

SPATIAL-TEMPORAL PARTICULARITIES OF THE ECOLOGICAL STATUS OF SURFACE WATER BODIES AND POLLUTION SOURCES FROM SIRET RIVER BASIN

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ABSTRACT:

The ecological status of surface water bodies from Siret River Basin is monitored systematically and spatial in accordance with the requirements of European Directives in the water area. Analysis temporary and spatial of qualitative and quantitative status of surface waters (rivers, lakes) is achieved according to the specificities of each body of water resulting from physical and geographical conditions, climatic and hydro-morphological regimes of river basin and from human activities. In order to know of those features, there are needed specific monitoring systems of water bodies. The parameters underlying the assessment of ecological status of rivers and lakes are monitored systematically and temporary: daily, monthly, quarterly, annually, according to these characteristics. In this context, the daily variations in environmental condition, expresses the current status of surface waters. Monthly changes are correlated with climate change and characterize the seasonal variations. On annual basis are identified the mean, minimum and maximum for each parameter and the trends (increase, decrease, regularity, periodicity, changes, etc.). Based on this information, extensive to multiannual level, it can achieve medium and long term forecasts and it might be issued the concepts and strategies for maintaining a balance and sustainable development of water resources.

In this paper we have presented some issues related to the synthesis of spatial-temporal ecological status of water bodies managed by Administration of Siret Water Basin (ABAS). Results of studies on the ecological status of water bodies have been presented for the year 2009. Also, in this paper it was presented an evolution of the quantities of pollutants from wastewater discharged in surface receptors and their purification by water users from of activity of ABAS area in 1999-2009 periods.

1. Introduction

In Romania, The Integrated Water Monitoring System has been operating in a scientific and definite structure starting with 1976 with the establishment of

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basin-wide water Departments. Water monitoring system worked since the early twentieth century, but at a much lower level, through an insufficient monitoring network and without an integrated quantity - quality, placing greater emphasis on hydrometric measurements station located just on a few major rivers in particular the order I.

The water monitoring network has always been completed and enhanced, but since 2002 it was raised the question of modernization and development of Integrated Monitoring System to achieve European standards and monitoring requirements to run in a dynamic, complex and spiral development. With the implementation of the Water Framework Directive in 60/2000/CE, a new concept was introduced, namely the concept of body of water. The concept was taken by Romania legislation by amending the Water Law 107/1996 with the Law 310/2004 which subsequently underwent further amendments and supplements to take other new regulations in the water sector so as to ensure the compliance with the new European Community provisions.

2. Materials and methods

2.1. Assessment of ecological status of surface water bodies

For classification and framing of surface water bodies in the state environmental quality and ecological status, were defined 5 ecological regulatory status - very good, good, moderate, weak, poor (table 1).

According to these definitions, to ensure that conditions and degrees of affordability of water bodies for each quality indicator were set, permissible limits values for admission to the five ecological statuses. Based on the values of these indicators, respectively on the basis of worst values, the classification of water bodies is interpreted as related states.

The quality elements for classification of ecological status of surface waters are:

- Biological parameters;
- Hydro-morphological parameters that support the biological elements;
- Chemical and physico-chemical parameters that support the biological elements:
 - The general characteristics: thermal conditions, oxygenation conditions, salinity, acidification status, nutrient conditions and in lakes and analysis should be transparent;
 - Specific pollutants (pollution of all priority substances identified as being discharged into bodies of water, pollution by other substances identified as being discharged in significant quantities in water bodies).

The characterization process of the quality of surface water flowing, involves overall assessment of analytical results obtained in systematic campaigns according to specific operating manuals.

Table 1. General definitions of ecological status of surface waters.

Very good condition	Good condition	Moderate Condition	Weak Condition	Poor condition
None or very slight anthropogenic values alterations of physico-chemical and hydro-morphological quality, for the type of surface water body, from those normally associated with that type under conditions no changes. The values of biological quality elements for the type of surface water body are those normally associated with that type, the conditions are unchanged and does not show, or only very little evidence of disturbance. Conditions are specific to the type and communities.	The values of biological quality elements for the type of surface water body has low levels change due to human activities, but deviates slightly from the values associated normally with the type of water body surface conditions unchanged	Biological values of quality for the type of surface water body deviates moderately from those associated with normal body type of surface water, the conditions are unchanged. Values moderate signs of disturbance as a result of human activities and are essential to disturbed conditions of good values.	Waters showing evidence of major alterations in the values of biological quality elements for the type of water body surface and the relevant biological communities deviate significantly from the values associated normally with the type of water body surface conditions unchanged will be classified as poor.	Waters showing evidence of major alterations in the values of biological quality elements for the type of water body surface and are absent in large parts of important biological communities, which are normally associated with the type of water body surface conditions unchanged Will be classified as bad.

2.2. Types, subsystems and integrated water monitoring programs implemented by the Water Basin Administration Siret Bacau

In accordance with the provisions of the Water Framework Directive 60/2000/CE fully transposed into Romanian legislation, the National System for Integrated Monitoring (SMIAR) includes three types of monitoring:

- Surveillance monitoring;
- Operations monitoring;
- Monitoring of Investigation.

The monitoring system provided by the Framework Directive and other European Directives investigation addresses three environments (water, sediment / suspended matter, biota) and includes six subsystems.

The water quality monitoring, currently applied by the Water Basin Administration Siret Bacau is carried out in accordance with the provisions of the Water Framework Directive 60/2000 and the other European Directives transposed into Romania law by the Water Law 107/1996 supplemented and amended. This system includes five specific subsystems:

- Subsystem rivers
- Subsystem lakes;
- groundwater subsystem;

- Subsystem wastewater;
- Sub Protected Areas

Siret River Basin Water Administration is not monitoring „transitional waters" and "coastal waters" subsystems, which are not specific to its area of activity.

Water quality monitoring network in the ABA for the subsystem Siret "rivers" systematically covers 2889 km of river from 10280 km of water courses administered by the ABA Siret, by:

88 quality monitoring sections of the watershed:

- 10 reference sections;
- 17 sections of drinking;
- 21 sections vulnerable areas;
- 39 sections with other monitoring programs;
- 1 section of the border.

Integrated water monitoring system at the ABA Siret level is now being made by 12 specific monitoring programs presented in table 2.

Table 2. Monitoring programs implemented by the Water Basin Administration Siret

No.	Types of monitoring programs	Total number of monitoring sections	Rivers	Lakes	Ground water	Wastewater
1	Surveillance	318	70	31	556	
2	Operational	255	37	15	62	141
3	Investigation	whenever needed				
4	Potable (Drinking)	63	13	4	46	
5	Reference	18	10	8		
6	For Ichthyofauna	114	86	28		
7	Vulnerable areas	152	21		131	
8	Habitat and species protection	21	7	14		
9	The best section available	6	6			
10	Intercalibration	21	16	5		
11	International conventions	1	1			
12	The impact on water erosion in hydromorphological	15	15			

3. Results and discussion

3.1. Categories studied surface waters and their classification in the summary of environmental conditions on the basis of biological and physico-chemical monitoring in 2009 the area of activity of the water basin Siret Administration

As part of quality assessment of surface water streams (rivers and lakes), in the study there were taken into consideration 382 water bodies located in the Siret River Area. Among these, only 64 bodies of water have been systematically monitored by physic, chemical and biological, as follows:

- 53 surface water bodies – rivers
- 9 surface water bodies - ponds;
- 2 surface water bodies - lakes.

The remaining 318 water bodies were assessed by surface similarity, the expert assessment and monitoring the results of the investigation.

In the year 2009, the 382 water bodies with a total length of 10280 km, were within the following environmental conditions:

- Very good: 43 bodies of water, representing 11.26%;
- Good: 322 bodies of water, representing 84.29%;
- Moderate: 17 bodies of water, representing 4.45%;
- Poor: no body of water;
- Bad: no body of water.

Environmental status of the 10280 km of rivers Siret ABA administration was assessed as:

10 280 km	Total watercourses, of which	100.00
4421.90 km	of water courses through systematic monitoring	43.02
5668.78 km	of water courses through study of similarity	55.14
187.42 km	of water courses related to 9 lakes	1.82
1.90 km	of water courses related to two natural lakes	0.02

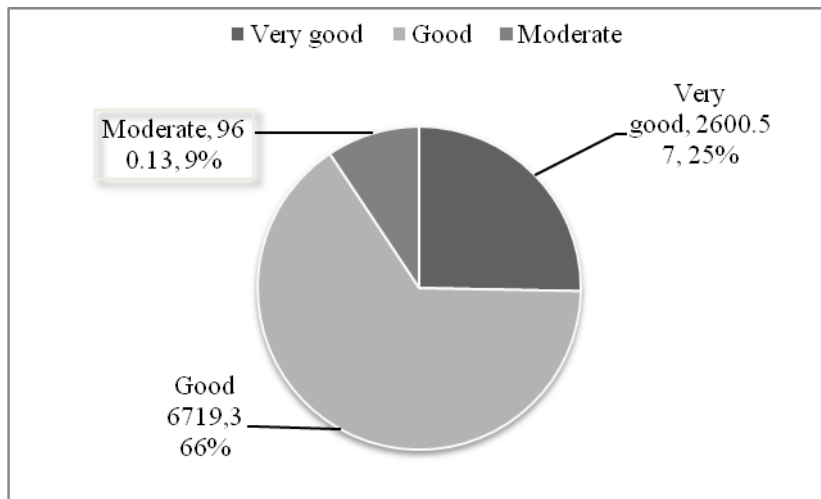


Fig. 1. Distribution of total lengths of ecological status of surface water bodies (rivers) on the area of activity of the ABA Siret in 2009.

In 2009 the classification in the environmental status of the 10280 km length of natural water bodies (rivers flowing) in the Siret River Area is as it follows (table 3 and figure 1):

- Very good: 2600.57 km bodies of water, representing 25.30%;
- Good: 6719.30 km bodies of water, representing 65.36%;
- Moderate: 960.13 km of water bodies, representing 9.34%;
- Poor: 0 km body of water, representing 0%;
- Bad: 0 km body of water, representing 0%.

Table 3. Synoptic length of water bodies (rivers) as assessed by cumulative environmental status for 2009.

Total length (km)	Length distribution of rivers as assessed ecological status									
	Very good		Good		Moderate		Weak		Poor	
	km	%	km	%	Km	%	km	%	km	%
10280	2600,57	25,30	6719,30	65,36	960,13	9,34	0	0	0	0

The subsystem „lakes” is monitored by 31 water quality monitoring sections for 11 representative lakes, of which 9 accumulations and 2 natural (Table 4):

Table 4. Systematically monitored lakes based on range of activity Siret River Basin Water Administration.

River course	Lakes monitored	
	Accumulation	Natural
Siret	Rogojesti, Bucecea, Răcăciuni, Călimănești	
Solcuța	Solca	
Dragomirna	Dragomirna	
Bistrița	Izvorul Muntelui, Bâta Doamnei	
Uz	Poiana Uzului	
Bicaz		Lacu Roșu
Lala		Lala

Regarding the ecological state of lakes water is found that 44% of the 9 lakes monitored fall into moderate ecological status, the remaining 56% falling into good and very good environmental status. Referring to the two lakes mentioned that Red Lake was classified as moderate and the lake ecology Lala in good ecological status. Table 5 shows the distribution of its 9 lakes (accumulation) as assess the potential ecological and chemical quality status in 2009.

Table 5. Distribution of reservoirs on the assessment of potential ecological and chemical status in 2009.

Total number of reservoirs (accumulation lakes)	Distribution reservoirs (accumulation) as potential environmental evaluation						Distribution of reservoirs on the assessment of chemical status			
	Maximum ecological potential		Good ecological potential		Moderate ecological potential		Good		Poor	
	No. bodies	%	No. bodies	%	No. bodies	%	No. bodies	%	No. bodies	%
9	4	44,44	1	11,12	4	44,44	7	77,77	2	22,23

3.2. The impact of wastewater on the receiving surface water bodies of the Siret River Basin

The total volume of wastewater discharged in 2009 was 108.34 million cubic meters. Of the total, 1.16 million cubic meters were not treated, 45.58 million cubic meters have been adequately treated and 61.60 million cubic meters have been poorly treated. Situation of wastewater treatment in year 2009 compared to previous years, are presented in Table 6.

Table 6. Wastewater treatment situation in the period 1999-2009 the area of activity Siret River Basin Water Administration.

Specification	Volumes evacuate (millions m ³ /year)										
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Sufficient treated water	37,12	16,33	40,34	88,15	92,70	75,02	78,94	75,65	69,43	30,36	45,58
Insufficient treated water	180,85	166,32	124,90	70,83	58,17	67,79	58,61	60,83	47,34	77,47	61,60
Untreated water	2,77	2,44	3,25	3,76	1,50	5,47	0,27	1,83	1,57	2,03	1,16
Total water that need treatment	220,74	185,09	168,49	162,74	152,37	148,28	137,82	138,31	118,34	109,86	108,34

Economic activities with special contribution of insufficiently treated wastewater discharged into the environment were:

- water capture and processing of water (municipal management activities), with a volume of 84.90 million m³
- chemical processing: mil.m³ 13.63;
- woodworking industry: 3.38 million m³
- Food industry: 1.70 million m³.
- Other: 4.73 million cubic meters.

The main pollutants discharged in four critical areas located in the BH Siret are:

- River Suceava, Suceava downstream area - CCOCr, suspensions, chlorides, residue filtered, phenols, sulfur, detergents, total phosphorus, nitrates, nitrites, ammonia, BOD5;
- river Bistrita, Piatra Neamt area downstream - the residue filtered, calcium, sulfates, nitrates, total nitrogen, BOD5, ammonia, CCOCr, nitrates, chlorides, sulfates, magnesium, detergent extractable substances, total phosphorus, phenols;
- Siret River, the area downstream the confluence with the river Bistrita - CCOCr, suspensions, chlorides, sulfates, detergents, substances extractable, total phosphorus, calcium;
- Trotuș river, downstream area Borzești - residue filtered CCOCr, BOD5, chlorides, sulfates, phenols, suspended, nitrates, synthetic detergents.

Chart 2 shows graphically how the volume of sewage discharged into the water on the area of activity 1999-2009 Administration Siret water basins.

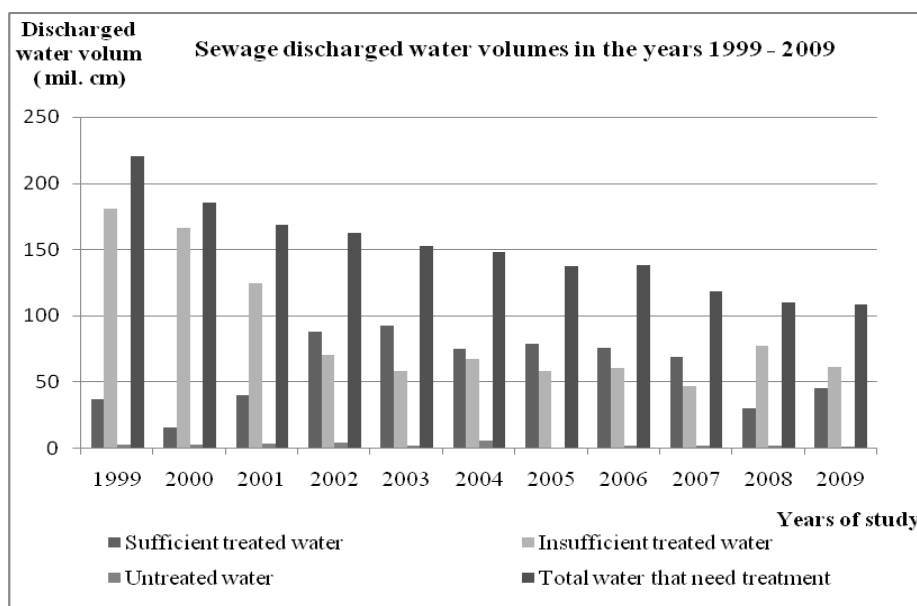


Fig. 2. Evolution mode volumes of waste water treatment plants discharged into surface receptor activity area Administration Siret water basin in the period 1999-2009.

In Table 7 it is shown a comparative statement of the quantity of pollutants discharged into surface receptors, in the period 1999-2009, the area of activity of the water basin Siret Administration.

Table 7. Comparison of quantities of pollutants discharged into surface receptors, in the period 1999 - 2009, the area of activity of the water basin Siret Administration.

contaminated evacuated	Volumes evacuate (tone/year)										
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CBO5	8712,2	8265,9	6638,0	6530,4	5986,7	4706,5	4408,3	4639,0	1198,5	5004,9	5070,07
CCOCr *	-	-	12789,9	15070,9	15914,6	14418,2	13040,0	13267,8	2003,1	13003,8	12864,25
Suspension	12776,9	13336,8	10999,8	10160,7	9678,1	9340,2	8122,6	7323,7	882,15	6721,0	6133,46
Residue fix	93065,2	87628,0	9524,7	38452,2	38025,7	33225,6	24160,8	19522,5	3824,1	593,3	26573,38
Phenol	8,9	5,8	2,4	3,02	5,736	12,0	26,9	9,438	0,61	0,11	1,884
Ammonium	1605,4	3013,5	1949,9	1479,4	1622,36	1392,0	707,8	1156,9	309,4	1029,2	981,012
extractible Substance	2148,2	1209,9	1081,6	791,6	767,13	728,6	1189,5	686,7	614,25	226,7	590,127

* In 1999 and 2000 was not analyzed the CCOCr indicator, chemical oxygen CCOMn being analyzed by the method.

4. Conclusions

Knowledge of the status of water resources is an objective requirement which can not be adequately met in the absence of a modern integrated water monitoring. As part of the management of water resources, monitoring activities occupy an important place, representing a major mechanism for protection of water quality and quantity. Siret River Basin Water Administration is constantly working on knowledge of state special quality of wastewater discharged and the impact of this on water resources, respectively, decrease up to stop the quantities of pollutants discharged into water resources.

Also be aware of and take action on economic polluters to reduce pollution, to establish programs automonitoring and achieve high performance treatment facilities to protect water quality in accordance with quality standards set by legislation. A positive aspect in recent years it is effectively applied by operator's auto monitoring programs and programs to prevent and control accidental pollution, under the coordination and supervision of specialized personnel in the Water Basin Administration Siret. As a result of these measures is the reduction in the number of accidental pollution from more than 30 pollution accidents occurring annually by 2000 to below 10 pollution accidents occurring annually after 2005.

It should be mentioned that in the area coordinated by Siret Water Basin Administration, there are still areas of rivers affected by pollution sources than in previous years, although the sources of pollution have decreased the intensity of pollution. However, due to lack of funds for development of modern treatment, sections of rivers downstream of urban industrial sites: Suceava, Bacau, Onesti, Marasesti Odobești, Rimnicu Sarat and sections located downstream from the mines or scaffolding are still affected by oil pollution. We note that in 2010 a

modern waste water treatment plant equipped with tertiary treatment step was put into operation at Focsani and the modernization of WWTP Piatra Neamt.

Also, since 2011 the modernized treatment plant from Bacău went into operation. By functioning at the design parameters, these three stations eliminated sources of pollution and helped improve the river water quality Bistrita, Siret and Putna (Vrancea County).

An unsolved problem in previous years including the present, which will also persist in 2011, is the sewage discharges from urban and rural areas, which have not yet achieved the new treatment plants (retrofit).

A number of municipalities and cities have ongoing programs for creating new treatment plants, or upgrading and improving existing ones (e.g. Suceava, Pascani), others are still at the stage of master plan studies or creating solutions.

Among measures to improve water quality, which the Administration pursued, Basin Water Siret permanent stands:

1. Completion of master plans for the achievement of treatment plants for urban agglomerations
2. Allocation of funds (budget, structural funds, own funds) for development of new treatment plants for municipalities in BH Siret;
3. Further actions to detect polluters who discharge hazardous substances and sewage networks emissaries;
4. Further studies and action programs and watershed point for understanding the impact of pollution sources on water bodies;
5. Continue fitting materials and water pollution facilities;
6. Continuous improvement of the Integrated Monitoring Network punctual and global level;
7. Accomplishment of the treated wastewater discharged auto monitoring of economic operators and enforcement mechanism in the water;
8. Applying of water management legislation, including penalties for water pollution.

All these measures mentioned, and others, are primarily aimed at achieving good ecological status of water and sustainable development of water resources.

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