



WATER QUALITY IN THE UPPER AND MIDDLE HYDROGRAPHIC BASIN OF THE ARGES RIVER

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Abstract

The growing pressures on the water resources have imposed the realization of legislative instruments for their protection and sustainable management on a European level. The Framework Directive 2000/60, defining **water** as a **patrimony** that needs to be *protected, dealt with and preserved* as such, assures the necessary framework for a sustainable water management. The qualitative monitoring of the waters of the upper and middle Arges basin, in order to attain the environmental goals, is carried out in 47 sections (24 river sections, 16 lake sections, 7 drillings for underground waters). This allowed for the definition of its ecological and chemical condition. For the year 2010 under analysis, the quality classes to which the water bodies corresponded were “good” and “moderate”.

Keywords: Arges, water body, monitoring, ecological condition, chemical condition

INTRODUCTION

The upper and middle hydrographic basin of the Argeș River lies in the center south of Romania, being limited to the north and south respectively by the 45°36' and the 44°50' parallel, and to the east and west respectively by the 24°30' and 25°28' meridians. From the perspective of the altitudes it goes through, it presents very various altimetric indexes, including the highest Carpathian Mountains (namely Făgăraș Mountains: 2543m), and it unfolds up to around 300m (the High Plain of Pitești).

According to the “Cadastral Reference System for Waters in Romania” (*Atlasul cadastrului apelor din România*), the hydrographic basin of Argeș totals a number of 175 water courses recorded in the cadastral reference system, summing up a total length of 4579 km and an area of 12550 km².

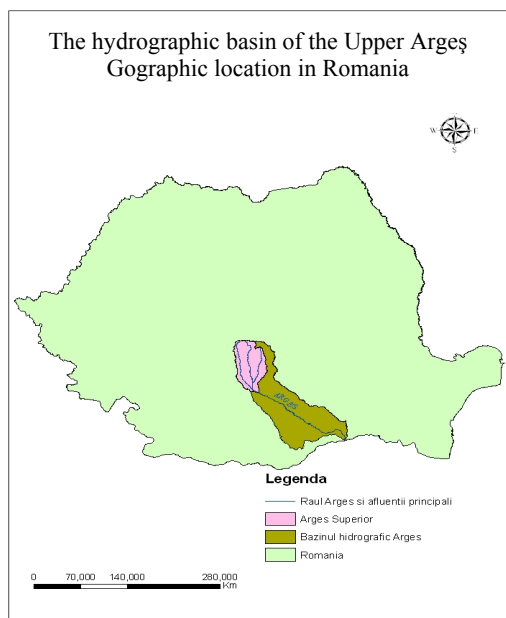


Figura nr. 1

However, in this paper, we will deal only with the upper and middle basin of Argeș River, namely from its sources to the Golești storage lake, an area covering 3261 km², comprising a number of 19 first order tributaries, and including the most important of the confluence zones of the Argeș River, namely that of Pitești.

Fig. 1. Geographic setting

Legislative aspects

On the level of the European Union, because of the increasing pressures on the water resources, legislative instruments were promoted for their sustainable protection and management. These instruments are in force for all the EU member states.

Out of these instruments, the most important is the Framework Directive 2000/60, which defines **water** as a **patrimony** that needs to be protected, dealt with and preserved as such.

This directive assures the necessary framework for a sustainable water administration, through a quantitative and qualitative water control and healthy ecosystems, its purpose being to reach a “good condition” as far as waters are concerned until 2015.

Having in view the strategic goal of protecting, preserving and restoring the water resources in order to attain the “good condition of the waters”, it has become necessary to adopt a new water monitoring and assessment strategy, both for surface and for underground waters.

So, beginning with the year 2006, a new monitoring system has been established, a system supporting the realization of the environmental goals established by the Framework Directive and by the other water-related directives.

The modernization and development of the National Integrated Water Monitoring System is a complex activity consisting in:

- Determining the monitoring subsystems (the subsystem “rivers”, the subsystem “lakes”, the subsystem “underground waters”, polluting sources)
- Determining the environments under analysis (river, lake, underground water, pollutants’ water; biota for rivers and lakes, sediments for lakes)
- Determining the structure from a spatial perspective (determining the sections to be measured)
- Defining the types of monitoring

For rivers and lakes: **S**= surveillance monitoring;

O= operational monitoring;

R= reference program (reference conditions for each water body in agreement to the demands of the Directive);

CBSD=the best section available (“cea mai buna sectiune disponibila”) – it applies in the case of the water bodies with a single risk category and for which it was not possible to establish any reference section;

P= potabilization – it applies for the sections supplying water from surface waters.

IC=inter-calibration program– sections participating to the European inter-calibration exercise;

ZV= vulnerable zones – sections situated in areas identified as vulnerable to pollution with nitrates;

IH= ichthyofauna

SH=species and habitats protection

CAPM= program for strongly modified water bodies (“corpuri apă puternic modificate”), aiming to delimit the hydromorphological alterations of the water.

EIONET= European Environment Information and Observation Network (Eionet) is a partnership network grouping the EEA (European Environment Agency) and the adhering countries.

For underground waters: **O**= operational monitoring;

S=surveillance monitoring;

ZV= vulnerable zones (for drillings situated in areas vulnerable to the pollution with nitrates from agricultural sources)

- Determining the monitoring parameters;

For the subsystem “rivers and lakes”: - biological elements: phytoplankton, microphytobentos, macrophytes, zoobentos, fish fauna;

-chemical elements: transparency (color, turbidity, matters in suspensions), temperature, oxygenation (dissolved oxygen, CCO-Mn, CCO-Cr, CBO5, COT, COD), salinity, acidity (pH, alkalinity), nutrients (nitrites, nitrates, ammonium), nitrates

For the underground waters system: - dissolved oxygen, pH, alkalinity, nitrites, nitrates, ammonium, oxidability

➤ Determining the monitoring frequencies;

For the subsystem “rivers and lakes”: the frequency was established in agreement to the monitoring programs; so, if a section serves for several programs, the monitoring is carried out with the frequency imposed by the program stating the highest frequency;

For the underground waters system: for the drillings with surveillance program, the frequency is once every six years, and for the operational program it is twice a year (minimal and maximal level).

The monitoring network in the upper and middle hydrographic basin of Arges River

In agreement to Article 2.10 of the Water Framework Directive 2000/60/EC, “*surface water body*” means a discrete and significant element of the surface waters such as: river, lake, canal, river sector, canal sector, transitory waters, a part of the coastal waters.

The (ground or underground) water body is the unit used to establish, report and verify the way of meeting the targeted goals of the Water Framework Directives

In the delimitation of the water bodies we had in view the typology of each of them. The typological classification was made considering three aspects:

- descriptive abiotic parameters (altitude of the basin, geology, area of the water catchment, lithological structure, specific flow, multiannual average precipitations and temperatures, types of fish fauna); cause-effect relations
- direct measurements of the variability of the biological communities; effect-cause relations
- overlapping of these approaches to define the types of water bodies.

On the level of the area analyzed in our paper (upstream from the Golesti storage lake), the water bodies on which we carried out the analysis of the qualitative state for the year 2010 are the following:

- 20 surface water bodies (natural and strongly modified rivers)

- 4 surface water bodies (9 storage lakes)
- 3 underground water bodies.

For these water bodies, a total of 47 monitoring sections were established, as follows:

- 24 sections for rivers
- 16 sections for lakes
- 7 drillings for underground waters

In point of the types of monitoring programs, there are:

- A. rivers:** 24 sections for surveillance monitoring S
 7 sections for operational monitoring O
 3 sections for potabilization monitoring P
 15 sections for ichthyofauna monitoring IH
 8 sections for vulnerable zone monitoring ZV
 1 sections for habitat and species monitoring HS
 6 sections for reference monitoring R
 3 sections for best-section-available monitoring CBSD
 3 sections for EIONET monitoring
 5 sections for IC monitoring
- B. lakes:** 9 lakes for surveillance monitoring S
 9 lakes for operational monitoring O
 3 lakes for potabilization monitoring P
 7 lakes for ichthyofauna monitoring IH
 12 lakes for vulnerable zone monitoring ZV
 2 lakes for habitat and species protection HS
 2 sections for IC monitoring
 2 sections for EIONET monitoring

Water quality evaluation

The characterization of the global state of the *water bodies* in the hydrographic basin of the Arges River, in agreement to the Water Framework Directive, was defined based on their ecological and chemical state.

The ecological state represents the structure and the functioning of the aquatic ecosystems. The elements defined are: elements of biological quality, hydromorphological and general physical-chemical elements supporting the biological ones and specific (synthetic and non-synthetic) pollutants.

The characterization relies on a classification system with 5 classes: very good, good, moderate, weak, and poor.

The chemical state of a water body is made based on priority substances, having in view the provisions of the Directive concerning the water-related environmental quality standards (Directive 2008/105/EC), transposed in the Romanian legislation by the Governmental Decision HG 1038/2010. The good *chemical state* of the surface waters is translated as the chemical state of a water body whose pollutants do not go over the concentrations established for the environmental quality standards.

In the case of the chemical states, the classification is carried out as follows:

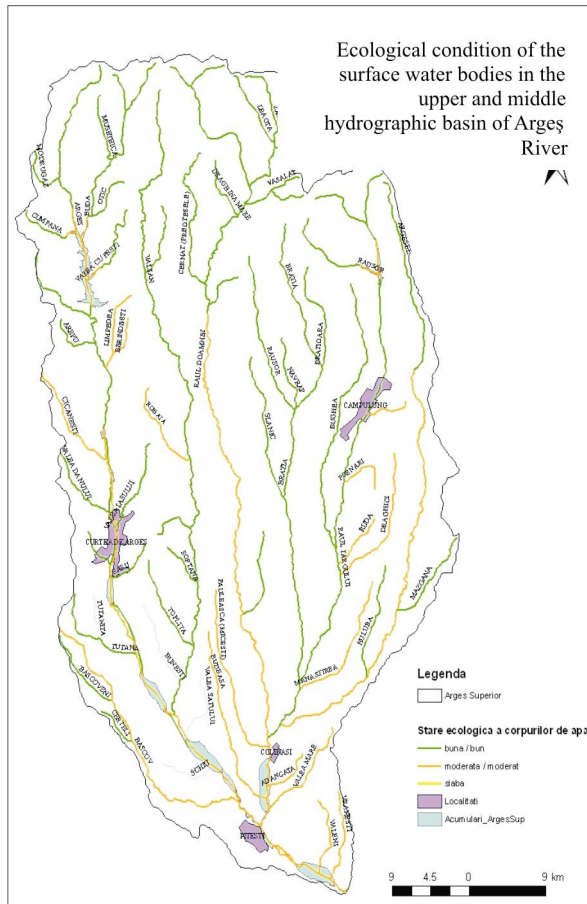
- a. good chemical state (B)
- b. poor chemical state (P)

The data centralization and characterization led to the inclusion of the water bodies into quality classes.

EVALUATION OF THE ECOLOGICAL AND CHEMICAL STATE OF THE MONITORED WATER BODIES - RIVERS

The ecological state of the 20 water bodies under analysis, with a total length of 564.8km, presents just two classes, namely moderate and good (fig. no. 2). 60% of the water bodies (12 bodies totaling a length of 334.56 km) belong to the “good” quality class, while the rest of 40% (8 bodies totaling a 230.24km length) belong to the “moderate” quality class. The reason why these water bodies do not reach the “good” quality class is the biological elements (macro-invertebrates) and physical-chemical elements ($P-PO_4=0.158\text{mgP/l}$, $N-NO_2=0.075\text{mgN/l}$, $N-NH_4=0.504\text{mgN/l}$). Fish fauna is why 2 water bodies do not reach the quality objective (Raul Doamnei – downstream from Slatina locality and Valea Mare rivulet). The physical-chemical elements (nutrients) are the reason why 2 water bodies totaling a length of 44.64km do not meet the “good” quality state: Raul Targului downstream from Campulung locality (strongly modified water body) and Valeni rivulet (naturally).

The chemical state is better represented. So, 18 (90%) of the water bodies out of the 20 under analysis met the environmental goal in 2010, namely a good state (fig. no. 3). The two water bodies with a poor chemical state appear so because the average annual concentration of HCH ($HCH=0.0224\mu\text{g/l}$) was superseded (Valeni Rivulet - naturally) and the average annual and maximum admissible concentration of Hg were exceeded ($MA=0.0587\mu\text{g/l}$; $CMA=0.132\mu\text{g/l}$) (Raul Targului downstream from Campulung locality (strongly modified water body)).



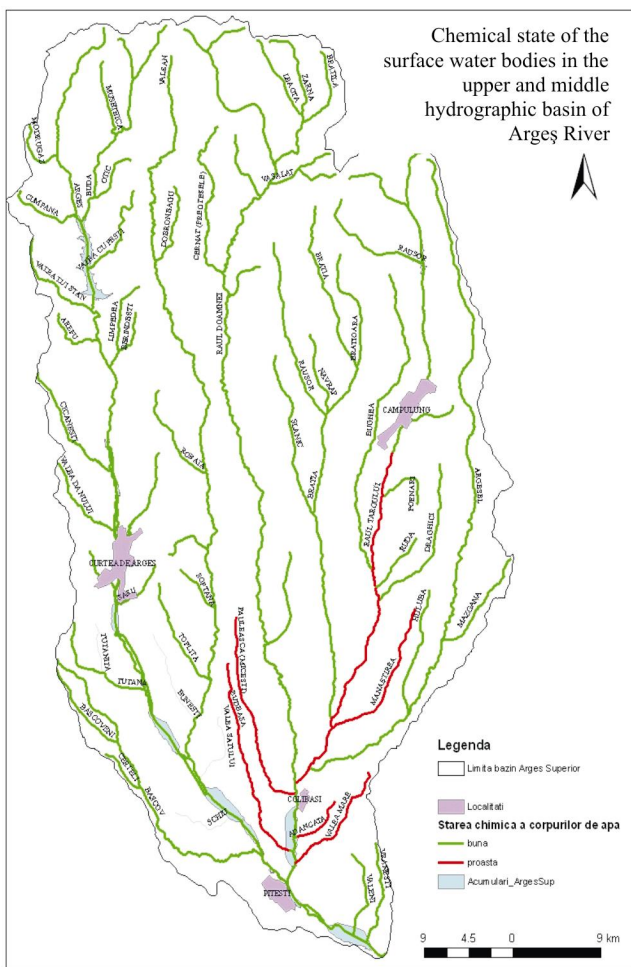
EVALUATION OF THE ECOLOGICAL AND CHEMICAL STATE OF THE MONITORED WATER BODIES – STORAGE LAKES

The Argeş River, throughout its length in the upper and middle basin (up to Golesti) was divided into 5 water bodies. One of them, the sector comprised between “downstream from the Vidraru storage lake – the entrance into the Oiesti storage lake” belongs to the “river” category, while the remaining four bodies, considering the existing chain of lakes, were categorized and monitored as belonging to the storage lakes programs. These 4 bodies are the following:

- a. LW10.1_B1 (AC. VIDRARU) is represented by the Vidraru storage lake
- b. LW10.1_B2 (CONTINUA ARGES: SECTOR INTRARE AC. OIESTI-AMONTE CONFL VALSAN) is made up of a chain of

storage lakes, the monitored lakes being Oiesti, Cerbureni, Zigoneni and Valcele

- c. LW10.1_B3 (CONTINUA ARGES: SECTOR AMONTE CONF. VALSAN - INTRARE AC. PRUNDU (AM. CONF. RAUL DOAMNEI) comprises the storage lakes Budeasa and Bascov.
- d. d. LW10.1_B4 (CONTINUA:ARGES- SECTOR INTRARE AC. PRUNDU (PITESTI) - AVAL AC. GOLESTI) includes the lakes Prundu and Golesti, the only monitored lake being the Golesti



storage lake.

The ecological condition of the 4 water bodies is moderate. The reason why the “good” quality potential is not reached is the biological elements (phytobenthos). In the case of the Golesti storage lake, to this should be added the physical-chemical elements ($P_{tot} = 0.106\text{mgP/l}$).

From the perspective of their **chemical state**, all the water bodies belong to the “good” quality class.

Fig. 3 Chemical state 2010

EVALUATION OF THE ECOLOGICAL AND CHEMICAL STATE OF THE MONITORED WATER BODIES – UNDERGROUND WATER BODIES

Concerning the chemical monitoring, the Framework Directive foresees two types of programs, namely the surveillance monitoring and the operational program. These programs provide the information needed to assess the chemical condition of the pollutants' concentrations and to identify and monitor their tendency.

In the area under analysis, considering the geographic conditions, 3 water bodies can be found (Fig. no. 4) RO AG 05, RO AG 08 and RO AG 12. Their geographic development goes far beyond the area of concern of our work, most of their extension falling outside its scope. The first two are hazardous water bodies from a qualitative perspective, their problem being the nitrates. RO AG 12 is an underground water body situated deeply underneath the surface.

The drillings included in the monitoring program situated in the area under analysis are few and will be presented in the table below:

Table no. 1 Drillings in the area under analysis

No.	Name of the drilling	Water body	Type of program	Water use	Program protected areas
1	Darmanesti F1	ROGWAG1090050	S	O	VZ
6	Bascov-Maracineni F6	ROGWAG1090050	S,O	O	VZ
4	Bascov Maracineni F1	ROGWAG1090080	S	O	VZ
5	Bascov Maracineni F2	ROGWAG1090080	S,O	O	VZ
2	Vladesti F1 artezian	ROGWAG3000120	S	-	-
3	Cosesti-Pacioiu F1 CL	ROGWAG3000120	S	O	-
7	Pitesti DAAV F1A	ROGWAG3000120	S	o	VZ

In 2010, the water quality of the underground water body ROGWAG05 was analyzed using 35 observational drillings, yet in the area under analysis there are just two drillings. They did not record any excesses in the monitored chemical substances, so the underground water body is considered to have a good chemical state.

The underground water body ROGWAG08 was analyzed using 21 observational drillings, of which one can find just two in the area under analysis. The average values obtained were compared to the threshold values of the Environmental Minister's Order MMO no. 137/2009 concerning the quality indicators for water bodies (nitrates, ammonium,

nitrites, sulphates, phosphates, chlorides, dissolved cadmium and dissolved lead) and no excesses were recorded, so the chemical condition of the water body is good.

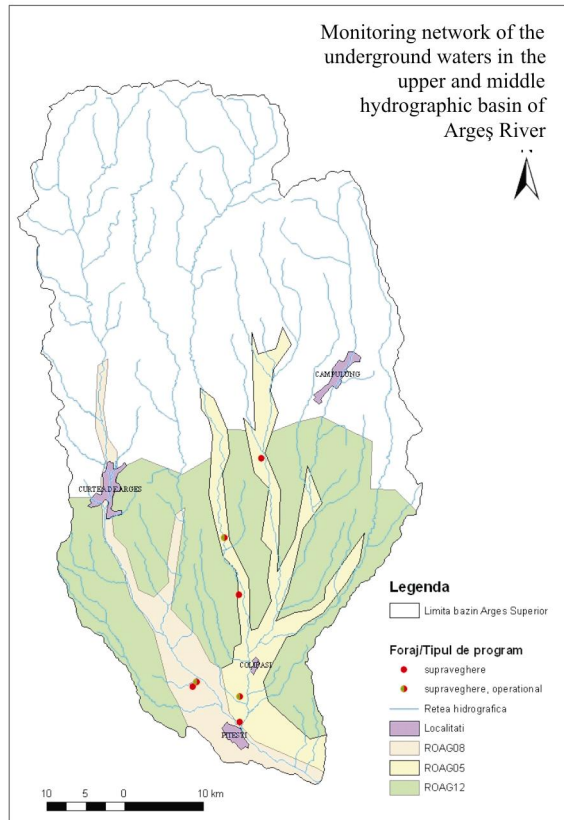


Fig. 4 Monitoring network

The underground water body ROGWAG12 covers a very large area, in the zone of the hydrographic basins of Argeș, Ialomița Buzău, Călmățui, Siret, Prut and Danube (in between Zimnicea and Galați). It is a water body situated deeply underground and valorized as a supply of potable water for the population or for industrial uses.

On the surface corresponding to this underground water body, there are several important places from where water is drawn (Alexandria; Apa Nova București; ADP Târgoviște; Ploiești NE and Ploiești NV); the water is monitored using 38 observational drillings. From their total, 13 recorded a certain level of pollution, which leads to the conclusion that the underground water body had a poor chemical condition. In the upper basin of the Argeș River, for this water body, the monitoring was carried out by

means of 3 drillings, which in 2010 recorded no excesses in point of their quality indicators.

CONCLUSIONS

By analyzing the data available and the information presented above, we can draw the following conclusions (for the year 2010):

- 11 water bodies (rivers) belong in the “good” quality class both in point of their ecological and chemical state (e.g.: Valea Iasului, Valsan, Bratia, Bughea and the upper courses of Râul Doamnei, Râul Târgului, Argesel and Arges)
- 2 surface water bodies belong to the categories moderate/poor (e.g.: Râul Târgului, downstream from Campulung Town and Valea Mare rivulet)
- 7 water bodies have a “moderate” ecological state and a “good” chemical state (e.g.: Bascov, Râul Doamnei downstream from Slatina locality, Draghici, Argesel downstream from the Namaiesti locality)
- The lakes present a moderate ecological state, their hazard elements being the biological elements (phytobenthos), while their chemical state is good.
- The 7 drillings that monitored the underground water bodies in the area under analysis did not record any values over the legal values for the parameters under analysis, so the chemical state of the water bodies is good.

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