilot case study.
- The research on the specific process of the renewable energy device begins with the complete analysis of the technical, scientific and economic factors, critical for the success of the project.
- Implementation of interdisciplinary projects to provide high quality consulting services and new technologies for end users and decision makers.

WATMAN project- Optimisation of water allocation in case of drought and water scarcity

WATMAN is a project that will implement the national disaster water management strategy developed by MMGA. This project will integrate the data resulting from SIMIN and DESWAT projects that are both in an implementation phase, creating the possibility of finally realizing the integrated informational-decision-making system in case of disasters. The two projects, through modernized meteorological and hydrological information systems, will provide real-time data and forecasts, which will represent the input data for the WATMAN project infrastructure in order to optimize the water management system.

Through this project it will be possible to achieve the following:

- Optimal use of water resources at basin and national level.
- Optimal ensuring / allocation of water resources at the basin and national level in terms of quantity and quality.
- Optimal management of water management infrastructure in case of disasters.
- Optimizing the operation of hydrotechnical works.
- Harmonization of the operation of hydrotechnical works and water resources in accordance with the EU Framework Directive.
- Development of a rapid alarm system for the population in case of disasters.
- Reduction of material damage and human life losses in case of disasters.
- Rapid assessment of disaster damage

- Improving Romania's bilateral relations by respecting bilateral agreements in the field of water.

From a project design point of view, it is structured in six chapters:

- Realization of the monitoring system for the water management infrastructure (monitoring of the water balance in accumulations and of the dams' behaviour in time, measurement of the diverted water volumes in the basins, monitoring of the important catchments, with the major influence of the natural drainage regime);

- Implementation of the alarm system in the floodable areas, for notifying the population in case of catastrophic floods, or in case of dam accidents. For the design of this system, there was a collaboration with the National Commission for Protection against Disasters (CNAID), which provided the list of localities in areas at high risk of floods and which do not have alarm systems. Additional sirens will be installed at 96 major dams of first and second degree of ANAR, as well as downstream, if there are localities where CLAID does not have a sufficient reaction time in case of accidents at dams to enter the device to alert the population. The system is designed to be integrated with that of Hydroelectrica, at the level of the CLAID / CJAID database. Also, the electric sirens will be able to be integrated in the electronic alarm system to be implemented.

- Design of a rapid intervention system in periods of floods and pollution, designed to strengthen the existing dams in danger, which will have mobile dams that can be installed in areas at risk of flooding. The rapid intervention units will also have water treatment equipment to be able to supply the necessary quantities in case of infestation of drinking water sources, due to floods or pollution. They will also have intervention equipment in case of accidental pollution, mainly with petroleum products.

- Modernization of the communications system in the water field, by adopting modern solutions, such as meteo burst, VPN, wireless / internet coupled with the classic radio or GSM communications, already used in the hydro-meteorological and water management information system.

    - The data collected and primarily processed, stored at the level of meteorological, hydrological and water management databases will be the basis for the use of a Decision Support System. It will include a complex package of models for flood management under the software application Dispecer Ape, as well as for optimizing the allocation of resources in periods of drought and restrictions on long-term / seasonal and monthly.

- Integration of the meteorological system with the hydrological and water management system will be facilitated by the implementation of the Interoperate component, which will complete the meteorological and agro-meteorological information system (providing data on soil moisture and radiation), on the one hand, and high-performance computer for the application of meteorological models on a detailed scale on the other hand, necessary for the precipitation forecast at a convenient scale for the inputs in the hydrological models.

    - The requirements for the integration of the six components is described in a separate section, where a figure of the integrated system of crisis management in the proposed water field is also annexed.

Economic measures targeting water scarcity and drought in Romania

Project description

The economic concepts of the Water Framework Directive 2000/60 / EC were transposed into the Romanian legislation in 3 stages (in 2004, 2006 and 2010), through amendments to the Water Law no.

107/1996 and the Government Ordinance no. 107/202 on the organization of the "Romanian Waters" National Administration.

As a result, in Romania, the economic mechanism in the field of water management has been modernized based on the following principles:

- the beneficiary pays;
- the polluter pays;
- cost recovery for water management;
- protection and sustainable use of water resources;
- saving and reusing water by applying economic incentives and sanctions.

The "Romanian Waters" National Administration applies, on behalf of the Romanian state, the economic mechanism regarding the public services provided:

- Providing raw water at the source in accordance with water permits;
- Qualitative and quantitative monitoring of surface and groundwater resources;
- Research in the field of water, operational hydrology and hydrological forecasting;
- Protection against dangerous hydro-meteorological phenomena, including drought;
- Reporting according to EU Water Directives.

To this end, specific contributions are established for the use of water resources and wastewater discharges. In order to stimulate water saving, the newest contribution system for water supply is structured by categories of sources and users, as it follows:

- Surface waters - inland rivers, lakes and reservoirs;
- Economic operators (including regional water operators), public institutions, religious, agro-zootechnical, industrial and other institutions;
- Power, nuclear and thermoelectric power plants;
- Hydropower plants;
- Irrigations;
- Aquaculture.

Agro-monitoring network - integrated water resources management system in Romania

The negative effects of extreme weather events on agricultural production require specific monitoring methods in order to predict the evolution of risk factors. As the weather, climate and soil are extremely variable in a region or sub-region, the density of agro-meteorological stations becomes important. Moreover, the integration of stations into a single network that allows centralized data collection, analysis and interpretation is essential to provide accurate information for decision makers.

The agro-meteorological activity within the NMA, which integrates complex issues regarding the current and future evolution of the vegetation status of crops and soil water supply in relation to the evolution of meteorological parameters, is a particularly important activity, with the ultimate goal to elaborate / edit

meteorological agro-bulletins and to disseminate information at the level of decision makers in the field of agriculture and private farmers.

The agro-meteorological measurement program includes 55 meteorological stations, as well as agro-meteorological information classified according to the references of the agricultural region and the types of crops, validated and managed based on specific programs organized in data structure modules, which represent the entire agro-meteorological monitoring system.

The main purpose of the agro-monitoring network is the continuous monitoring of agro-meteorological phenomena (thermal, water and mechanical alert / risk), in order to identify in real time the most vulnerable areas and disseminate information to users who want to make the right decision to prevent and mitigate the effects on crop efficiency.

The specific objectives are:

- Monitoring daily agro-meteorological parameters and changes in soil moisture content at the crop level;
- Identification of agricultural periods and areas, severely affected by extreme events;
- Making long-term agro-meteorological forecasts on plant growth, development and efficiency;
- Design and diversification of agro-meteorological products, in order to improve the quality of specialized agro-meteorological services and scientific assistance of agricultural decision-makers;

Success Factors

Agro-meteorological forecasts include specific information (air temperature, precipitation, ETP, soil moisture, crop water demand) needed to assess extreme events (drought or excess moisture). This data collected by the National Observation Network are analysed and compared with critical thresholds in order to assess the hazard and make recommendations for policy makers and farmers.

Processing and interpretation of meteorological data (from the synoptic meteorological database / ORACLE) are carried out using specific applications such as AGRO-SYNOP, AGROSERV and AGROTEMPSOL. Agro-meteorological data is specialized information from the network of meteorological stations running agro-meteorological programmes, representative of the areas of agricultural interest in Romania. Soil moisture dynamics during the active crop vegetation period (March-November) are monitored with specialized equipment such as 55 portable soil moisture measurement systems (DELTA-T).

The amount of water available in the soil is determined directly by sensors from different observation points (agro-meteorological platforms), representative for agriculture. Data collection is done every 10 days at the level of the Meteorological Services by the agro-meteorological specialists in the network, then transmitted electronically via the computer to the NMA Agro-meteorology Laboratory, for the purpose of developing maps on the soil moisture reserve (m3 / hectare) accessible to plants (autumn wheat and maize), at dates of agricultural interest and at different depths (0-20 cm, 0-50 cm and 0-100 cm). The entire agro-monitoring system is supported by the development and improvement of demand in terms of the collection and transmission of rapidly flowed agro-meteorological data, and the production of statistical data series - data banks and the calculation of agro-meteorological indices. The possibilities offered by GIS remote detection techniques (software products for spatial mapping of the main agro-meteorological parameters / precipitation, drought indices, etc.), increased the accuracy of spatial coverage using the NDVI vegetation index obtained from satellite images made by SPOT VEGETATION.

In order to implement the Nitrates Directive in Romania, the project "Integrated Control of Nutrient

Pollution" managed by the Ministry of Environment, Waters and Forests was developed. For the period 2016-2021, the cost of measures for the implementation of the Nitrates Directive financed by the second phase of the project “Integrated Control of Nutrient Pollution” (second phase - additional financing), was of 50 million euros at national level.

Within LIFE + Program, the LIFE09 ENV / RO / 000612 project (acronym Clean WATER) entitled “Integrated system for the analysis and protection of water resources threatened by nitrogen pollution” was developed and carried out at the level of Bârlad basin; it was found that the highest values of nitrate concentrations (> 50 mg / l) in the monitored water bodies are recorded in the immediate vicinity of rural localities (agglomerations with less than 2,000 equivalent inhabitants) compared to extra-urban agricultural lands. To the Management Plans of the updated river basins / hydrographic spaces, additional measures have been proposed, respectively wastewater collection and treatment systems for agglomerations under 2,000 PE (individual and centralized), as well as communal and individual manure storage platforms, which contribute to the achievement of environmental objectives for the related water bodies.

Achieved Results

- delimitation of water bodies, both for surface and underground ones (re-evaluation of the monitoring network by analyzing the optimal number of sections at the level of re-delimited water bodies)
- improvement of the National Monitoring System by updating the network and monitoring programs;
- the monitoring network and programs for surface and groundwater have been updated, and expanded with a view to monitoring as many water bodies as possible in a planning cycle; the number of monitored parameters has also increased, so that the level of confidence in assessing the condition to increase;
- several priority substances foreseen by Directive 2008/105 / EC as amended and supplemented by Directive 2013/39 / EU were included in the monitoring process, including the monitoring of the 3 substances (hexachlorobenzene, hexachlorobutadiene and mercury) foreseen in Article 3 of the SCM Directive in the biota investigation environment.
- an inventory of emissions, discharges and losses of priority substances has been prepared and will need to be constantly updated
- making an inventory of surface water bodies and terrestrial ecosystems interdependent with water.
- from a quantitative point of view, no groundwater body has been identified at risk of failure to reach good condition
- Considering the re-delimitation of groundwater bodies as well as the modification and extension of the minimum list of pollutants in the groundwater for which threshold values have been determined, and which must be included in the monitoring in order to identify the trends;
- the methodology used in assessing the chemical status took into account in addition to the parameter exceeded on each borehole also on the surface (acceptable extension of exceedings as on each parameter not to exceed 20% of the total surface of the groundwater body) on which the exceedings are found relative to the surface of the whole body of water
- groundwater bodies were redefined, and their characterization was based on the inclusion of new

data and information (monitoring points, captures, graphs, land use maps for each groundwater body)

- updating the threshold values for some parameters and extending the minimum list of pollutants for which threshold values have been determined, a list which also includes synthetic artificial substances (benzene, trichlorethylene, tetrachlorethylene);
- in order to achieve the environmental objective "non-deterioration of the state" of water bodies, it was aimed that the values of concentrations of priority substances in sediments and / or biota have decreasing values, respectively constant over time and on the use of high-performance treatment technologies;
- the percentage of water bodies reaching environmental targets is high
- the situation of discharged wastewater volumes decreases significantly in the case of industry due in particular to the reduction of industrial activities, as well as the application of "Best Technologies" in relation to saving and purifying water, used in technological processes in industry.
- At national level, measures have been established for both wastewater treatment and technological changes in production processes in order to reduce / eliminate discharges, emissions, losses of priority / priority hazardous substances and hazardous substances (lists I and II). Starting from List II of hazardous substances in Directive 2006/11 / EC and the list in Annex VIII of the WFD, a list of specific pollutants has been established at national level, for which environmental quality standards have then been derived.

Future Approaches

- it has been established that for the next planning cycle, all groundwater bodies will be included in the operational monitoring program given their vulnerability to pollution.
- expanding the monitoring program of priority substances (by increasing the number of priority substances monitored and including them in the chemical assessment, improving the performance of methods of priority substances analysis in accordance with the requirements of Directive 2009/90 / EC20;
- increasing the number of monitored surface water sections / bodies by applying an investigative monitoring
- changing the approach in the assessment of chemical status (grouping of water bodies) by using the monitoring data of priority substances from several water bodies (eg: certain substances / groups of priority substances from more water body, other substances / groups of priority substances from other body of water);
- the possibility of developing several types of maps in which to represent the chemical state;
- inclusion of monitoring data on mercury, hexachlorobenzene and hexachlorobutadiene in biota (fish) in assessing the chemical status of surface waters;
- performing the analysis of the trend of the concentration of priority substances that can accumulate in sediments in order to verify compliance with the principle of non-deterioration;
- updating the assessment of water use requirements at the level of river basins, for the period 2020-2030, in order to substantiate the actions and measures necessary to achieve the objectives of sustainable management of water resources of river basins;

- developing scenarios for the water use in climate change conditions for the most affected economic sectors in low rainfall areas (e.g. agriculture) and proposing measures to mitigate and adapt to climate change;
- identification of water saving measures in the river basins prone to hydrological drought and analysis of the possibility to reuse the urban wastewater and in animal husbandry sector;
- developing studies on the assessment of water resources in the river basins and their estimation until 2050 taking into account the influence of climate change and studies on hydrological extremes and the impact of climate change;
- development of studies to establish the vulnerability of water management systems to climate change (e.g. adaptation of reservoir exploitation programs to the modified hydrological regime and new water requirements, which take into account the natural variability of the hydrological regime in climate change conditions, recorded in previous periods).

6.4 Sweden - The County Administrative Board of Östergötland

The good practices presented by the County Administrative Board of Östergötland has been approved within the stakeholder group for BIGDATA 4RIVERS in Sweden. The suggestions were based on results from the internal workshop where participants from several stakeholder areas within CAB attended.

Good Practice 01: Local action plans – Tinnerbäcken

Designation of the good practice

Development of local action plans for individual water bodies that do not reach the environmental quality standards. Local action plans enable assessment of pressures and development of efficient and relevant measures in the process of achieving the environmental quality standards of a waterbody.

Context of application (problems that were on the source of the good practice)

Linköping city is among the most densely populated areas in Sweden as the fifth largest municipality and the eight largest city when considering population. The city is expanding as the population keeps increasing which caused the need for developing large areas within the sub catchment area of the river Tinnerbäcken. In the sub catchment area, there were plans for development of residences and trading facilities in for instance the former military training areas as well as densify existing areas. As the municipalities are responsible for complying to the EQS of waterbodies an investigation of necessary measures was initiated in 2018. The investigation was finalized in 2019 resulting in a list of possible measures (Figure 82). This joint investigation was intended to prevent the same type of issues having to be dealt with in each individual detailed plan by taking a collective approach around Tinnerbäcken as a whole.

Figure 82 | Investigation of measures with Action plan for river Tinnerbäcken

Source: DHI (2019)

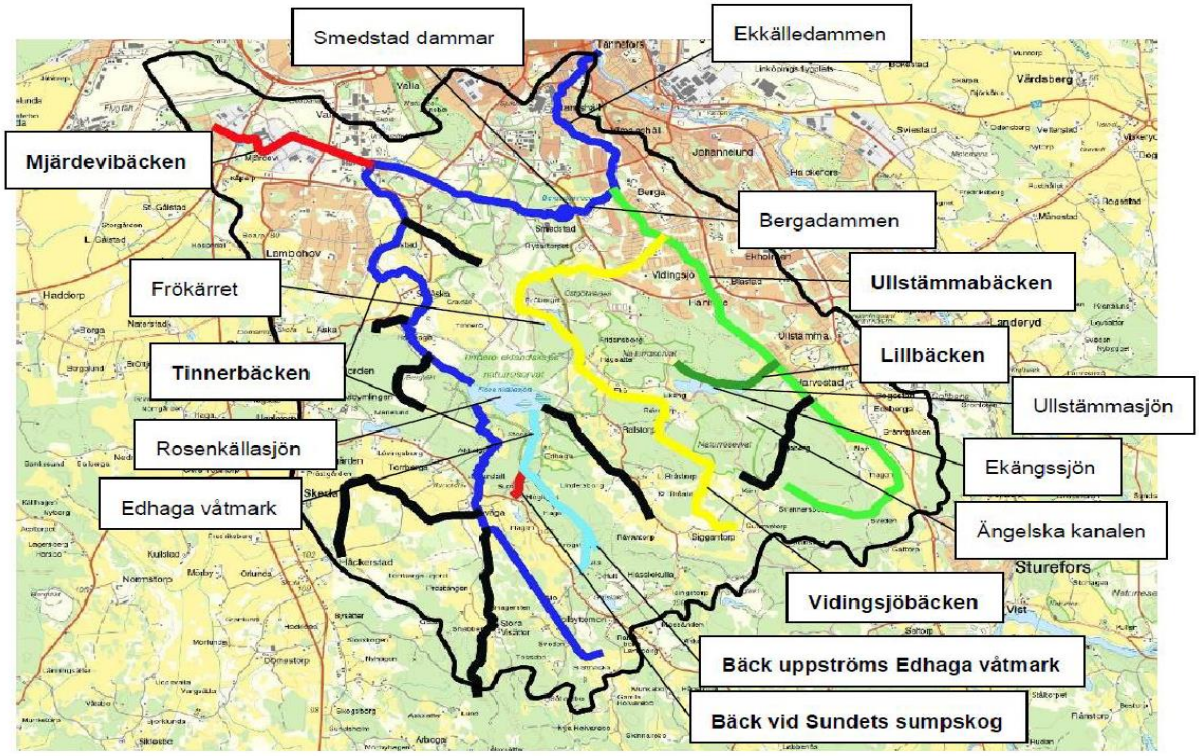
The report had two main purposes:

- Develop measures for enabling Tinnerbäcken to reach good status and update the status classification;
- Identify the risks of suggested developments, find measures to counteract the identified risks and calculate a cost allocation model.

Brief description of the technology developed/apply (is applicable)

The action plan was ordered by Linköping municipality from an external consultant. The investigations of the river included surveys of the sub catchment area and land use in the catchment area (Figure 83). Also, a description of the current ecological status and chemical status was investigated and is described in the action plan.

Figure 83 | Catchment area of river Tinnerbäcken



LEGEND: Tinnerbäcken - dark blue; connecting rivers - other colours.

Source:DHI (2019)

The Ecological status of Tinnerbäcken was classified into the category bad in the previous cycle (2010-2016), due to the lack of fish and connectivity issues. During the latest cycle, status in Tinnerbäcken has improved to moderate ecological status.

Nutrient status from the river confirmed the biological data, where phosphorus status exhibited concentrations within bad status. Average concentration of phosphorus needs to be reduced from 84 µg/L (measured in sept-dec 2018) to 34 µg/L to achieve good status. Also, the chemical status was classified as bad since the PFOS concentration in Tinnerbäcken was 0,0015 µg/L partly due to leaching from contaminated soils at firefighting training sites in proximity to the river. Possible impact from contaminated sites was assessed regarding military training field, drycleaners and garden centers.

The hydro morphological status (connectivity, morphology and hydrological regime) was also included in the investigation of the river. Tinnerbäcken was divided into five segments where three were assessed to be of bad status and two of poor status where both the connectivity and morphological state was resulted in a total score rendering the classification of bad status for Tinnerbäcken.

Investigation of diffuse sources, point sources and hydro morphological impacts

An investigation of different sources showed that there are several impacts for nutrients (phosphorus) such as urban wastewater, private sewers, agricultural lands, forest and other land. There was a calculated impact through measurements of phosphorus in 2018 landing on a total load of 919 kg phosphorus/year. This was predicted to increase to 1 016 kg/P/y due to conversion of agricultural land to hardened surfaces causing a greater total impact due to surface runoff. As a part of the water management, it was calculated that the need for phosphorus reduction was 565 kg/P/y before exploitation

to reach good status, the investigation showed this would increase to 662 kg/P/y.

For heavy metals it was estimated that there would be a slight increase in concentrations in Tinnerbäcken. However, there was an estimation that the measures necessary for the adequate reduction of nutrients would counteract metal increase as well.

Sources of most impact for hydro morphological quality elements were drainage of urban wastewater and agricultural lands which could lead to changes in waterflow and sediments. In addition, both erosion and flooding were investigated as a base for measures necessary.

Suggested measures and their efficiency

In the action plan for Tinnerbäcken there were a wide range of measures recommended to ensure that the change in land use would not affect the environmental quality standards negatively. As all impacts have been evaluated measures necessary to comply with the EQS are suggested in the action plan such as:

- Treatment measures in existing urban areas aimed at nutrient reduction that will also have an effect in increased metal concentrations from change in land use surrounding Tinnerbäcken.

Reduction in proposed areas for exploitations
Several suitable locations for measures were developed as well as the potential of coordination of measures concerning urban wastewater.

Natural reduction
The investigation surveyed reduction in natural lands such as multifunctional wetlands, flood areas or adaptation of trenches. Measures under this category were stated to be more cost-efficient than measures in urban areas due to less conflicts of interests.

Individual sewers
The contribution from individual sewers were estimated insignificant therefore no measures were evaluated.

- **Increased knowledge in agriculture**

Administrative measures (applying for grants for measures), construction of protection zones, phosphorus retention dams and catching crops.

The efficiency of these measures has not been evaluated in terms of connections between them. This could mean that measures have been both over- and underestimated causing the conclusion that all measures most probably will be necessary to reach good status in Tinnerbäcken.

Measures in hydro morphology
A few measures in hydro morphology were identified as possible in Tinnerbäcken such as restoration of the watercourse by shapes and processes corresponding to the natural state etc.

Flood measures
There are measures presented for modelled downpours of rain in areas where the risk of floods has been deemed most likely. Difficulties are pointed out in these measures as they can affect the hydro morphological properties of the watercourse (such as embankment walls and dams).

State of the good practice (proven/test phase/concept validation)

This type of action plans has been in use previously, but they are still not abundant. There are needs for an increased us of this kind of approach to reach the EQS of several water bodies in Östergötland county.

Major difficulties during the implementation;

There were described difficulties in predictions due to the type and amount of data provided, for example in hydro morphological predictions. This was described to cause insecurity in predictions and ultimately in the amount of measures needed.

Implementation time

The action plan document was initiated in 2018 and finalized in 2019.

Results obtained/expected;

The expected results of the action plan were to avoid several minor investigations in exploitation of lands surrounding Tinnerbäcken whilst at the same time consider the environmental quality standards and improve the status of Tinnerbäcken.

Cost and profits obtained/expected;

The final part of the action plan describes the cost of the investigation and measures for each area planned for exploitation. The cost of the investigation (cost of action plan) which is distributed over:

$$1\ 000\ 000\ SEK * \frac{Area\ _{of\ exploatation\ zone}}{Total\ exploitation\ area\ in\ Tinnerbäcken}$$

Areas where the soil consists of clay were estimated to exhibit more difficult conditions for reduction which rendered an economical grant for construction of measures in natural lands based on reduction cost/kg phosphorus. The measures suggested for natural land were stated to have two purposes;

1. Reduction
2. Flood mitigation

The total cost of these were:

$$10\ 700\ 000\ SEK * \frac{Area\ _{of\ exploatation\ zone}}{Total\ exploitation\ area\ in\ Tinnerbäcken}$$

The cost of each area was estimated to:

Table 20 | Estimated Costs for each area

Estimated cost distribution, per exploitation area				
Exploitation area	**Cost of investigation (tSEK)**	**Grant for measures in natural lands* (tSEK)**	**Grant for measures in natural lands (Flood) (tSEK)**	**Total grant (tSEK)**
All	1000	1390	10 700	13 090

*tSEK = thousand SEK. *Based on assumption that all 74 exploitation areas are located on clay soil*

Other possibilities of application

This type of approach could not only be used by other municipalities when considering environmental quality standards in exploitation of land with altered land use, but also in managing waters not reaching the determined EQS. By taking a holistic approach, investigating all factors involved in the status of the waterbody, the management and improvement could be more efficient, and measures would be better fitted to accommodate the needs to reach good status of waters in Östergötland.

Good Practice 02: Ozone oxidation wastewater treatment – Nykvarn Linköping

Designation of the good practice

Adaptation and implementation of ozone oxidation treatment technology in the Nykvarn WWTP in Linköping to reduce pharmaceutical residue.

Context of application

In wastewater treatment plants the loads of contaminants posing a threat to the environment are supposed to be reduced (or removed) by both biological and chemical processes. This is true for some contaminants such as nutrients and larger particles (i.e. coffee). However traditional WWTP does not remove pharmaceuticals causing the environment to receive the discharge of excreted pharmaceuticals (from both human and veterinary drugs) through treated wastewater.

Brief description of the technology developed/apply

In 2014 the Swedish environmental research institute (IVL) and Tekniska verken AB (owned by Linköping municipality) started their collaboration in adapting the technology now installed at full scale. The technology was installed at Linköping's largest WWTP in Nykvarn which discharge into river Stångån leading to lake Roxen north of Linköping (Figure 84).

Figure 84 | Location of Nykvarn WWTP in river Stångån

Source: Ostgotakartan 2020

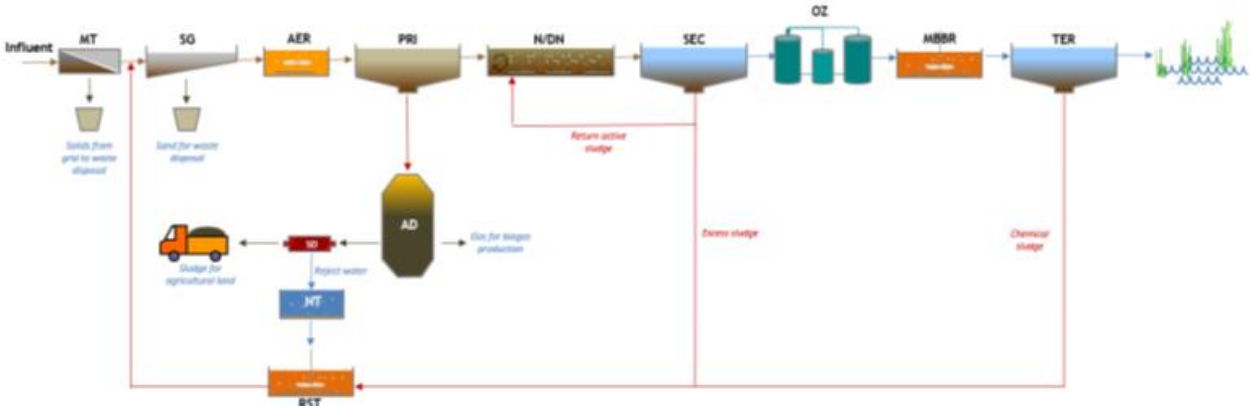
The plant handles 42 000 m^3 sewage water daily and is dimensioned to handle 235 000 PE (estimated an average treatment of 180 000 PE in 2015). Incoming water takes about 12 hours to treat where the steps of treating the wastewater include:

1. Mechanical treatment (MT):
    a. Screens and grid
2. Sand and grease removal (SG)
3. Primary aeration (AER)
4. Primary clarifier (PRI)
5. Activated sludge (N/DN) – nitrification/denitrification
6. Secondary clarifier (SEC)
7. Ozone plant (OZ)
    a. The ozonized wastewater flows through a series of chambers while the dissolved ozone concentration is declining.
8. MBBR-plant
    a. Consists of three separate lines with four reactors in each line. In total, the MBBR contains around 600 million carriers. Generally, nitrification and other oxygen-consuming reactions occur in the two first reactors of each line. Denitrification occurs in the two last reactors and ethanol is added as a carbon source. Aluminum chloride is added directly after the last reactors in MBBR to precipitate remaining phosphorus and to flocculate

suspended solids, which are removed in the tertiary clarifier.

9. Tertiary sedimentation (TER)
10. Treated water is then released to the recipient (Stångån).

Figure 85 | Process of waste water treatment at WWTP in Linköping (Nykvarn), Sweden



Source: (Sehlén, o.a., 2020)

Ozone oxidation treatment for removal of pharmaceuticals

The pharmaceutical wastewater treatment at Nykvarn WWTP is performed after the chemical treatment step. Approximately 90% of pharmaceuticals that enter the treatment are removed. Most of the pharmaceuticals entering the wastewater is excreted by humans and not the result of disposal of unused prescribed drugs into the household toilets. Due to the design of medical substances, such as being able to resist for example the acid environment of human intestines, they are difficult to break down in previously existing steps in WWTPs.

Figure 86 | Ozone generator tank at Nykvarn WWTP

Source: (Tekniska Verken, 2019)

Due to effects observed in the environment being linked to pharmaceutical residues, such as feminization of fish causing reproductive problems and changed behavior in perch exposed to oxazepam (antidepressant pharmaceutical), the importance of removing such substances was brought to attention. The effects of pharmaceuticals in the environment also caused three problematic substances to be included in the priority substances by the EU (diclofenac and two estrogenic compounds). Ozone

treatments have been shown to reduce the occurrence of antibiotics, antidepressant drugs, painkillers and multi resistant bacteria (MRSA) in treated wastewater. It could also in combination with biological treatment reduce organic carbons and nitrogen concentrations.

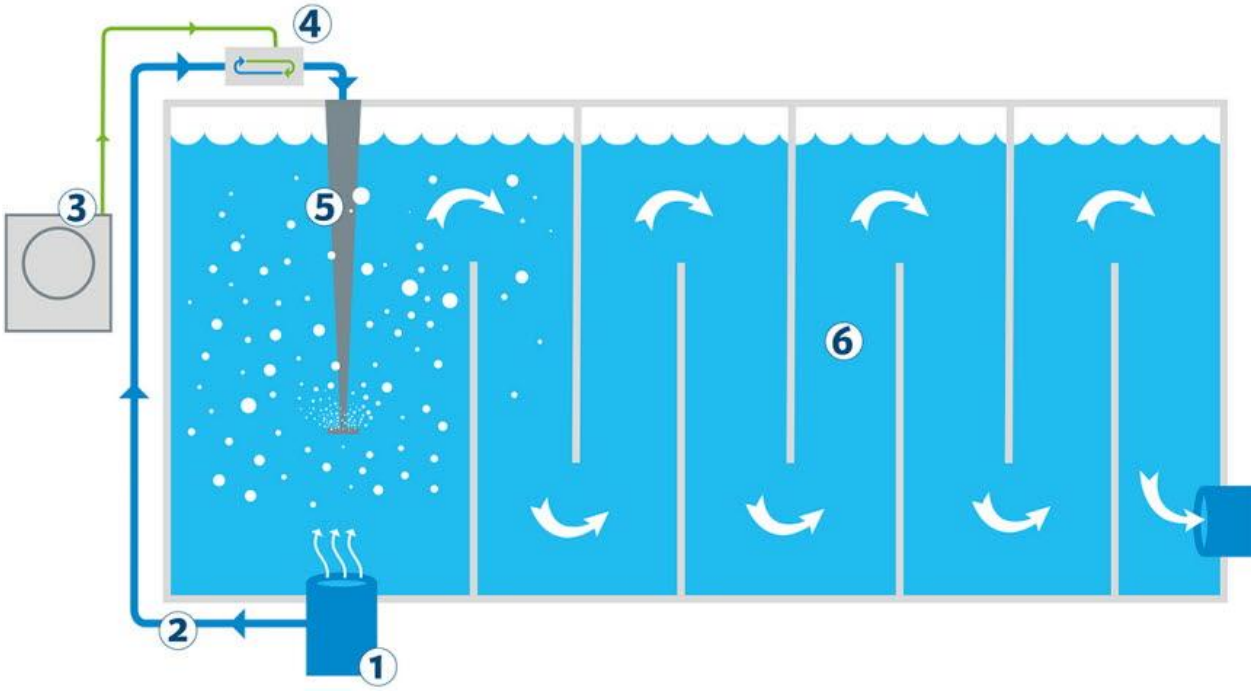
In the pilot test at Nykvarn the reduction of pharmaceuticals was observed to be highly efficient. Concentrations of pharmaceuticals post treatment and dilution were observed under the risk level

Operation

Removal by ozone oxidation treatment is a six-step process where:

1. Water enters the reactor tank of 600 m^3 through a pipe from the biological treatment
2. Part of inflowing sewage water is redirected and mixed with ozone gas (about 0,5-0,8 mg O_3 / mg DOC), before it is returned into the reactor tank
3. Oxygen is converted to Ozon in the ozone generator which is transferred into an injector
4. Gaseous ozone is mixed into the redirected sewage water (step 1)
5. The side flow is returned to the reactor tank through a lancet which disperse the ozone into the water
6. Water is then flowing up and down the reactor tank to allow reactions between ozone and the pharmaceutical residues so that the added ozone is completely consumed before sewage water is transferred to the next treatment step.

Figure 87 | Schematics of ozone treatment step



Source: (Tekniska Verken, 2018)

State of the good practice

The treatment system was tested in pilot scale during 2015 and evaluated by IVL (Swedish environmental research institute). Testing ended and was reported to the Swedish government in 2017 and a full-scale pharmaceutical treatment (ozone) system was installed and taken into use at the Nykvarn WWTP in

2017.

Major difficulties during the implementation

Difficulties observed during the trial of the method was the dosage of ozone, so that this was not in itself an environmental hazard. It was also a considered risk that an increased toxicity would be the result of ozone oxidation treatment, this was ruled out by the pilot test by IVL. There was also a risk that the efficiency of the denitrification step following ozone treatment would be impacted which was also excluded.

Implementation time

The method was tested for application in Swedish WWTP in Nykvarn by Tekniska verken and IVL, starting in 2014 and reported in 2017 before the full-scale system was implemented in Nykvarn WWTP in 2017.

Results obtained

Results obtained by implementation of ozone oxidation treatment of wastewater in Linköping is that the returned water to the recipient Stångån has a lower concentration of pharmaceuticals. This could reduce negative effects in biological quality elements under the water framework directive as well as chemical status indicators.

Cost and profits obtained

Cost of implementing the ozone oxidation treatment was estimated at 25 million SEK, as well as operational costs (such as oxygen). Operation of the treatment does however not demand additional employees to operate it, which alternative treatment methods (such as active carbon) would have demanded.

Other possibilities of application

This type of water treatment could be applicable for industries producing or emitting substances such as pharmaceutical or with chemical structures similar to pharmaceuticals.

6.5 Portugal - CIM Alto Minho

The preliminary identification of good practices, resulting from the events and sessions held with the CIM Alto Minho Group of Local Stakeholders, resulted in the pre-selection of 1 possible good practice, which is presented below. This good practice was identified by the stakeholder Portuguese Environment Agency (APA), which is the national water authority. Work is underway to identify and characterize other potential good practices.

Good Practice 01: Cross-border collaboration in the implementation of projects related to water management (risks, quality, emerging pollutants)

Designation of the good practice

Cross-border collaboration in the implementation of projects related to water management (risks, quality, emerging pollutants)

Context of application

Shared management of the Minho and Lima international hydrographic basins, with the following needs emerging more recently:

- Application of different methodologies for the monitoring of shared water bodies (border and cross-border), by Portugal and Spain;
- Improve the management of floods and drought situations, as well as the mitigation of their effects in the Minho and Lima international hydrographic basins;
- Promote the protection and conservation of the fluvial habitat of the Minho hydrographic basin, in its international section;
- Identify the sources and the main emerging pollutants (PE) in the hydrographic basins of Northern Portugal and Galicia (Spain).

Brief description of the technology developed/apply

The technologies developed / applied vary depending on the type of project and the theme of the collaboration (risks, quality, emerging pollutants).

State of the good practice

Cross-border collaboration is carried out continuously in the qualitative and quantitative management of water resources, being essential to achieve the environmental objectives imposed by the Water Framework Directive (WFD).

As it is a collaborative process, in which both parties are constantly learning and adapting, there has been a need to invest in joint studies and projects with a view to better understanding the problems that occur in these basins, allowing the implementation of new tools and methodologies capable of harmonizing planning, monitoring and responding to current and future situations, such as those that will result from climate change, with regard to the management of water resources.

Currently, 4 joint projects are underway:

- The joint assessment program of Water Bodies in Portuguese-Spanish hydrographic basins;
- Prevention of Flood and Drought Risks in the Minho-Lima International river Basin (RISC ML);
- Protection and Conservation of Migratory Fish on the International Section of the Minho river and its affluents (Migra Miño-Minho);
- Emerging pollutants in the waters of Galicia-Northern Portugal: new tools for risk management (NORWATER).

Major difficulties during the implementation

Resulting from a good articulation between the two Member States, the management of the Minho and Lima basins, with regard to shared water bodies, has not presented any relevant difficulties. It is noteworthy only that, since Portugal is mostly dependent on the inflows from Spain, it can affect the management of the basins.

Implementation time

Collaboration occurs continuously, with moments when it is more intense, as a result of the development

of joint projects.

Results obtained

Although the responsibility for the management of water resources is clearly separated between the two Member States, they are consulted during the elaboration of the main planning instruments, namely in the elaboration of national plans, such as the Hydrographic Region Management Plans (PGRH) and Flood Risk Management Plans (PGRI).

Collaboration is also present in cross-border monitoring and information sharing.

Cost and profits obtained

The costs of this collaboration are not measurable. However, the costs associated with ongoing joint projects can be estimated.

Other possibilities of application

Applies to all water bodies shared cross border by two or more countries

Likewise, current cross-border cooperation is a good example of shared river basin management and can be expanded to other areas of natural resource management.

Good Practice 02: Regulation, by the Regulatory Authority for Water and Waste Services (ERSAR), of the quality of the service provided by entities managing water supply and wastewater sanitation systems ("what can be measured, can be managed")

Designation of the good practice

Regulation, by the Regulatory Authority for Water and Waste Services (ERSAR), of the quality of the service provided by entities managing water supply and wastewater sanitation systems ("what can be measured, can be managed")

Context of application

In Portugal, ERSAR (Regulatory Entity for Water and Waste Services) has the competence to regulate the quality of service with the objective of improving the effectiveness and efficiency with which water and waste services are provided, being carried out using the performance assessment of entities managing water supply systems, wastewater sanitation and waste treatment.

Brief description of the technology developed/apply

Annually, the managing entities report to ERSAR a set of 14 indicators for each of the water supply, wastewater sanitation and urban waste management services, which allows regulation by benchmarking.

The indicators that incorporate the system for evaluating the quality of service provided by the management entities are divided into three groups:

- i) **Adequacy of the interface with users** - this group of indicators aims to assess whether the service provided to users was adequate, namely at the level of greater or lesser physical and economic accessibility to the service and the quality with which it is provided;
- ii) **Service management sustainability** - this group of indicators aims to assess whether basic

measures are being taken to make the service provision sustainable;

- iii) **Environmental sustainability** - this group of indicators aims to assess the level of safeguarding of environmental aspects associated with the management entity's activities.

ERSAR provides all basic data and indicators resulting from the evaluation cycle of the quality of the service provided to consumers. This information can be used by all interested parties for more specific studies and analyses, if referring to the source of the data.

State of the good practice

This practice was implemented in 2011 and, over the years, new relevant data / indicators have been added. The data reported annually by each management entity is validated by technicians with adequate qualifications.

Major difficulties during the implementation

This process includes the reporting of 85 data related to the water supply service and 84 data related to the wastewater sanitation service, requiring a strong effort and commitment on the part of the management entities in the implementation of procedures for the collection and registration of the information necessary for reporting data / indicators.

Implementation time

1 year

Results obtained / expected

ERSAR provides all basic data and indicators resulting from the evaluation cycle of the quality of the service provided to consumers. This information can be used by all interested parties for more specific studies and analysis, if referring to the source of the data.

Cost and profits obtained / expected

Improving the performance of the functioning of water supply systems and wastewater treatment systems; control and reduction of losses in the water supply network; control of illegal discharges; increasing the efficiency of treatment processes; analytical control of water quality; increase in the population served by water supply and wastewater sanitation systems; etc.

Other possibilities of application

Preparation of technical reports, forecasting trends in the evolution of indicators; improving knowledge about processes and infrastructure; improving the performance of service providers; information to users and the general public; etc.

Good Practice 03: National irrigation program

Designation of the good practice

National irrigation program.

Context of application

The creation of the National Irrigation Program (PN • Irrigation) aims to develop sustainable irrigation in

Portugal within the framework of a medium / long term strategy. It is an initiative of the Portuguese government to support farmers in adapting to climate change, which will create more than 90 thousand hectares of irrigation by 2022, with a public investment of 534 million euros.

Brief description of the technology developed/apply

This program covers interventions in irrigated areas (new, rehabilitation and modernization and pumping reinforcements) making use of recent community initiatives to promote productive investment and the respective financing conditions, through financing contracted by the Portuguese Government from the European Investment Bank (EIB) and the Council of Europe Development Bank (CEB). This program aims at the controlled supply of water to plants in quantity and at the right time, guaranteeing productivity and the survival of planting.

State of the good practice

The PN • Irrigation was approved by the Resolution of the Council of Ministers (RCM) No.133/2018, of 20 September, having been created with the objective of defining the irrigation financing strategy in the national territory, in the period 2014-2023. The National Irrigation Program is financed through the Rural Development Program (PDR 2020), the European Investment Bank (EIB) and the Council of Europe Development Bank (CEB): EIB - 187 million euros; CEB - 80 million euros; PDR - 267 million euros.

Major difficulties during the implementation

Demonstrate the importance of irrigation for the development of rural territory, for combating desertification of the interior and for increasing national production.

Implementation time

The execution of the PN • Irrigation results from three different sources of financing: the funds allocated to the actions 3.4.1 - Development of the Efficient Irrigation and 3.4.2 - Improvement of the Efficiency of the Existing Irrigation of the Rural Development, Program 2014-2020 (PDR2020) loans granted by the EIB and CEB. The aspect associated with the implementation of the PDR2020 has been in progress since 2014. Regarding the component of support included in the financing contracts signed between the Portuguese Republic, the EIB and CEB, this has a period of execution from 2018 to 2023.

Results obtained / expected

The interventions in new areas of irrigation and rehabilitation, modernization and pumping reinforcements of the existing irrigations, foreseen in the PN • Irrigations, have as their final mission the appreciation of the agricultural activity, continuing to improve the quality of the products and increase the productivity of the factors of production. To this extent, the PN • Irrigation aims at the expansion, rehabilitation and modernization of existing irrigation systems and the creation of new irrigated areas, namely with the potential to connect to existing ones, with the objective of promoting irrigation and other collective infrastructures, in a perspective of sustainability, contributing to adaptation to climate change, combating desertification and more efficient use of resources.

Cost and profits obtained / expected

This program is expected to contribute to the more efficient use of water in agriculture and to the creation of more than 10,000 permanent jobs, helping to secure populations, creating wealth and improving living conditions in the country side.

Other possibilities of application

In a context of the need to ensure an effective fight against the phenomenon of fires in rural territory, this program comes to make more resources available for that fight, emphasizing the fact that a better occupied and more cultivated territory will be better defended.

Good Practice 04: SI.ADD –Information and Decision Suport System (SI.ADD) for water resources management in the north region of Portugal

Designation of the good practice

SI.ADD –Information and Decision Suport System (SI.ADD) for water resources management in the north region of Portugal

Context of application

The creation of the Information and Decision Support System (SI.ADD) for ARH Norte arises from the need to compile, organize and systematize information on water resources, on a geographical basis, to support decision-making processes, namely in support of the preparation of Plans Management of the Northern Hydrographic Regions.

Brief description of the technology developed/apply

This system assumes a modular, evolutionary, and collaborative character with applications, transversal to the organic framework, the mission, and functions of this institution, from the planning of water resources to management and institutional cooperation. In the end, it is intended that the SI.ADD is an element of internal management and efficiency, but also promoter of the proposal, the responsiveness and external image of the institution. In support of the Management Plan for the Northern Hydrographic Regions (PGRH-Norte), a wide range of geographic databases were collected, documentation and quality assessment work was started, as well as the preparation of support to PGRH-Norte in its technological and procedural basis. The components and architecture of the SI.ADD of the ARH Norte, I.P. are described in the “Revista Recursos Hídricos”, Vol. 32, No.1, 5-12, May 2011, ‘The information system and decision support [SI.ADD] of ARH Norte, I.P.: objectives and development’.

State of the good practice

The ARH Norte, I.P. in close collaboration with internal and external users conceived, implemented, and intends to maintain several modules of a WEBSIG, to be functionally integrated in the corporate SI of ARH Norte, I.P., the SI.ADD.

Major difficulties during the implementation

The design, development and adoption of the information system comprise considerable multidimensional challenges, from a legal, financial, and technological point of view, which are reflected in the internal organizational and procedural dimension. Among the difficulties encountered during the implementation of the SI.ADD. We highlight the dispersion of sources, formats and the organization of the databases used and necessary (in addition to the dispersion by several institutions, they were often in analog format, spatial referencing or in different referencing systems).

Implementation time

2 years

Results obtained / expected

In the production and use of geographic information, the different applications and models allow to integrate the processes of planning, monitoring and management of water resources, however, lacking information with high and increasing spatial, thematic, and territorial quality.

Cost and profits obtained / expected

Internally, for the ARH Norte, I.P., this system provides for: production, accumulation, replacement, integration and data analysis; modelling and simulation of scenarios to support planning and management; internal communication and decision, external disclosure and promotion of participation.

Other possibilities of application

It is intended that this corporate SI(G), the SI.ADD of ARH Norte, IP: i) undertake its territorial and thematic dimension, in a posture of sharing products and experiences and establishing networks that promote scales and economies; and ii) respect the community (eg. INSPIRE, SEIS and WISE, etc.) and national (SNIG, SNIT and SNIRH, InterSIG, INSAAR, etc.) guidelines and dynamics.

Good Practice 05: GP5 – Water quality monitoring and modelling (AQUASIM – a tool for simulation a data analysis of aquatic systems)

Designation of the good practice

GP5 – Water quality monitoring and modelling (AQUASIM – a tool for simulation a data analysis of aquatic systems)

Context of application

This good practice born from the need to create prospective water quality scenarios, to support the preparation of PGRH and the definition of rehabilitation measures for aquatic ecosystems (inland surface waters).

Brief description of the technology developed/apply

The AQUASIM is a simulation and data analysis software for aquatic systems that comprises several compartments: rivers, lakes, perfectly agitated reactors, tubular reactors, biofilm, and sediment reactors. The AQUASIM allows users to define the spatial configuration of the system to be investigated as a set of compartments, which can be connected to each other by links.

State of the good practice

The use of AQUASIM software to support decision-making processes in the management of water resources is proven by several technical and scientific publications, including:

RIBEIRO, Daniel; MARTINS, Gilberto; RODRIGUES, Ana C.; CUNHA, José; BRITO, António G.; NOGUEIRA, Regina (2006). Reutilização de águas residuais: modelação da adsorção de nutrientes no solo. 8º Congresso da Água, Figueira da Foz, 13- 17 March;

RODRIGUES, Ana C.; MARTINS, Gilberto; RIBEIRO, Daniel; NOGUEIRA, Regina; MONTEIRO, Paulo; BRITO, António G. (2006). “Modelação da qualidade da água do Rio Ferreira: Avaliação preliminar de riscos ambientais”. 8º Congresso da Água, Figueira da Foz, 13- 17 March.

Rodrigues, A.C., Martins G., Ribeiro D., Cunha J., Brito A.G., Nogueira. R. (2005) – Impact of wastewater

reuse in natural ecosystems: modelling and simulation with AQUASIM. III Int. Seminar DEPURANAT – Sustainable Management of Wastewaters in Rural Areas, Limoges (France), 21-22, October.

Rodrigues A.C., Brito A.G., Nogueira R. (2004). Modelling of water quality in Lake Furnas - Azores. International Seminar on Biomanipulation and Lake Restoration. Ed. J. M. Azevedo. Univ. Azores, Ponta Delgada, 1st March.

Major difficulties during the implementation

The reliability and robustness of the models developed in AQUASIM environment will depend on the quantity and quality of the data necessary to build, calibrate and validate the model.

Implementation time

6 months - 1 year (o calibrate and validate the water quality model in extreme situations, including periods of drought and high rainfall)

Results obtained / expected

Development of water quality models for different types of aquatic ecosystems, allowing the construction of prospective scenarios, to support decision-making processes and the definition of ecosystem requalification measures.

Cost and profits obtained / expected

The development of water quality models for different types of aquatic ecosystems provides a better understanding of the biogeochemical processes that occur in the ecosystem in relation to water quality.

Other possibilities of application

The models of water quality also allow to identify sources of pollution and to evaluate the impact of the discharge of pollutants in aquatic systems (inland surface waters), as well as to estimate the time necessary for the restoration of normal conditions, either through self-cleaning or through restoration measures.

Good Practice 06: Agroindustrial wastewater treatment – energy recovery from wastewater

Designation of the good practice

Agroindustrial wastewater treatment – energy recovery from wastewater.

Context of application

This good practice aims to contribute to: i) the implementation of the National Plan for the Circular Economy; ii) the creation of collective / integrated systems for the treatment and recovery of waste water from agricultural industries, which can be a more robust alternative solution in relation to individual treatment solutions.

Brief description of the technology developed/apply

The process of anaerobic digestion for the treatment and recovery of waste water with an high fraction of biodegradable organic compounds (as is the case with the waste water of most agricultural industries), through the production of methane, is well documented in technical articles and scientific.

State of the good practice

Silva, Sandra; Rodrigues, Ana Cristina; Ferraz, Ana; Alonso, Joaquim, 2017. An Integrated Approach for Efficient Energy Recovery Production from Livestock and Agro-Industrial Wastes. In: Waste Biomass Management – A Holistic Approach, Singh, Lakhveer, Kalia, Vipin Chandra (Eds.), SpringerNature Eds., ISBN 978-3-319-49595-8, Ch15, pp 339-366.

Kroff P., Rodrigues A. C., 2011. Produção de energia renovável a partir de fontes orgânicas. In Ferraz, A. I., Rodrigues A. C., Biotecnologia, Ambiente e Desenvolvimento Sustentável. Publindústria, Edições técnicas Técnicas, Lda. (ed.), pp. 253-266.

Renata D'arc Coura, Ana Ferraz, Paulo Belli, Ana Cristina Rodrigues, António Guerreiro de Brito, 2016. The effect of pretreatment by ultrasound on anaerobic co-digestion of sewage sludge and bovine manure. In: Livro de Resumos do Congresso BioIberoAmerica – Biotecnologia Integrando Continentes, realizado em Salamanca, 5 - 8 june 2016.

Coura, Renata, Rodrigues, A.C., Belli,P, Ferraz, A., Brito, A.G. (2015). The effect of ultrasound pretreatment on anaerobic codigestion of municipal sewage sludge and bovine manure. 2015 International Workshop on Environment and Alternative Energy "Increasing Space Mission Resiliency Through Sustainability", Madrid, Espanha, 9 – 13 november 2015.

R. Coura, A. Ferraz, J. Alonso, A.C. Rodrigues. Assessment of biodegradation rates during co-digestion of dairy wastewaters in batch reactors. International Congress on Water, Waste and Energy Management, 16 - 18 july 2014, Porto, Portugal.

Rodrigues, A., Ferraz, A., Mamede, J. e Alonso, J. (2009). Tratamento de efluentes agro-pecuários por digestão anaeróbia num Reactor Descontínuo Sequencial à temperatura ambiente. 3rd International Congress of Energy, Environmental Engineering and Management, 25 – 27 November, Portalegre, Portugal.

Major difficulties during the implementation

Define the management model for collective treatment units.

Implementation time

1-2 years

Results obtained / expected

Energy recovery of wastewater with an high organic load in anaerobic (co-) digestion processes to produce biogas / methane as a source of electrical and / or heat energy.

Cost and profits obtained / expected

Elimination or reduction of the discharge of organic pollutants into aquatic environments; methane production as an alternative energy source; promote the transition to the Circular Economy and the reintegration of by-products in the production processes.

Other possibilities of application

In addition to biogas / methane, anaerobic digestion also has the digested product, which can be used as a fertilizer.

Good Practice 07: Floating islands for river water quality improvement; Constructed wetlands for wastewater treatment

Designation of the good practice

Floating islands for river water quality improvement; Constructed wetlands for wastewater treatment

Context of application

Plant Beds and Floating Islands with Plants are considered a low-cost “nature-based solution” (NBS) that provides quality water suitable for a variety of non-potable uses, including irrigation, as well as other additional benefits.

Brief description of the technology developed/apply

Plant Beds are biological and multifunctional systems inspired by natural wetlands, aiming to simulate their purification functions, based on biogeochemical processes. Therefore, these systems are dimensioned and designed to optimize and promote those processes in a defined area. It has great potential for application, especially in rural areas where there is no sanitation network in place and decentralized treatment systems are considered. They can also be applied to wastewater from industry, agriculture, landfill and mine leachate, road runoff, among others.

State of the good practice

The treatment of wastewater and the rehabilitation of aquatic ecosystems using plant beds is well documented in technical and scientific articles, including:

Calheiros C. S. C., Almeida C. M. R., Mucha A. M., 2018. Chapter 8. Multiservices and Functions of Constructed Wetlands. In: Wetland Function, Services, Importance and Threats. Editor: Wojciech Halicki. Published by Nova Science Publishers, Inc. New York. Pages 269-298. ISBN: 978-1-53613-562-6.

Calheiros C. S. C., Bessa V. S., Mesquita R. B., Brix H., Rangel A. O. S. S., Castro P. M. L., 2015. Constructed wetland with a polyculture of ornamental plants for wastewater treatment at a rural tourism facility. Ecological Engineering. 79: 1-7.

Major difficulties during the implementation

Some restrictions to the implementation of this technology are related to the fact that, in general, larger areas are available than conventional treatment systems, a control of the entry of solids has to be made in order to avoid bed clogging and in case of high levels water toxicity could harm the system's biodiversity.

Implementation time

3 months – 1 year

Results obtained / expected

Improvement of water quality; reduction in the concentration of nutrients (N and P); elimination or reduction of eutrophication processes.

Cost and profits obtained / expected

The main advantages of the Plant Beds are: the possibility of an effective treatment without resorting to

complex equipment or specialized workers; low operating and maintenance costs; good integration into the landscape; possibility of reusing and valuing water.

Other possibilities of application

Possibility of using biomass for ornamental purposes and / or energy recovery.

Good Practice 08: Environmental management systems (ISO 14001); Risk management systems (ISO 31000); Sustainable forest management certification

Designation of the good practice

Environmental management systems (ISO 14001); Risk management systems (ISO 31000); Sustainable forest management certification.

Context of application

The ISO 14001 and ISO 31000 standards are internationally recognized benchmarks for the implementation and certification of Environmental Management Systems (SGA) and Risk Management Systems (SGR); the standard NP 4406 is the Portuguese standard that establishes criteria and indicators for the implementation and certification of sustainable forest management systems. They are all optional.

Brief description of the technology developed/apply

The standards mentioned before establish the requirements for the implementation and certification of management systems.

State of the good practice

There are several organizations with these management systems in place and certified.

Major difficulties during the implementation

Obligation to fulfil with all legal and other requirements to which the organization subscribes; define appropriate methodologies for meeting the established requirements; absence of robust information systems that provide the data necessary for the construction of indicators easily and quickly.

Implementation time

6 months – 1 year

Results obtained / expected

The implementation and certification of environmental management systems and / or risk management systems and / or sustainable forest management systems will clearly contribute to the control of environmental aspects that may give attention to environmental impacts with a particular impact on water resources.

Cost and profits obtained / expected

Organization and systematization of updated information; compliance with legislation; improving the image of organizations.

Other possibilities of application

Monitoring and support for planning the processes and activities of organizations.

Good Practice 09: NOR-WATER Emerging pollutants in the waters of Galicia - Northern Portugal: new tools for risk management

Designation of the good practice

NOR-WATER project - Emerging pollutants in the waters of Galicia - Northern Portugal: new tools for risk management

Context of application

The focal purpose of the project is to identify the main emerging pollutants (PEs) and their sources in the basins of Northern Portugal and Galicia, in addition to developing, implementing and harmonizing a set of innovative multidisciplinary tools to mitigate the impact of PEs on these masses of water. The project will contribute to the improvement of water quality and enhance the implementation of the WFD in this cross-border context. The project aims to:

- Identify the main PEs, including compounds derived from fire runoff, as well as their sources and their transformation products in the hydrographic basins of Northern Portugal and Galicia.
- Develop new analytical methods, ecotoxicological tools and prediction and modelling tools for PEs with the greatest potential risk in ecosystems.
- Evaluate the effectiveness of wastewater treatment plants, to eliminate PEs and develop tools to improve treatment systems and increase the efficiency of removing PEs.
- Transfer the results to entities that have competence in implementing the WFD, in the management of inland and coastal water bodies, and to technological companies in charge of water purification. In parallel, it is intended to carry out cross-border environmental education activities, thus contributing to a change in behaviour in civil society.

Brief description of the technology developed/apply

The technological tools in development take into account different parameters / variables to support modelling, focus on chemical compounds in greater concentration in the waters under analysis and intended with historical values gathered to support the forecast of the evolution of biomass in aquatic ecosystems.

State of the good practice

Based on the selection of sites decided between the partners, historical data has been gathered, likewise a characterization has been made of these selected sites and two samplings have been collected (in different levels of rainfall and, consequently, flow).

The estuary of the Minho River has been considered among partners as the better place for implementation of the Pilot project, basically by existence of robust historical data since the 1980s.

At the same time, the University of Santiago de Compostela (also a partner of the NOR-Water project) has been analysing and recording PEs in larger concentration in the hydrographic basins of the rivers Sado, Ave, Minho and Lima, as in the hydrographic basins of Galician waters, with about 3200 chemical compounds already listed. These analyses are based on specific analytical protocols for carrying out routine activities, in order to ensure sufficient data for the production of an ecotoxicological assessment

that allow to draw conclusions about the effects of PEs on organisms and in the trophic chains (with greater detail in the Rio Minho Estuary).

Major difficulties during the implementation

Due to budget cuts in the final phase of application submission, the pilot project will be financed by one of the project partners (consulting board) which could affect the analysis and implementation phases and, due to the Covid19 pandemic and related national tighten measures, it could be some delays during the project.

Implementation time

The project began in 2019 and its end is expected in 2021, although the Covid19 pandemic could interfere with the execution deadline initially defined.

Results obtained / expected

Although there are no sharable results until now, taking into account that the project is still on an initial phase, roughly it is expected a list of PEs with the greatest potential risk in ecosystems alongside a higher indicator of the effectiveness of wastewater treatment plants. The goal for the developing tools is them to eliminate PEs, specifically to improve treatment systems and to increase the efficiency of removing PEs on the waste water treatment stations.

Cost and profits obtained / expected

When fully developed, the technological tools will be validated by end users (in real situations), with the respective integration in a Waste Water Treatment Station, where the intention is to reduce the pollutants emerging at the end of the wastewater treatment cycle. Also, the project includes an advisory panel, made up of Portuguese and Spanish institutions, among which EFACEC and Águas do Norte, whom constitute final consumers of these technological tools.

Other possibilities of application

The development of new modelling and ecotoxicological tools to assess the environmental risk of PEs will enable the determination of the bioaccumulation factors of the priority PEs and transformation products (and also of the chemicals derived from the runoff of forest fires identified in the previous activities) and also will enable the use of toxicokinetic models to shape their behaviour in organisms.

Good Practice 10: SIGIMAP - Global System for Innovation and Modernization of Portuguese Agriculture

Designation of the good practice

SIGIMAP - Global System for Innovation and Modernization of Portuguese Agriculture

Context of application

The SIR - Irrigation Information System is a website (platform) under the responsibility of the Directorate-General for Agriculture and Rural Development (DGADR) as the National Irrigation Authority and this system was initiated by the Central Administration. It is dynamic and intends to join the knowledge of all the actors in the sector, of which the DGADR, the Regional Directorates for Agriculture and Fisheries, the Management Entities of hydro-agricultural developments and even private entities and companies comprise.

The main beneficiaries of this system are Irrigation Associations and this system started its activity with eight pilot associations, chosen for presenting, to date, greater technical capacity and data for perform the analysis of the SIGIMAP platform.

Brief description of the technology developed/apply

The platform presents a GIS nature, allowing the visualization of data geographically (via satellite maps, military charter, among others), such as the use of tools commonly associated with GIS such as measuring and querying attributes. It is important to mention that SIGIMAP platform enables both downloads and data upload by the entities (shapefile; .xls), but it does not allow them to view or download the data of the other entities.

State of the good practice

The SIGIMAP platform is organized into six modules, namely:

- the irrigation potential module;
- the cultural aptitude module;
- the irrigation management module;
- the integrated management module;
- the territorial management module;
- the performance module.

In these modules, various tools existing on the platform can be applied such as the humidity index or the classification of protected areas in order to deeply analyse and compare the information uploaded.

The irrigation potential module allows the analysis of the irrigation installation potential by type of crops, based on classes from high to zero potential.

In the cultural aptitude module, the analysis considers crops, spending and production efficiency by crop.

The irrigation management module it is possible to introduce the irrigation system / network for an agricultural exploitation and based on two representations, the geographical network or the schematic network, the platform allows the calculation of water volume used, quantification and location of water losses in the network, the water quality in relation to the different components of the same and at the different water distribution points, among others.

The integrated management module allows a comparison of efficiency between entities for different cultures (not disclosing the identity other entities in comparison).

The territorial management module facilitates processes of exclusions and inclusions of agricultural developments, as well as land use changes. The platform simplified the administrative procedure and reduced the time required.

The performance module allows financial analysis, as well as the presentation of budgets for entities using cost indicators, considering that the level of detail of the analysis depends on the specificity of the data uploaded.

Major difficulties during the implementation

The major difficulties encountered during the implementation of the SIGIMAP platform are the lack of data associated to the north territory of river Tejo, due to the non-existence information about soils and

climatological indicators. This absence makes the process of analysis difficult; although the tendency of the platform is to increase the detail of analysis during implementation time. Despite that fault, DGADR already has a partnership protocol with the IPMA (national weather entity), in order to overcome the problem as soon as possible, and also is expecting that in 2021 will acquire updated national data on soils.

Other difficulty is related to the lack of data owned by the irrigation entities which becomes the conceivable analyses poor in comparison with the possibilities of the platform functions. However, in the annual report of mandatory cropping by the DGADR, most of the data required for the platform is already necessary and therefore, if complementing the report information with the platform information it could facilitate the upload of data into the platform later and improve its use by irrigation entities.

Implementation time

This system was initiated in 2018 and its still being reenforced with information and new functions, it is an ongoing project being improved as possible during time.

Results obtained / expected

This system aggregates a part of the knowledge about national irrigation, that corresponds to the hydro-agricultural developments. Also, it is intended that this system function as a tool for work and dissemination of knowledge that allows the improvement of planning and management of the irrigation sector in Portugal.

Cost and profits obtained / expected

There are many subsequent benefits from the analysis produced by the SIGIMAP platform related to the hydro-agricultural developments, however the most important is the increase of the water efficiency use and the percentual decreased costs associated with a better management plan of the crops, water use, irrigation networks, among others.

Other possibilities of application

The platform also comprises information about national dams, the project Alqueva Agrícola and its intervention pan (will make it possible to boost the transformation of vast areas of rainfed land into irrigated areas and to carry out competitive cultures, leading the Alentejo region to stop being one of the most depressed in the country, to become one of the regions that makes the greatest contribution to the National Agricultural Product), legislation about hydro-agricultural developments and other information of related importance.

6.6 France - Cluster DREAM

Good Practice 01: Regional cooperation (public research centers, private bodies, public entities) to promote new and innovative projects for a better management of water resources

Designation of the good practice

Regional cooperation (public research centers, private bodies, public entities) to promote new and innovative projects for a better management of water resources. Identification of skills in the territory to promote innovative projects for a better management of water resources and animation/start-up of this territorial network.

Coordinating and animating multi-partnership regional cooperation in the 'water and digital' field.

Context of application

- a rich ecosystem / a territory network with public and private actors working in isolation on the field of water resource management for common objectives
- a lack of link between the local needs and the existing skills in the territory
- the cross-cutting of water and digital issues and the lack of connection

Brief description of developed/applied technology (applicable)

The territory of the Centre Val de Loire Region gathers complementary and mobilizable skills to achieve good status (or higher) of the water bodies. The connections between these local stakeholders have been structured in order to have the entire value chain in the "water and digital" field. Thanks to this structuration, the Region becomes unique in the development of innovations for a smart water management, as proved by the public and private entities and worldwide renown in this sector in the territory. The connection between private, public and academic actors proved to be a powerful tool and a good practice to improve the one between water and digital.

The cooperation with all the actors “Water & ICT” in the territory is successful thanks to the following approach:

- local skills identification among the private and public actors working in the water and ICT sectors and organization of this new ecosystem
- Organization of targeted meetings to assess existing needs and tools or to be developed.
- Development of cooperation tools for multi-partner regional cooperation: collaborative projects, new regional infrastructure (JUNON, PIVOT, DREAM Cluster, DIH)

State of the good practice

Validating the concept/constantly evolving in order to suit to the local stakeholders needs.

Major difficulties in implementation

Network organization

Implementation time

Creation of the DREAM cluster “Water & Environment” in 2010 that materialized regional cooperation/in brainstorming well before.

Results obtained / expected:

Development of a unique ecosystem in France to improve territorial “Water & ICT” synergies and to connect the management of the water resource and the ICT innovation.

The “Water & ICT" collaborative project in the territory: Within this framework, since 2010, 12 public-private collaborative and local projects dedicated to “water & ICT” emerged on the territory. These projects were supported by the DREAM cluster. DREAM Cluster plays a key role in the implementation of regional innovation strategies by gathering almost 100 main private and public regional and national actors in the field of water management. The cluster can rely on:

- very strong local policies for water and its environment
- national and international reference centers on knowledge of water resources
- the presence and expertise of major companies' water and major industrial sectors using environmental technologies and services developed within the cluster DREAM Cluster is well-set up at the Centre-Val de Loire Level Region and are so influence the PI addressed

The creation of regional infrastructures (PIVOT and JUNON) promoting synergy of academic actors and the enhancement of scientific results in tangible economic data:

The good practise contributes to develop territorial projects such as *PIVOTS program*

As part of the European smart specialization policy, the Center-Val de Loire region has been supporting the PIVOTS (Platforms for Innovation, Valorization, and Environmental Technology Optimization) program since 2016. The project is carried out by the BRGM (France's reference public institution for Earth Science applications in the management of surface and subsurface resources and risks.) with other public and private structures (University of Orleans, the French National Centre for Scientific Research, ANTEA).

Objectives:

- Creating a center of excellence and scientific collaboration (7 platforms) to address major environmental issues in the field of air, water and soil.
- Transfer of research and development knowledge to the economic world.

Several technologies/processes are distinguished by platform. For example, the platform development of sensors for detecting pollutants, clean-up processes foster the development of technologies in this sector.

The added value for the development of "ICT & Water" thematic:

- the emergence of a new regional scientific dynamic
- the creation of regional infrastructure.
- Gathering, throughout the entire value chain, public and private actors in environmental quality monitoring and management sustainable use of natural resources (soil, subsoil, surface water, groundwater, sediment, air) (Programme ARD CVL JUNON Document Stratègique Global 2020).

The good practise contributes to develop territorial projects such as *JUNON project*

Since 2019, based on the needs of the public and private stakeholders in the Centre-Val de Loire, a new territorial project emerged and will strengthen the "Water & ICT " thematic. The JUNON project aims at developing a research and excellence center focused on the use of Artificial Intelligence in environmental issues. With the PIVOTS program (ARD 2020 program of the Center-Val de Loire Region), it will develop new innovative services in the digital and environmental metrology sector. Within these projects, "Digital Twins" will be created for increasing the capacity for monitoring and predicting regional natural resources (including water resources). JUNON will focus on water (quantity and quality) as well as on gas flows and air quality at the soil interface considering these two resources (Water and Air) as priorities for local populations and economies (Programme ARD CVL JUNON Document Stratègique Global 2020).

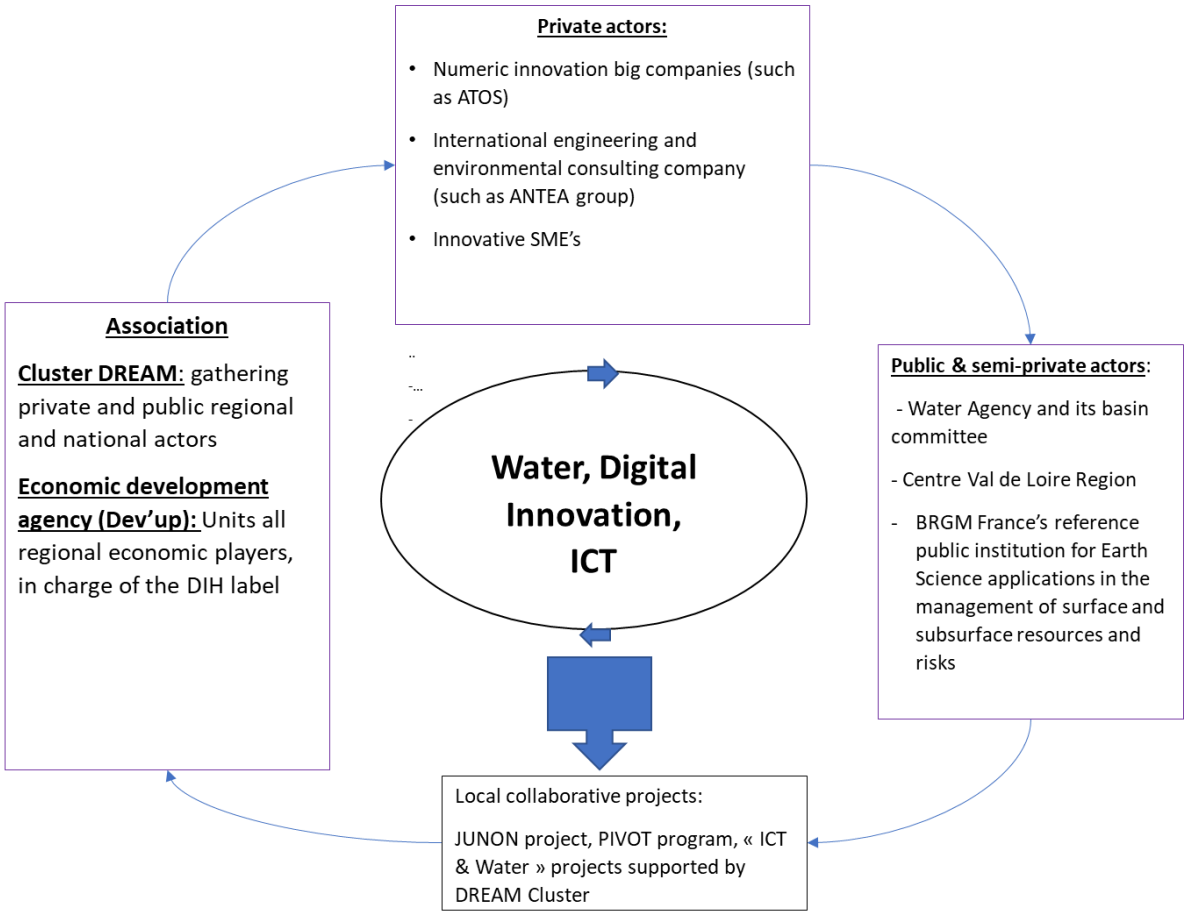
Integration of the ecosystem in a wider network: The mobilization of the ecosystem in other networks or programs such as the European digital innovation hub (DIH) label. A DIH is a multi-partner regional cooperation and aims at identifying by skills, in the region, the different technologies and stakeholders' activities for new technologies (Porteneuve 2020).

Costs and benefits obtained/expected

Subsidies of the Centre Val de Loire Region from the PIVOTS program: 6,299,386 euros for a program of 14 Million euros. For the project supported by the cluster DREAM: around 766,000 euros in grants for a total average amount of 1,868,000 euros.

Monitoring of water resources: vital issue for the sustainability of the territory

Figure 88 | The ecosystem in the Region Centre-Val de Loire leading to the emergence of a "Water & ICT" collaborative



Good Practice 02: Centralize/collecting water quality data

Designation of good practice

Centralize/collecting water quality data

Application context (problems that were the source of good practice)

The environmental monitoring process is generating more and more digital data. For example, the thousands of stations managed by the Loire-Bretagne and Seine-Normandie water agencies generate an impressive number of data for physico-chemical quality (generally 6 to 24 samples per station) and hydrobiology (biodiversity) crossed with sensor data (hydrometry, piezometry) (Pierre 2020).

Brief description of developed/applied technology (applicable)

In view of the quantity and diversity of the many sources that exist concerning data on water bodies, one of the objectives on Loire's Centre-Val region is also to centralize data of the various physico-chemical parameters. In order to make them interoperable to have a clear and integrated vision of the state of the environment and develop reliable models.

State of good practice

Validation of concept

Major difficulties in implementation

Recover data from different sources and standardize the data collected

Implementation time

On going with the development of several smart tools

Results obtained/expected

A web service has been developed in Orleans called “Hubeau” https://hubeau.eaufrance.fr/and provides access to data on fish, water quality, hydrometric, temperature, etc.

The goal is to provide Rest APIs that facilitate access to SIE data. The format obtained is easier to use.

Data collected on the territory [example of contracts and SAGE monitored by the EPTB] Multi-partners: specific data can come to specify the degree of information (example: addition of agricultural data).

Costs and benefits obtained/expected;

Saving of time and cost: Ease of remote use by the actors on the ground making it possible to react quickly to envisage a rapid intervention in the event of problem [example of the Wave Network: a network of quantitative observation of watercourses which has developed an application on the phone. This application gives people in the field the opportunity to fill in real time information on the state of rivers (eg low flow, pollution, etc.).

Other application options

Not applied.

6.7 Lithuania - Kaunas University of Technology (KTU)

Good Practice 01: Floating Island for nutrient removal

Designation of the good practice

Constructed floating islands are increasingly applied for water restoration and creation of natural floating riverbanks. Greener coastal cities contribute to nutrient removal capacity.

Context of application

Klaipeda city (Lithuania) contains fortification fragments (such as reconstructed Jonas Hill, Goldern's bastion of 17th century) that are nowadays used as popular visiting sites close to the old town and new built living houses. Enclosed embayment suffer from limited exchange of water with the main Dane River canal as well as accumulating nutrients and poor water quality. Therefore, the floating mats could be an extra space for plant growth with water restoration effects.

Nutrient removal by floating island would contribute to overall water quality management in the coastal areas of south-eastern Baltic Sea.

Brief description of the technology developed/apply

Constructed floating island is an eco-engineering solution applied for water restoration and creation of natural floating riverbanks in the cities. Wetland plants are supported by artificial buoyant mats. Nutrient rich water is treated by bacteria attached on the plant roots performing nitrification/denitrification (release of N_2 gas), biological breakdown and detoxification. Roots and installation itself enhance particle retention. As a result increased water clarity, reduced algae and cyanobacteria growth as well as reduced nutrient levels could be achieved. The increased habitat and food availability further enhances aquatic food chain and partly restores deteriorated biodiversity in turbid waters. In addition, floating wetlands provide habitats for aquatic and terrestrial fauna (insects, birds) as well as number of cultural aesthetic services.

State of the good practice (proven/test phase/concept validation)

The floating island of the total area of approximately 28 m^2 installed in Dane River or river embayment. In addition, we need to collect 2000 euros as maintenance costs for 3 ys, which includes costs for mooring, planting, harvesting, replanting the damaged vegetation etc.). We have this price estimation as a result of experience based on the already installed islands in the Curonian Lagoon.

Major difficulties during the implementation

Not applied.

Implementation time

The installation of an island is in May 2020. The maximum growth could be reached in ~July. The growth and succession of vegetation could be documented in pictures. The first harvest and weight recording are in late September 2020. The cumulative harvest will be announced on the website.

Results obtained/expected

The quantified nutrient reduction/removal is 0.14 kg for 1 year(s).

The nutrient removal capacity of the island is the sum of nutrients accumulated in the aerial biomass (stems and leaves) and underwater biomass (roots), nitrogen loss by microbial activity, phosphorus uptake by microorganisms and sedimentation. Our estimates of plant biomass and nutrient content in the harvest from the 28 m2 island installed in the Curonian Lagoon equals to 103g of N and 5g of P/m2. The aerial biomass could contribute only ~10% of nutrient removal while the rest is accounted for root-associated microbial community. Therefore, we could assume that annual removal of 28 m2 could be 2870g of N and 140g of P. For 3 ys respectively 8610g of N and 420g of P.

Plants will be harvested each year. Fresh weight of plants will be estimated and converted to P units, the report on the impact of an island will be announced on the Nutribute platform.

Cost and profits obtained/expected

For an island there is a need a sum of ~10 000 euros, which we have within LiveLagoons project funds (about the project: http://www.balticlagoons.net/livelagoons/).

Good practice 02: Solutions of Stormwater Management: Kretinga town surface (stormwater) runoff infrastructure development



Designation of the good practice

While implementing the developed programme of measures to reduce pollution of surface water bodies in the Akmena–Danė River Basin, the Institute initiated the implementation of specific measures in the river basin from the EU funds: the development of the special plan for Kretinga town stormwater management and construction of the two specified experimental wastewater treatment facilities from the stormwater runoff dischargers by installing the natural stormwater treatment measures – retention ponds / wetlands planted with the selected vegetation.

Context of application (problems that were on the source of the good practice)

The Pastauninkas stream collects the flow of 253 l/s from the area of 9.35 ha surface drainage (discharger K11 (K-12)), while only the initial, the most polluted wastewater flow – 40 l/s – needs treatment, since the other part of stormwater in most cases is not polluting. The following surface water management facility was formed:

Brief description of the technology developed/apply

The flow rate near the Akmena River, Kranto g. (discharger K-25) reaches 309 l/s from the area of 8.44 ha, while only the initial flow – 50 l/s – needs treatment. The following technological solution was chosen:

- 1 Installed: flow distribution well, pre-dam, retention pond, flow accounting and sampling well, groundwater monitoring well;
- 2 In order to ensure the facilities' conformity to architectural and aesthetic aspects (the landscape) of the area and to ensure slow surface water flow and pollutant settling, it was resolved to make ponds with small bank slopes;
- 3 The pond terraces are planted from the inlet to the outlet.

The following natural wastewater treatment processes shall take place in both treatment facilities: settling and filtration of suspended solids, organic material absorption on the plants and soil, microbial degradation and assimilation of organic compounds, uptake of nutrients and metal compounds in selected plants.

State of the good practice

The Good practice installed and operates.

Major difficulties during the implementation

Nothing to mention.

Implementation time

The practice was implemented in 2013.

Results obtained/expected

Up-to-date solutions for surface runoff treatment improve water quality and ecological status of the Pastauninkas stream, the Akmena River and, finally the Baltic Sea, at the same time developing new ideas for the stormwater management in other towns and cities and the protection of water bodies.

Cost and profits obtained/expected

Not applicable.

Other possibilities of application

Storm water management in other places.

Note: Also, there were identified, and contacts received about the good practices implemented in Lithuania with using ICT or GIS, such as:

- Water network management, Real time Data from sensors (IoT);
- Public awareness, Data and App sharing about Water supply and Sever networks;
- Prevention of accidents in Water network, asset management;
- Flood hazards and risk maps;
- Cadastre of Rivers, Lakes and Ponds;
- Water Ouality in Rivers and Lakes;
- Water level monitoring and prediction;
- Monitoring of achievements in Environmental projects.

However, we still need time to contact the GP's owners if they will be interesting to share these GPs.

7. INDICATORS (OF WFD OR OTHERS) MORE RELEVANT FOR EACH REGION

7.1 Spain - Iberian Association of Riverside Municipalities of Duero River

At a national level there is a system of indicators is a set of key measures that characterize the state of the environment and its pressures in Spain. It is part of an effort to synthesize the most relevant information contained in the environmental and anthropic data collected by the Ministry. It summarizes in some 40 variables the most outstanding values and that best characterize the state and evolution of the environment. The effort to design and calculate these indicators goes far beyond their publication, since they are information that is used in the water management process. However, its publication is key to promoting its awareness by society and to promoting its widespread use as a diagnostic and monitoring tool of the main water problems in Spain. This set of indicators are made available to the public through the SIA platform. It should also be noted that, within the scope of their competences, each autonomous region and hydrographic confederation may also define and adopt its own set of indicators. In the following table some of the indicators used by domain are presented.

Table 21 | Most Relevant Indicators

DOMAIN	INDICATOR
Sustainable Development	Physical accessibility of the service (%)
	Economic accessibility of the service (%)
	Population with safely managed drinking water services (%)
	Volume of gross official development assistance for water and sanitation as part of a government-coordinated spending plan (€)
	Volume of net official development assistance for water and sanitation as part of a government-coordinated spending plan (€)
	Proportion of local administrative units that have established policies and operational procedures for the participation of local communities in the management and sanitation of drinking water (%)
	Proportion of local administrative units that have established policies and operational procedures for the participation of local communities in bathing water management (%)

7.2 Greece - Regional Development Fund on Behalf of the Region of Attica

The project is connected with the priority axis 06 “Improving the Quality of Life in the Urban Environment” whose indicators linked to water management are indicated below:

Table 22 | Most Relevant Indicators

DOMAIN	INDICATOR
Improving the Quality of Life in the Urban Environment	Additional population served by improved water supply services
	people in households with a real (not potential) connection to the water supply system.
	Population percentage that has access in a good quality water supply (%)

Investments in the water sector in order to meet the requirements of the Union's environmental acquis and address the needs identified by Member States for investments that exceed those requirements	Additional population served by improved water supply services (number)
	Population percentage that has access in a good quality water supply (%)

7.3 Romania - The National Union of Romanian Entrepreneurs

The relevant indicators for the project are the following:

Table 23 | Most Relevant Indicators

DOMAIN	INDICATOR
Water monitoring purpose	CHE - Chemical status
	DAP - Drinking water - Annex IV.1.i to the WFD
	ECO - Ecological status
	HAB - Protection of habitats or water-dependent species - Annex IV.1.v to the WFD
	INT - International network under another international convention
	INV - Investigation monitoring
	MSF - Monitoring network provided by the Marine Strategy Framework Directive
	NID - Nutrient-sensitive area under the Nitrates Directive26 - Annex IV.1 to the WFD Directive
	OPE - Operational monitoring
	REF - Monitoring point within the reference network
	RIV - International network under a river protection convention (including bilateral agreements)
	SOE - EIONET State of the environment monitoring
	SUR - Surveillance monitoring
	TRE - Assessment of chemical trends
	Total no of monitoring points regardless of purpose

7.4 Sweden - The County Administrative Board of Östergötland

Several indicators are currently used to evaluate the progress of the goals of the Regional Environmental Objectives of Östergötland. Relevant for this project are:

Table 24 | Most relevant indicators

DOMAIN	INDICATOR
All Regional environmental objectives	Percent of all water bodies that reach good ecological, chemical status and

DOMAIN	INDICATOR
	groundwaters reach good quantitative status.
No Eutrophication	Nitrogen and phosphorus loads in the ocean (tonnes in relation to calculated tolerable load)
	Environmental status for eutrophication according to the Swedish Marine Environment Ordinance (The amount of ocean waters over the ecological quotus EQR)
	Precipitation of nitrogen to boreal forests (Deposition in kg/N/hectare)
	Status of nutrients according to the Water Management Ordinance (amount of water bodies reaching good or high status)
	Number of oxygen deprived and oxygen free seabeds (Distribution (area))
Flourishing lakes and streams	Good status for all water bodies (amount of water bodies with good status per cycle)
	Protected liminc areas (number of areas appointed for preservation)
	Buildings close to the shoreline (Amount of new buildings)
	Measures to remove physical barriers (amounts of performed measures)
	Rejuvenation of the freshwater pearl mussels (Amount of watercourses with obsereved rejuvenation)
A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos	Ecological and chemical status of coastal waters (Number of water bodies in good or high status)
	Sustainably exploited fish and shellfish stocks in the coast and sea (Proportion of fish and shellfish stocks that are used in a sustainable way)
	Buildings close to the coastal shoreline (Amount of housing, ancillary buildings and other buildings within 100 meters of the sea shoreline.)
	Marine debris on beaches (the amount of marine debris on unexploited beaches)
	Environmental toxins in herring and baltic herring (the total environmental risk when exposed to a number of known environmental toxins in herring and herring at different sampling stations)

To reach the objectives each indicator needs to improve and this will take time, due to establishment of measures and due to the time of natural restoration. More intermediate indicators that are more administrative could thus be of importance. Currently one indicator is “percent of water catchments used for water supply that have a water protection area”. In addition to these indicators, other relevant indicators need to be developed, such as “Percent of the spatial plans that contain measures to reach good ecological, chemical and quantitative status in the water bodies of the catchment area”.

7.5 Portugal - CIM Alto Minho

The main indicators adopted in Portugal under the Water Framework Directive are listed in the following table.

Table 25 | Indicators adopted in Portugal under the Water Framework Directive

DOMAIN	INDICATOR
Adequacy of interface with	Physical accessibility of the service (%)

DOMAIN	INDICATOR
user	Economic accessibility of the service (%)
	Failure of supply ([number / (delivery point.year)] or [number / (1000 extensions.year)])
	Safe water (%)
	Response to complaints and suggestions (%)
Sustainability Management service	Coverage of total expenses (%)
	Service adherence (%)
	Uninvoiced water (%)
	Adequacy of treatment capacity (%)
	Pipeline rehabilitation (% / year)
	Damage to ducts ([no. / (100 km.year)])
Environmental Sustainability	Actual water losses ([m3/(km.dia)] or [(l/extension.day)]
	Compliance with licensing (%)
	Energy efficiency of lifting installations ([kWh / (m3.100 m)]
	Treatment of water sludge (%)
Water and Sanitation	Water captured by source
	Water Distributed/consumed
	Water Distributed/consumed per inhabitant
	Population with water supply systems (%)
	Population with wastewater drainage systems (%)

7.6 France - Cluster DREAM

In this part of the joint Analytical Report are presented a brief description of the main indicators adopted to assess the level of implementation of RBMP or to assess the water policy in the Centre Val de Loire Region and at national level. The main indicators are listed in the following table.

Table 26 | Most relevant indicators

DOMAIN	INDICATOR
Water Quality	Amount committed for individual aid granted to farmers for the implementation of place of organic farming, payments for environmental services and agri-environment and climate measures (€)
	Number of priority water catchments identified on which funding is provided by the water agency for the implementation of an action plan (unit)
	Performance of phosphorus treatment by wastewater treatment plants (%)
	Quantity of priority and dangerous substances resulting from economic activities, industrial and artisanal, eliminated (kg)
Quantity	Annual volumes collected by use – municipalities, agriculture, energy suppliers, industries (Mm3)

DOMAIN	INDICATOR
Governance	Number of regional contracts validated per year
Drinking water & sanitation	Compliance rate of samples from distributed water carried out for sanitary control compared to quality limits for microbiology (%)
	Compliance rate of samples from distributed water carried out for sanitary control compared to quality limits with regard to physicochemical parameters (%)
	Distribution network performance (%)
	Linear network loss index (m³/km/d)
	Average rate of renewal of drinking water networks (%)
	Water resource protection progress index (%)
	Rate of service by wastewater collection networks (%)
	Rate of sludge from purification works evacuated using channels that comply with regulations (%)
	Average renewal rate of wastewater collection networks (%)
	Knowledge index of discharges into the natural environment by wastewater collection networks (unit)

7.7 Lithuania - Kaunas University of Technology (KTU)

In this part of the joint Analytical Report are presented a brief description of the main indicators adopted in Lithuania in the context of the water policy and rivers management. The main indicators are listed in the following table.

Table 27 | Indicators adopted in Lithuania

DOMAIN	INDICATOR
Improve the status of surface and groundwater bodies	Part of water bodies in good condition (%)
	Number of surface water bodies classified as at risk due to diffuse pollution (in units)
	Number of existing barriers to fish migration (in units)
	Quantity of fish used for biomanipulation to fish water bodies (in tonnes)
	Number of wastewater treatment plants with increased wastewater treatment efficiency to achieve water protection objectives (in units)
Achieve and / or maintain a good state of the Baltic Sea environment	Number of qualitative environmental indicators (out of 11 indicators) that correspond to the state of the Baltic Sea environment (in units)
	Change in the inflow of nitrogen compounds into the central Baltic Sea compared to their inflow in the reference period (1997-2003) (42 029 tonnes)
	Change in the inflow of phosphorus compounds into the central Baltic Sea compared to their inflow in the reference period (1997–2003) (2,271 tonnes)
	Percentage of pollutants exceeding the environmental quality standard - annual average values (hereinafter - EQS) - in water (%)
	Percentage of pollutants exceeding the maximum allowable concentration in bottom sediments (%)

DOMAIN	INDICATOR
	Percentage of contaminants in excess of MV-EQS in biota and seafood (%)
	Percentage change of new non-native animal species entering the Baltic Sea waters under Lithuanian jurisdiction due to economic activities, compared to 2000–2012 (%)
	Average annual amount of litter discharged to the shore of the Baltic Sea and accumulating at the shoreline per 100-meter stretch of beach (in units)
	Continuous ambient noise level in the waters of the Baltic Sea under the jurisdiction of Lithuania in the 63/125 Hz 1/3 octave frequency bands
	Share of dumping and sand excavation areas in the Baltic Sea (as a percentage of the total seabed habitat area (138,497 hectares)) (%)
Provide the country's population with high-quality public drinking water supply and wastewater treatment services and to reduce environmental pollution with wastewater	Availability of drinking water supply services, percent (%)
	Availability of wastewater treatment services, percent (%)
	Percentage of wastewater collected up to the set requirements
	Number of wells where fluoride concentrations in drinking water are exceeded (in units)
	Renovated water supply and sewage collection networks (in kilometres)
	Percentage of surface wastewater treated up to specified requirements (%)
	Percentage of violations of legal requirements in the field of water (%)
	Percentage of Lithuanian population well informed about water (%)
	Number of units of environmental inspections performed in the water sector (In number)

Under Investment Priority 5.3. Investing in the water sector to meet the requirements of the Union's environmental acquis and to address needs, identified by the Member States, for investment going beyond those requirements:

Table 28 | Programme-specific result indicators for the CF

Programme-specific result indicators for the CF								
No	Indicator	Unit	Category of region	Baseline value	Baseline year	Target value (2023)	Source of data	Frequency of reporting
1.	Average total nitrogen concentration in Lithuania's territorial waters of the Baltic Sea	mg/l	Less developed	0.50	2011	0.25	Environmental Protection Agency	Annual
2.	Share of surface waters of good status	%	Less developed	54	2010	72	Environmental Protection Agency	Annual

The quality of water in Lithuania's rivers has improved significantly over the past decade thanks to large investments in wastewater management system; however, the Curonian Lagoon, the Baltic Sea shore, about two-thirds of Lithuania's rivers and about one-third of lakes do not meet the requirements for a good status of water yet (in 2012, the share of water bodies of good water status accounted for 54%).

The main factors of human economic activities having an impact on the status of surface water bodies are the diffuse pollution and point source pollution (municipal and industrial wastewater discharged from a specific source of pollution), and on the biodiversity of the Baltic Sea – human activities at sea and pollution accidents.

In line with the Marine Strategy Framework Directive, the Water Framework Directive and the Helsinki Convention 1992 on the Protection of the Marine Environment of the Baltic Sea, Lithuania's strategic goal in the field of water protection is to achieve, by 2020, a good status of the Baltic Sea area in its jurisdiction, in the Curonian Lagoon, and in about ¾ of its inland surface water bodies.

These goals will be pursued by continued monitoring of the quality of Baltic Sea water and other waters, research activities and implementing measures aimed at improving the ecological and chemical status of waters, as envisaged in river basin management plans. These measures will contribute to the goals, provisions and key actions set by the Commission Communication "A Blueprint to Safeguard Europe's Water Resources", the Directive for Maritime Spatial Planning and the EU Strategy for the Baltic Sea Region, addressing the challenges faced by the aquatic environment and ensuring sustainable growth and use of resources.

The envisaged investment will create the conditions to improve the status of surface water bodies and the Baltic Sea. Continued cooperation with the neighbouring states within the Helsinki Commission and under various EU and intergovernmental agreements will contribute to the achievement of successful results.

The achievement of good environmental status of surface waters and the Baltic Sea will depend greatly on the management of diffuse pollution and the application of good farming practices in agriculture.

Under Investment Priority 5.3.2. Enhance accessibility of water supply and wastewater treatment services and improve efficiency of the system:

Programme-specific result indicators for the CF								
No	Indicator	Unit	Category of region	Baseline value	Baseline year	Target value (2023)	Source of data	Frequency of reporting
1.	Accessibility of water supply services	%	Less developed	76	2012	90	Ministry of the Environment	Annual
2.	Accessibility of wastewater treatment services	%	Less developed	67	2012	90	Ministry of the Environment	Annual

In urban areas, the share of households with access to drinking water supply and wastewater management services is quite large (97.8% and 96.5%, respectively, in 2011). Agglomerations with over 2,000 population equivalent have urban wastewater collection systems where 98% of the wastewater collected is subject to secondary treatment, 85% to treatment under stricter requirements (tertiary). However, better availability of good quality water supply and wastewater management services is still relevant in smaller agglomerations (in rural areas, households with access to water supply and wastewater management services accounted for 68.1% and 61%, respectively).

In Lithuania, there are 1,267 settlements with the population between 200 and 2,000. Inhabitants of these settlements account for 20% of the Lithuanian population. Their drinking water supply and wastewater treatment systems do not meet requirements of EU Water Framework Directive 2000/60/EC and EU Urban Waste Water Treatment Directive 91/271/EEC. Some of these settlements discharge wastewater to surface water bodies partially treated or untreated, thus making an adverse impact on the state of

surface water bodies. The status of 45% of the Lithuanian surface water bodies is satisfactory or poor. To improve the status of these water bodies, it is crucial to set a priority of investing not only into large settlements, but also into settlements with the population below 2,000. It will ensure the compliance of services provided to consumer with health, environmental and quality requirements as well as public supply of drinking water and the provision of wastewater treatment services, in optimal conditions and at optimal prices, to a maximum number of people and other potential users (reaching a long-term target of 95% of the population), which will also contribute to the implementation of ITI development programmes.

Currently there are 359 suppliers of drinking water in Lithuania; they cover 98% of Lithuania's territory, but only 73 of them are engaged in water supply and wastewater management as their principal activity. The cost of services provided by these enterprises vary greatly: in larger agglomerations, enterprises can offer lower prices to consumers due to better management and the economy of scale, while enterprises based in rural areas incur higher costs and do not have the possibility to ensure adequate quality of services and to implement the cost recovery principle. To reduce the gap between urban and rural areas in terms of public supply of drinking water and wastewater management services, measures must be taken to improve the management of water supply companies and optimise their operations.

Investment in the availability of water supply and wastewater management services and in the improvement of efficiency of the system will ensure water efficiency, reduce losses in the distribution networks and the wear and tear of water networks, ensure the implementation of the "polluter pays" principle and the cost recovery principle and reduce point source pollution, all this contributing to the improvement of the status of surface water bodies and the Baltic Sea.

8. STAKEHOLDERS

Within the scope of Interreg Europe projects, for each policy instrument addressed, a stakeholder group is created. The stakeholder group ensures that interregional learning does not only take place at individual level, but also at organisational and stakeholder levels. In most cases, a single organisation cannot achieve changes in policy. Since the policy-making process is complex, with a variety of players involved, it is important that these stakeholders take part in the interregional learning process. This group has therefore an intra-regional focus and is constituted by players from each region. Some of these stakeholders may be those who implement measures of the action plan later on.

The Local Stakeholder Group (LSG) members' main role is to follow up the regional action plan elaboration and validation (of the final version). They will participate in the interregional workshop where all partners' action plans will be presented and discussed presenting their perspectives of the work developed and the lessons learned during the project implementation. They also participate in the definition of the contents of the knowledge transfer seminars and some of them will be invited to make part of them. They are central agents in the dissemination of the project results and outputs, and participate in all relevant communication actions organized in their region.

In this part of this document the LSG more relevant to each policy instrument addressed by the project are identify for each partner.

8.1 Iberian Association of Riverside Municipalities of Duero River

The LSG relevant for policy instrument addressed by AIMRD in the project (ERDF Regional Operational Programme Castilla-León) is composed of the following entities:

- Junta de Castilla y León (JCYL);
- Representatives of the counties of the Castilla y León region (Ávila County Council, Burgos County Council, Léon County Council, Palencia County Council, Salamanca County Council, Segovia County Council, Soria County Council, Valladolid County Council, Zamora County Council);
- The 42 Municipalities associated of the AIMRD;
- Duero Hydrographic Confederation (CHDuero);
- The Regional Federation of Municipalities and Provinces of Castilla y León (FRMPCL);
- Sociedad Pública de Infraestructuras Y Medio Ambiente de Castilla y León (SOMACYL).
- The University of Valladolid (Universidad de Valladolid – UVA);
- The Regional Development and Coordination Commission of North of Portugal (CCDR-N).

All these stakeholders have participated in the preparation of the ROP Castilla y León (AIMRD policy instrument addressed) due to their knowledge about the regional reality or their relevance for the implementation (and results achievement) of the policy instrument, also some of these stakeholders will be who implement the measures of the action plan later.

The Stakeholder Group pursued to include the managing authority of the policy instrument addressed, the counties of the Castilla y Léon region, the regional federation of municipalities and provinces, the major university of the region, a public institution that works towards the integrated and sustainable development of the Norte Region of Portugal, the association that represents all the municipalities linked by Douro river, the entity dependent on the Ministry of Agriculture and Fisheries, Food and Environment,

in charge of water management in the Duero river basin ant the public organization that aims to guarantee the protection and conservation of the environment.

It is expected that these entities will provide knowledge, expertise and experience (contributions) for the elaboration and implementation of the regional action plan and supports the use of the lessons learnt after the end of the project.

8.2 Regional Development Fund on Behalf of the Region of Attica

The stakeholders are determined by jurisdiction or obligation by law, consumption/usage or due to their objectives (such as research, education):

- Ministry of Environment and Energy
    - Directorate of protection & management of aquatic environment (former Special Water Secretariat).
- Decentralized Administration of Attica
    - Directorate of the Water.
- Region of Attica
    - Directorate of Environment & Climate Change;
    - Directorate of Flood Prevention Works;
    - Directorate of Technical Works;
    - Directorate of Industry, Energy and Natural Resources.
- Managing Authority of Attica ROP 2014-2020;
- Athens Water Supply and Sewerage Company (EYDAP S.A.);
- National and Kapodistrian University of Athens;
- National Technical University of Athens.

8.3 The National Union of Romanian Entrepreneurs

The LSG relevant for policy instrument addressed by The National Union of Romanian Entrepreneurs in the project is composed of the following entities:

- Locally:
    - Administrators and custodians of protected areas;
    - Water body management bodies;
    - Trade companies;
    - Fishing associations;
    - ROMSILVA - Forestry directorates;
    - Municipalities / Local Councils;
    - Universities and research institutes.
- At the county level:

- SGA / ABA (Water Management System / Water Basin Administration);
- County Councils;
- EPA (Environmental Protection Agency);
- DS (Health Directorate).

- At national level:
  - ANAR (“Romanian Waters” National Administration);
  - INHGA (National Institute of Hydrology and Water Management);
  - ANPA (National Agency for Fisheries and Aquaculture);
  - ANANP (National Agency for Protected Areas);
  - Ministry of the Environment;
  - Ministry of Water and Forests.

8.4 The County Administrative Board of Östergötland

The LSG relevant for policy instrument addressed by The County Administrative Board of Östergötland in the project is composed of the following entities:

- Representatives from the municipalities in the region;
- Representatives from the water councils in the region;
- Representatives from the County Administrative Board.

Municipal authorities play a role by securing support for developing and implementing measures to attain the environmental objectives, in a dialog with local people and stakeholders and in their own activities. The water councils consist of representatives of landowners, municipalities, local fishing organisations, water management organisations, farmers etc. and constitute an important link between the local agents and the authorities. The County Administrative Board of Östergötland has experts on water management and energy and resource efficiency, responsible for the regional environmental objectives of Östergötland and the regional implementation of the Water framework directive.

All stakeholders are linked with the policy instrument addressed (Regional Environmental Objectives of Östergötland), and will have a key role in the interregional learning process of the project - each one of them has its own role and perspective, from regional to local and both public and private levels, they will incorporate in the action plan definition. CAB will transfer to them the new knowledge and best practices found during the project implementation and get LSG support in adapting it to local reality and needs (aiming at improving to the regional policy instrument). Also based on the project findings, the municipalities will also incorporate these changes/improvements in their local policy instruments. Our ambition is now to work closer together with the policy instrument as well as with the good practises. Through regularly contact, dialog and meetings, the stakeholders will make suggestions and recommendations on the development of the policy instruments and action plans. They will be also invited to participate in the regional events of the project and in the knowledge transfer seminars.

8.5 CIM Alto Minho

The Local Stakeholder Group (LSG) relevant for policy instrument addressed by CIM Alto Minho in the project (Alto Minho 2020 Strategy & Action Plan) is composed of the following entities:

- Portuguese Environment Agency (APA) / Northern Hydrographic Region Administration (ARH North);
- Águas do Alto Minho (AdAM);
- Northern Agriculture and Fisheries Regional Directorate (DRAPN);
- General – Directorate for Agriculture and Rural Development (DGADR);
- Port Authority of Douro, Leixões and Viana do Castelo (APDL)
- European Grouping of Territorial Cooperation Rio Minho (AECT Rio Minho)
- Integrated Rural Development Association of Lima (ADRIL)
- Integrated Rural Development Association of the Minho Valley (ADRIMINHO)
- Polytechnic Institute of Viana do Castelo (IPVC)
- Captaincy of the Port of Caminha;
- Associated municipalities of CIM Alto Minho: Arcos de Valdevez Municipality; Caminha Municipality; Melgaço Municipality; Monção Municipality; Paredes de Coura Municipality; Ponte da Barca Municipality; Ponte de Lima Municipality; Valença Municipality; Viana do Castelo Municipality; Vila Nova de Cerveira Municipality.
- Rio Minho Aquamuseum;
- Atributo Business Center (ABC).

All the stakeholders are linked, more or less directly, with the policy instrument addressed (Alto Minho 2020). The Stakeholder Group sought to include the national water authority, the national agriculture and fisheries authority, the entity active in the water supply and sewerage areas, a public institution that works towards the integrated and sustainable development of the Norte Region of Portugal, European Territorial Cooperation Groups, regional development associations, centres of knowledge creation / universities, a regional port authority, a business centre linked to the Territory and the associated municipalities of CIM Alto Minho. These entities will provide knowledge, expertise and experience (inputs) for the elaboration and implementation of the regional action plan and supports the use of the lessons learnt after the end of the project.

8.6 France - Cluster DREAM

In the Centre Val de Loire Region, the stakeholders involved in the project are:

- Public authorities: the Regional Council is the authority responsible for the political instrument.
- State administrations:
    - Ministry of Research (DRRT)
    - Ministry of Industry and Labour (DIRECCTE).
- Innovation agency:
    - The economic development agency of the Central-Val de Loire Region, Dev'up supports all companies or economic project carriers and is in charge of monitoring the Region's smart specialization strategy.
- Research organizations:
    - University of Orleans and in particular the "Interface, Confinement, Materials and

Nanostructures (ICMN) platform.

- National Institute for Agricultural and Environmental Research (INRAe).
- The Bureau of Geological and Mineral Research (BRGM) is a public institution of an industrial and commercial nature. It is jointly under the supervision of the Ministry of National Education, Higher Education and Research of the Ministry of Environment, Energy and the Sea and the Ministry of Economy, Industry and Digital.

- Private actors:
  - ATOS aims to achieve digital transformation, innovation and value creation and is involved in the S3 priority of the 2014-2020 FEDER Centre-Val de Loire operational programme.
- Public entities:
  - The Regional Agency for Biodiversity aims to bring about collective actions to preserve environments and species and to raise awareness of biodiversity issues. The agency capitalizes and shares useful scientific and technical information to guide the decisions of public and private actors.
  - The Loire-Bretagne River Basin Water Agency, provides financial and technical assistance for actions of common interest in the service of water and environment. The water agency provides to elected officials and watershed users with an overview of water management issues and the financial means to undertake a coherent policy.

The combination of these private and public organizations allows the emergence of diverse and complementary ideas.

8.7 Kaunas University of Technology (KTU)

The LSG relevant for policy instrument addressed by Kaunas University of Technology in the project is composed of the following entities:

- Ministry of Environment of the Republic of Lithuania;
- Environmental Protection Agency (EPA) (implementing policy institution);
- Lithuanian Energy Institute (Laboratory of Hydrology);
- Kaunas City Municipality;
- Association of Local Authorities in Lithuania (ALAL);
- Vandens tiekėjų asociacija (VTA) (National Water Association);
- HNIT-BALTIC Lithuania;
- Klaipėda University;
- Baltic Environmental Forum Lithuania.

Ministry of Environment of the Republic of Lithuania is the main managing authority of the Government which forms the country's state policy of environmental protection, forestry, utilization of natural resources, geology and hydrometeorology, territorial planning, construction, provision of residents with housing, operating utilities, as well as coordinates the implementation of government policies.

The Environmental Protection Agency as an implementing body of the Ministry deals with drafting the National Environmental Strategy and other specific programs regarding the efficient use of water

resources and wastewater management organizing its implementation and preparing measures related to the implementation of the national water policy. Together with the Ministry of Environment, they bear the main responsibility for the implementation of the addressed policy instrument. They both are interested in learning on EU policy development and in getting experience regarding policy instruments and support schemes as well as implementation mechanisms with proven efficiency in comparable EU countries.

The City of Kaunas, Klaipėda is committed to reduce pollution in surface waters. Based on their previous experience in implementing measures, Kaunas city municipality and Kaunas region will be invited to take part in working out good practices and supporting KTU in influence the improvement of PI proposed by the project.

The Laboratory of Hydrology, regular participant of European thematic networks, discussion, performs applied research, cooperates with business, governmental and public institutions. It will be a key contributor to the content work to be delivered together with Kaunas Regional Environmental Agency performing water quality control and thematic studies on water issues. Both will be regularly invited to share knowledge and experience regarding water treatment and water quality.

The local stakeholders' group are involved in a targeted way in project activities to be part of interregional learning, namely the site visit to be held in Lithuania, where they will interact with the project partners, exchange experiences and good practices and explaining them their regional reality.

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