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THE EVALUATION OF THE WATER CHEMISTRY AND QUALITY FOR THE LAKES FROM THE SOUTH OF THE HILLY PLAIN OF JIJIA (BAHLUI DRAINAGE BASIN)

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Abstract
In order to highlight the quality of the lake waters from the Bahlui drainage basin, we chose to analyse four principal lakes (Pârcovaci, Tansa, Chiriţa, Podu Iloaiei) and six secundary lakes (Aroneanu I and II, Ciric I, II and III and Cucuteni). The global presentation of the lakes' water chemistry and quality is a sum of two different ways of analysis: the first based on standards (promulgated in 2006), according to which the lakes are analyzed as static ecosystem (the quality of the water corresponds to five different categories) and the second considering the lakes a dynamic ecosystem and working with the average of different quality parameters, from different periods. After we made the analysis, we showed that from the four first-order lakes, two (Chiriţa and Pârcovaci) can be included in the first quality category, and all the second-order lakes can be included in the third and fourth quality categories. This can be explained trough the clogging of the reservoirs or through the pollution caused by human activities in the hydrographic basin.
Keywords: lakes, hydrochemistry, evaluation, Bahlui drainage basin

1. Introduction

Bahlui drainage basin is located in the north-east of Romania, overlapping an area with a central position in the central part of the Moldavian Plateau, in direct hydrological relation with the hydrographic network of Prut River (fig.1). In this sense, Bahlui River is a tributary on the right side of Jijia River, in the sector of common riverside of Jijia and Prut. This fact gives Bahlui Basin a certain genetic and evolutionary autonomy in relation to Jijia basin and Prut basin, autonomy manifested in time both in the way in which the water resources appeared and evolved, and in the role of the anthropic factor in their respective management.

Considered one of the most anthropized hydrographic basins in our country, arranged in a proportion of 71% from a hydrotehnical viewpoint (*Savin Nicoleta*, 1998), the hydrographic basin of Bahlui River can be taken as a model of efficient water resources management in the east of Romania, model that could be extended to the entire geographic area between Prut and Siret.

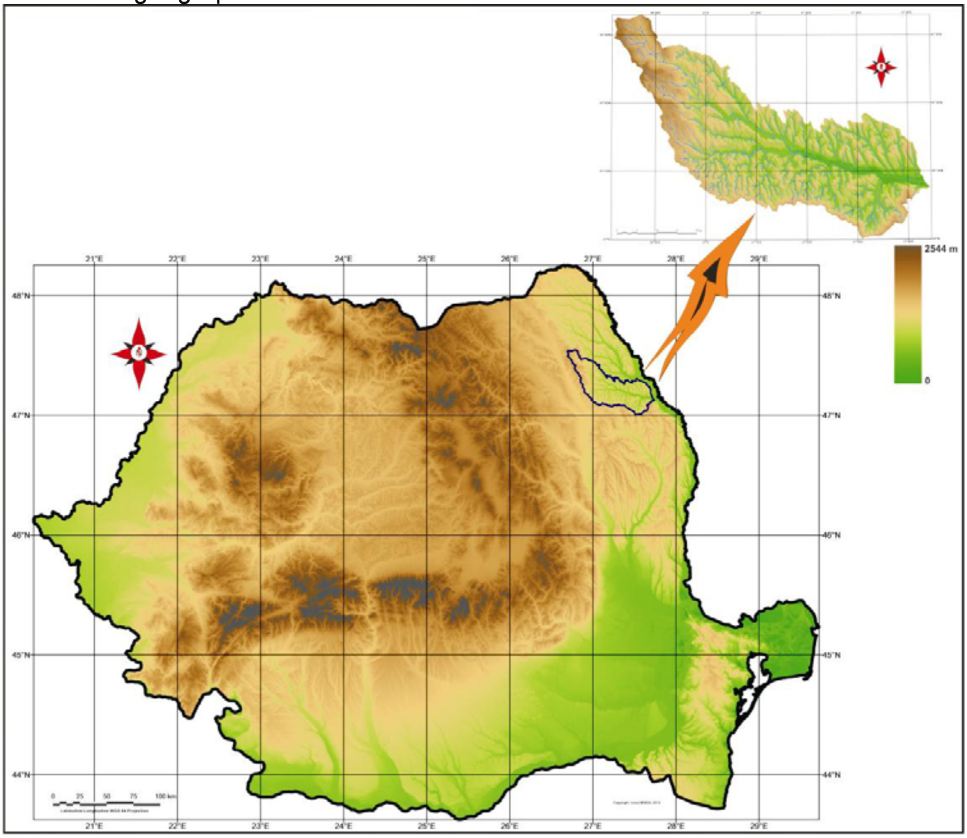

Fig. 1 The geographic position of the Bahlui hydrographic basin in Romania

In the hilly Plain of Jijia, as in the whole country, the lakes in their various forms (natural and storage lakes, swamps, ponds, fish ponds) occupy an important proportion of the geographical area.

The physical-geographic and the socio-economic conditions specific for the southern part of the hilly Plain of Jijia favored in time, the emergence and development of numerous lakes and ponds. The natural lakes are very few (only the so-called *bulhace*, appeared on slopes affected by landslides). Instead, the anthropogenic lakes exceed 150 units (those larger than 5 ha); they were primarily meant to provide the necessary water supply for the household and industrial consumption of the towns in the basin, having a role of protection of the population and of the farmland against flooding and high floods, and of mitigation of these phenomena and of flow regulation; the water has also been used for irrigation and livestock farms, the arrangement of fisheries or recreational units.

The general scheme of hydrotechnical development of the basin has 12 complex reservoirs (Pârcovaci and Tansa, on Bahlui River, Podu Iloaiei, on Bahlueţ river, Plopi on Gurguiata River, Sârca on the Valea Oii River, Cucuteni, on Voineşti River, Ciurbeşti, Ezăreni in Nicolina basin, Aroneanu and Ciric III, on Ciric River, Rediu on Rediu River and Chiriţa on Chiriţa River) and six non-permanent reservoirs (Ciurea, Cornet and Bârca in Nicolina basin, Cârlig and Vânători on Cacaina River and Vămăşoaia on Vămăşoaia River). The total volume of these reservoirs is 219 mil.m^3 and the area occupied by the water surface exceeds 2000 ha, or approximately 1% of the basin.

On the basis of the historical data, cartographic materials and our personal data, in the evolution of the lakes from Bahlui basin can be distinguished several stages: the *historical stage* until the early 19th century, when most of the lacustrine units appeared, the *modern stage*, which includes the 19th century and the first half of the 20th century, marked by two periods of decline in the number of lacustrine units (at the beginning of the 19th century and at the beginning of the 20th century), caused by certain socio-economic factors (land reform, lack of continuity in their proper maintenance etc.) and the *contemporary period*, which started from the second half of the 20th century and stands out through the application of land systematization programs, most of the lake units of this basin being reconditioned and arranged from a hydrotechnical point of view.

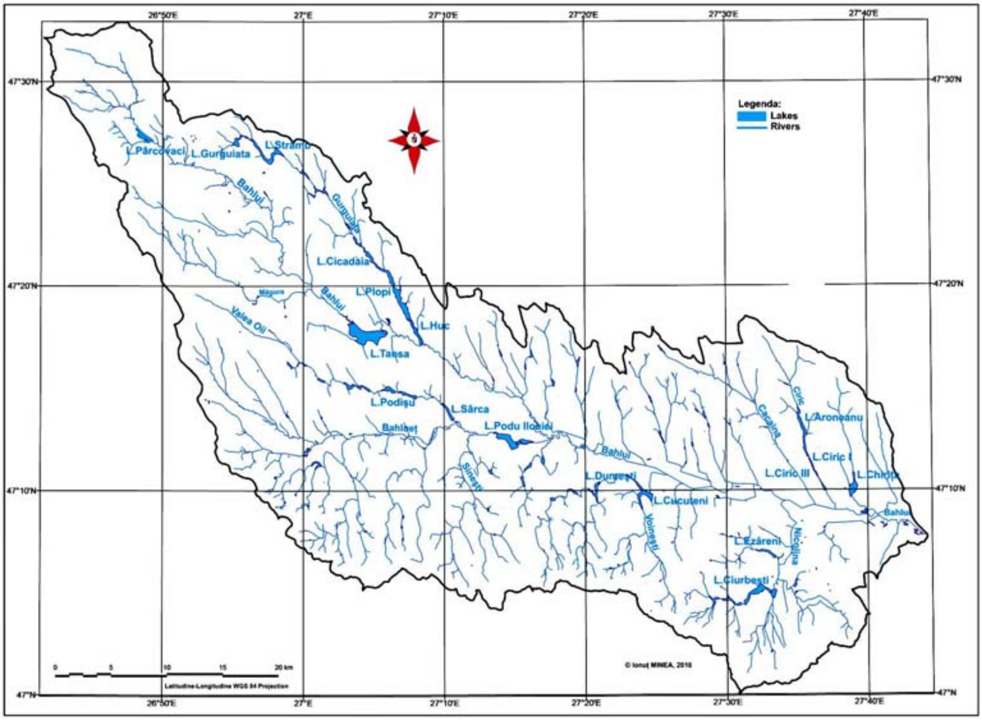

Fig. 2 The lake units from the Bahlui drainage basin, in 2009

2. Metodology

The research methodology for the lacustrine units in terms of water chemistry and quality does not take into account their origin, so that, the same means and methods of study can be applied to all types of lakes. Beside the morphometrical parameters, the hydrological analysis of a lake unit concerns as well the lake water chemistry and quality parameters, depending on which a series of measures can be taken in order to have the possibility to use these aquatic units for economic purposes.

The water supply of a lake comes from generally available sources but also through local sources. The general and durable water sources are represented by the precipitations and by the tributaries, while the local ones, limited in time, are represented by the springs and the runoff from the slopes.

The hydrological studies concerning the lake water chemistry in this basin are relatively few. *Schram Maria* (1971) made an analysis of 40 water samples taken from the reservoirs across the hilly Plain of Jijia. She identified a high degree of mineralization (over 1000 mg/l), with higher values during the dry periods, a hardness between 18 and 30°G, and a predominance of the bicarbonated-water lakes in the west of the basin, while the mixed bicabonatated and sulfated waters predominate in the east of the basin.

The elaboration of the *Management Plans* for the hydrographic basin according to the EC Framework Directive 2000/60, led to the realization of an abiotic typology of the lakes according to the origin of the lacustrine basin (natural or anthropogenic), and according to certain parameters (altitude, average depth, geological composition, retention time). For each body of water present at the surface were identified, in terms of pollution, the principal sources (point, diffuse and hydromorphological) and an assessment of the human impact was made through the analysis of five groups of chemical indicators: oxygen regime, general ions, nutrient regime, heavy metals, specific pollutants, determining the quality classes and the ecological condition of the lakes' water. In Bahlui basin, where most lakes are of anthropogenic origin, the abiotic typology of the reservoirs includes 11 types of lakes.

The storage lakes' water quality in the Bahlui hydrographic basin was monitored by specialists from Prut-Iaşi Water Administration, through the interpretation of the physical-chemical, biological and bacteriological analyses on the samples taken with a frequency determined by the importance of the reservoir (first order – every three months, second order – every six months) and depending on the temperature and rainfall regime (in the case of the complex storage lakes, the sampling frequency was higher). Please note that the data presented cover the period 1997-2004, during which the tests were made following a methodology as accurate and homogeneous as possible, being partially published in annual reports concerning *The stage of the general water quality in the hydrographic basin of Prut River*. Until the year 1995, some data on the chemistry of the lakes in the Bahlui basin can be found here and there in different hydrological directories and specialized papers.

To highlight the water quality of Bahlui hydrographic basin, we chose for analysis four first order reservoirs (Pârcovaci, Tansa, Chiriţa and Podu Iloaiei) and six second order storage lakes (Aroneanu I and II, Ciric I, II and III and Cucuteni).

The global overview of the water chemistry and quality in the Bahlui hydrographic basin is the result of the correlation of two models of study:

a) The first one, the *Standard regarding the benchmarks for surface water quality classification* (2006), in which it is considered that the reservoir is a static ecosystem, and which operates with the absolute values of the test results. The water quality is rigorously classified into five categories, according to certain limitats.

b) The second considers the storage lake to be a dynamic ecosystem, and therefore operates with comparative average values of the quality indicators, from a period considered actual (e.g. the year 2004), compared to a previous period (e.g. the year 1998) (*Crăciun,* 2003).

For the application of the second method, for each indicator was calculated the tendency to increase, decrease or stagnate (remain stable) in point of water quality. To this end, we defined a series of characterization parameters (*Crăciun,* 2003):

$$r_1 = \frac{x_b}{x_r}$$

where: r_1 - rate of change of quality;

x_b - the percentage of improvement trends;

x_b - the percentage of worsening trends.

If r_1 is positive, the trend is of improvement, while if it is negative the trend is of worsening

$$r_2 = \frac{\%x_b}{\%x_r}$$

where: r_2 - rate of change of quality classes;

x_b% - percentage of the tendencies of improvement;

x_2% - percentage of the tendencies of worsening.

This parameter has the same interpretation as the previous one.

The last parameter proposed refers to the speed of the evolution (r_3) also called projection factor, determined as the ratio obtained by dividing the ratios corresponding to the period under analysis (1997-2004) and those corresponding to the prior period (owing to the lack of data, we took as basis of reference the period 1997-2000).

Summing up all the trends having the same sense or generating the same effect in the evolution of quality (with or without changing the category of quality), we obtained the tendency frequency chart for each of the reservoirs. Using it, depending on the dynamics of the tendencies, we analyzed the evolution of the water quality, in the sense of improvement, worsening or preservation, for each storage lake and globally for the entire basin.

3. Analysis of the water chemistry and quality for the first order reservoirs

In order to analyze the water chemistry and quality of the first order reservoirs we applied the parameters described above. Moreover, we made certain extra observations concerning the change in the main hydrochemical parameters.

For *Pârcovaci reservoir*, the trends of the parameters analyzed fall within the group tending towards the deterioration of the water quality: r_1=0.7, r_2=0. Out of the 26 parameters analyzed, 6 (23%) showed trends of improvement, while 8 (31%) had worsening trends in point of quality, and 12 (46%) maintained the same quality as during the previous year. Even under these conditions, the lake's water quality belongs to the first quality category, but change can occur anytime in the future, especially in the sense of worsening.

Chemically speaking, the water quality of the Pârcovaci reservoir corresponds to the principal purpose for which it was created, the public water supply of Hârlău town, belonging to the 1st or 2nd category for all the indicators except pH (which in recent years has exceeded the value of 8.1) and hardness (very high, over 24^0G). The ratio between CCO-Mn and respectively BOD_5 and dissolved oxygen has an average value for the period under analysis of respectively 0.77 and 0.39. The evolution in time is relatively constant, but for parameters such as pH, hardness and nitrogen/nitrate, ammonium and phosphorus content, more attention is necessary, especially as this reservoir is meant for public water supply.

From a biological perspective, no essential changes have been noticed, both in quantity and in quality of the planktonic biocenoses. The algae microflora has average values of 224000-587000 cel/l, with a relatively low density, which led to an average annual phytoplankton biomass from 0.26 to 1.82 mg/l.

The zooplankton density values increased from 110,000 cel/l (1998) to 305,000 cel/l (2003), and the germs from 8000 cel/l (1997/1998) to 14200 cel/l (2001).

Analyzing and correlating the physico-chemical indicators to the biological and bacteriological ones, it results that this reservoir belongs, in terms oligotrophic category, to the *oligotrophic* category, tending to become *oligo-mezotrophic*. The overall quality forecast is of worsening towards the second category, if the evolution of the above parameters is not attenuated (Table no. 1).

In the *Tansa reservoir* case, the trend of evolution of the parameters under analysis shows a slight tendency of worsening: r_1=0.9, r_2=1/2<1. Out of the total of 26 parameters, 6 (23%) produced improvements in quality, 10 (38.5%) recorded a worsening and 10 (38.5%) remained constant.

The physico-chemical analyses of the water show a second to third water quality category (according to the parameters: nitrates/nitrites, fixed residues and hardness) and even to fourth category (CCO-Mn, CBO_5, ammonia and total iron). Moreover, the ratio between CCO-Mn and respectively BOD_5 and dissolved oxygen has an average value for this period of respectively 1.88 and 1.32 (fig. 3). The reason is found in the sources of pollution situated upstream from the reservoir: S.C. Cotnari S.A. and Hârlău town, discharging insufficiently treated water into Bahlui River. Some parameters have changed their quality category from the second category to the third or from the third to the fourth category, even since 2000, in the case of certain parameters such as nitrites, pH, total nitrogen, ammonia or fixed residue. Carbonates, calcium or magnesium preserved the same category throughout the period (Table no. 2).

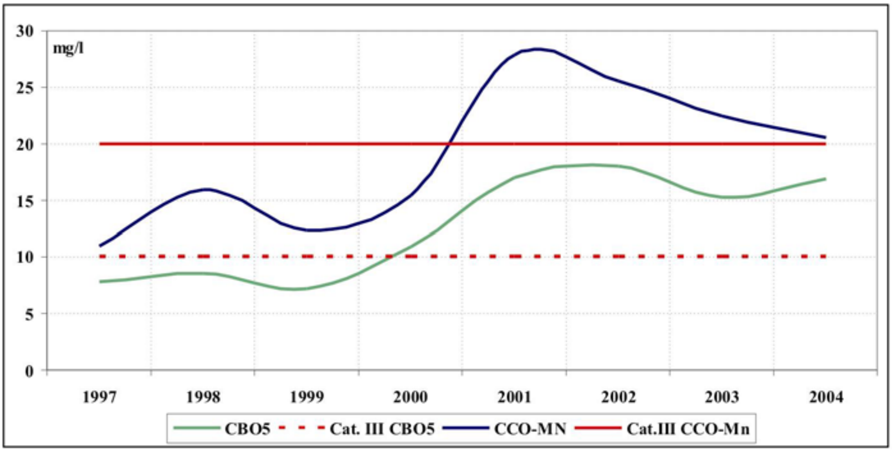

Fig. 3 Variation of the CCO-Mn and BOD_5 parameters, compared to the standard values corresponding to the third class quality, in Tansa reservoir, between 1997-2004

The amount of phytoplankton, which is considered the main link in the food chain of an aquatic ecosystem, underwent qualitative and quantitative changes from 740,000 to 1,500,000 cel/l, with an average biomass of 1.40 to 1.89 mg/l. Diatoms is the most current form of phytoplankton.

Among the most frequently encountered zooplankton species, there are rotifers and ciliates and their density ranged in average between 34 and 223 animals/l. The bacteriological analysis situates the reservoir in the third class, and during the hot season even in the fourth category. Although during the years under analysis no biological flowering of the water occurred during the hot season, there is a permanent (potential) risk of occurrence of this phenomenon because of the polluted water discharged by the upstream businesses, as occurred in 1994 when a biological catastrophe caused by the reduction of the oxygen from the water killed 200 tons of fish.

Correlating the results of the physico-chemical, biological and microbiological analyses, the reservoir belongs to the *mesotrophic* stage with a significant potential of negative change in point of quality, if no measures are taken to prevent the discharge of polluted wastewater into Bahlui river or in the reservoir.

The main source of pollution of the *Podu Iloaiei reservoir* is the treatment station of Targu Frumos town, and a number of livestock farms located along the Bahlueţ valley. The graph of the frequency of the evolutionary trends of the parameters under analysis shows that Podu Iloaiei reservoir is one of the reservoirs with a constant tendency of slight worsening: $r_1 = 1.02$, $r_2 = 2/3 < 1$. Out of the 26 parameters analyzed, 2 (8%) produced a quality improvement, 7 (27%) a worsening, and 17 (65%) had a relatively constant evolution.

From a physical-chemical point of view, the reservoir water is in the fourth category, according to pH, CBO_5, CCO-Mn, magnesium, iron, ammonium and total hardness and in the third class as far as the nitrate/nitrogen, the phosphorus and the phosphates are concerned. The ratio between CCO-Mn and dissolved oxygen often exceeds the value of 2.5 (3.67 -1 998, 2.70 in 2000, 3.68 in 2003, 3.81 in 2004) and the ratio between CBO_5 and dissolved oxygen has the average value of 2.09 (oscillating between 1.5 in 2000 and 2.38 in the year 2003) (Table no. 3).

From a biological perspective, the lake's water has a varied biocoenosis, but with a very high density, specific of contaminated waters. Phytoplankton biomass oscillated between 2,100,000 cel/l (1997) and 7.6 million cel/l (1998), with an average value of 450,000 cel/l. The zooplankton density also varied between a minimum of 34,000 cel/l (1997) and 662,000 cel/l (2000), the total biomass ranging from a minimum of 2.64 mg/l to a maximum of 15.3 mg/l. The high values of the biological parameters indicate a high potential of the reservoir in point of nutrients that can cause the "flowering" of water, especially during the hot season of the year.

Correlating the results of physical-chemical water analysis, which show a 3^{rd}-4^{th} water quality category, to the results of the biological tests, it may be considered that this reservoir belongs to the *eutrophic* category in point of trophicity, without a forecast of good development, if nobody takes into account the need to improve the treatment of the domestic and industrial wastewater at the station of Targu Frumos, or to reduce the pollution caused by the livestock farms in the hydrographic basin.

Table no. 1 Water quality categories of Pârcovaci reservoir

No.	Quality parameter	Quality categories							
		1997	1998	1999	2000	2001	2002	2003	2004
1	pH	III	III	III	III	IV	IV	IV	IV
2	Dissolved O_2 (mg/l)	I	I	I	I	I	I	I	I
3	Saturation O.D. (%)	I	I	I	I	I	I	I	I
4	CBO_5 (mg/l)	I	I	I	I	I	I	I	I
5	CCO-Mn (mg/l)	I	I	I	II	I	I	I	I
6	Minimum total nitrogen (mg/l)	I	I	I	I	I	I	I	I
7	Nitrites (mg/l)	II	II	II	II	II	I	I	I
8	Nitrates (mg/l)	II	II	II	I	I	I	I	I
9	Ammonium (mg/l)	II	II	II	II	II	II	II	II
10	Total phosphorus (mg/l)	I	III	II	I	II	II	II	II
11	Phosphates (mg/l)	I	I	I	I	I	I	I	I
12	Fixed residue (mg/l)	I	I	I	I	I	I	I	I
13	Calcium (mg/l)	I	I	I	I	I	I	I	I
14	Magnesium (mg/l)	I	I	I	I	I	I	I	I
15	Sulfates (mg/l)	I	I	I	I	I	I	I	I
16	Chlorides (mg/l)	I	I	I	I	I	I	I	I
17	Carbonates (mg/l)	I	I	I	I	I	I	I	I
18	Phenols (mg/l)	I	I	I	I	I	I	I	I
19	Total iron (mg/l)	I	I	I	I	III	I	I	I
20	Total hardness (^{0}G)	III	III	III	III	III	III	III	III
21	Coliform bacteria total (1000/l)	I	I	I	I	I	I	I	I

*according to the data provided by Prut-Iaşi Water Administration or taken from the *Stage of the overall water quality in the hydrographic basin of Prut River* published during the period 1997-2004 by the above-mentioned authority

Table no. 2. Water quality categories for the Tansa reservoir

No	Quality parameter	Quality categories							
		1997	1998	1999	2000	2001	2002	2003	2004
1	pH	III	III	III	IV	IV	IV	III	III
2	Dissolved O_2 (mg/l)	I	I	I	I	I	I	I	I
3	Saturation O.D. (%)	I	I	I	I	I	I	I	I
4	CBO_5 (mg/l)	II	II	II	III	IV	IV	IV	IV
5	CCO-Mn (mg/l)	II	II	II	III	III	III	IV	IV
6	Minimum total nitrogen (mg/l)	I	II	II	II	III	II	II	II
7	Nitrites (mg/l)	III	III	III	IV	III	III	III	III
8	Nitrates (mg/l)	III	III	III	II	III	III	III	III
9	Ammonium (mg/l)	III	III	III	IV	IV	IV	III	IV
10	Total phosphorus (mg/l)	I	I	I	I	II	II	II	II
11	Phosphates (mg/l)	III	III	III	II	II	II	II	II
12	Fixed residue (mg/l)	III	II	II	III	III	III	III	III

13	Calcium (mg/l)	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
14	Magnesium (mg/l)	**II**	**II**	**II**	**II**	**III**	**II**	**II**	**II**
15	Sulfates (mg/l)	**I**	**I**	**I**	**I**	**II**	**II**	**II**	**II**
16	Chlorides (mg/l)	**II**	**II**	**II**	**II**	**II**	**II**	**II**	**II**
17	Carbonates (mg/l)	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
18	Phenols (mg/l)	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
19	Total iron (mg/l)	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**
20	Total hardness (^{0}G)	**IV**	**III**	**IV**	**III**	**IV**	**III**	**III**	**III**
21	Coliform bacteria total (1000/l)	**I**	**I**	**I**	**II**	**III**	**I**	**I**	**I**

*according to the data provided by Prut-Iaşi Water Administration or taken from the *Stage of the overall water quality in the hydrographic basin of Prut River* published during the period 1997-2004 by the above-mentioned authority

Table no. 3. Water quality categories for the Podu Iloaiei reservoir

No	**Quality parameter**	**Quality categories**							
		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
1	pH	**III**	**III**	**III**	**IV**	**IV**	**IV**	**IV**	**IV**
2	Dissolved O_2 (mg/l)	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
3	Saturation O.D. (%)	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
4	CBO_5 (mg/l)	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**
5	CCO-Mn (mg/l)	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**
6	Minimum total nitrogen (mg/l)	**II**	**II**	**II**	**II**	**II**	**II**	**II**	**II**
7	Nitrites (mg/l)	**III**	**III**	**III**	**III**	**III**	**III**	**III**	**III**
8	Nitrates (mg/l)	**III**	**III**	**III**	**III**	**III**	**III**	**III**	**III**
9	Ammonium (mg/l)	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**
10	Total phosphorus (mg/l)	**II**	**III**	**III**	**I**	**III**	**III**	**III**	**III**
11	Phosphates (mg/l)	**III**	**III**	**III**	**III**	**III**	**III**	**III**	**III**
12	Fixed residue (mg/l)	**II**	**II**	**II**	**II**	**II**	**II**	**II**	**II**
13	Calcium (mg/l)	**II**	**II**	**II**	**I**	**I**	**I**	**I**	**II**
14	Magnesium (mg/l)	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**
15	Sulfates (mg/l)	**I**	**I**	**I**	**I**	**II**	**II**	**II**	**II**
16	Chlorides (mg/l)	**II**	**II**	**II**	**II**	**II**	**II**	**II**	**II**
17	Carbonates (mg/l)	**I**	**I**	**I**	**II**	**II**	**II**	**II**	**II**
18	Phenols (mg/l)	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
19	Total iron (mg/l)	**IV**	**IV**	**IV**	**IV**	**V**	**IV**	**IV**	**IV**
20	Total hardness (^{0}G)	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**
21	Coliform bacteria total (1000/l)	**III**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**

*according to the data provided by Prut-Iaşi Water Administration or taken from the *Stage of the overall water quality in the hydrographic basin of Prut River* published during the period 1997-2004 by the above-mentioned authority

The *Chiriţa reservoir*, situated on the homonymous river, has a particular importance, as source of drinking and industrial water for the city of Iasi. From a scientific point of view, this reservoir is not particularly interesting, because it is actually a transit reservoir for the water pumped from Prut River. Given the lack of stagnation, there is no possibility to take over the physical-chemical features of the area and form an actual lacustrine ecosystem. So, the physicochemical and biological characteristics of the water from Prut River, considered first quality water, are transferred as well to the water of the reservoir. But not all the physical-chemical parameters fall into this category of quality.

The analysis of the frequency chart of the trends of the parameters evaluated shows that the reservoir belongs to the first class, with an obvious tendency of quality conservation (r_1=1.0, r_2= 0/0). Out of the 26 parameters analyzed, a number of 2 (8%) presented trends of improvement, 4 (15%) had worsening trends, and the remaining 20 (77%) retained the same quality category.

In general, the physical-chemical parameters can be included, with a few exceptions, in the first quality category, with a few exceptions concerning the organical and the bacteriological charge, which tend towards the second category (hardness) or even the third category (pH, nitrates, ammonium, CCo-Mn), which reflects a slight degradation of the water from the reservoir.

The average value of the zooplankton density is 18,000 cel/l (with maximum values of 12,000 cel/ l in 1998 and 26,000 cel/l in 2001). The phytoplankton has an average value of 265,000 cel/l, while the corresponding phytoplankton biomass has an average value of 0.75 mg/l (ranging from 0.2 mg/l in 1997 to 1.6 mg/l, in the year 2000).

Having in view the parameters analyzed for the period 1997-2004 and correlating the physical-chemical indicators with the biological and bacteriological parameters, it results that in terms of trophicity the water quality falls in the *oligotrophic* category. In the future, there is a possibility for the water quality to deteriorate, especially as it is directly influenced by the water quality of Prut River, upstream of the Ţuţora catchment.

4. Analysis of the water chemistry and quality for the second order reservoirs

Following the examinations of the water samples taken monthly, these lakes have been classified into quality categories according to the *Standard regarding the classification of the surface water quality*, approved by *Order 161/2006* (Table no. 5). In general, all the second order lakes are classified in the third and fourth categories of quality, which shows a degradation of their water quality, both chemically and especially biologically. The clogging of these lakes, plus the fact that the pollution of the water coming into these reservoirs has increased during the recent years, led to poorer quality parameters.

Table no. 4 Water quality categories of Chiriţa reservoir

No	Quality parameter	Quality categories							
		1997	1998	1999	2000	2001	2002	2003	2004
1	pH	III	III	III	IV	IV	IV	IV	III
2	Dissolved O_2 (mg/l)	I	I	I	I	I	I	I	I
3	Saturation O.D. (%)	I	I	I	I	I	I	I	I
4	CBO_5 (mg/l)	I	I	I	I	I	I	I	I
5	CCO-Mn (mg/l)	II	II	II	II	III	III	III	III
6	Minimum total nitrogen (mg/l)	I	I	I	I	I	I	I	I
7	Nitrites (mg/l)	II	III	II	IV	II	II	I	I
8	Nitrates (mg/l)	III	III	III	III	III	III	III	III
9	Ammonium (mg/l)	II	III	II	IV	III	III	III	III
10	Total phosphorus (mg/l)	I	I	I	I	II	I	I	I
11	Phosphates (mg/l)	I	I	I	I	I	I	I	I
12	Fixed residue (mg/l)	I	I	I	I	I	I	I	I
13	Calcium (mg/l)	I	I	I	I	I	I	I	I
14	Magnesium (mg/l)	I	I	I	I	II	I	I	I
15	Sulfates (mg/l)	I	I	I	I	I	I	I	I
16	Chlorides (mg/l)	I	I	I	I	I	I	I	I
17	Carbonates (mg/l)	I	I	I	I	I	I	I	I
18	Phenols (mg/l)	I	I	I	I	I	I	I	I
19	Total iron (mg/l)	I	I	I	I	II	I	I	I
20	Total hardness (^{0}G)	II	II	II	II	II	II	II	II
21	Coliform bacteria total (1000/l)	I	I	I	I	I	I	I	I

*according to the data provided by Prut-Iaşi Water Administration or taken from the *Stage of the overall water quality in the hydrographic basin of Prut River* published during the period 1997-2004 by the above-mentioned authority

The overall quality of these reservoirs, if we compare the values recorded in 2004 to the ones of the year 1997, is negative, in the sense of the worsening of the water quality (r_1 <1 and r_2> 1). This can be explained by the wastewater brought in by the tributaries, due to the malfunctioning of the urban water treatment plants upstream or to the uncontrolled discharge of polluted waters by different trading companies.

The study of the frequency of the evolutive tendencies in point of global quality shows that all the second order reservoirs have a negative tendency (r_3 = 0.85). The trophic stage is generally *eutrophic* or *meso-eutrophic*, indicating that in the future there is a possibility to attain a higher quality category only if measures are taken in the sense of reducing the quantity of pollutants that end up in the river and of decreasing the eutrophication degree.

4. Conclusions

In general, it has been noticed, for all the first order reservoirs analyzed, that the quality class changes occurred strictly in continuity to the variation of the tendencies of the parameters evaluated: improvement (switching to a higher water quality category) occurred only when the value of the physical-chemical and biological parameters decreased and deterioration (changing to a lower water quality category) occurred only when the value of the parameters increased. These changes are in fact the final result of the increasing density in point of quality, which tends to "*crowd*" towards the upper limit of the quality category, generating the dynamics of r_1, which in turn affects the variation of r_2 (*Crăciun,* 2003). The value of the speed of this dynamics is for the period 1997-2004 (1997-2004/2000-2004): r_3 = 0.95, indicating a *constant evolution*.

In conclusion, out of the four first-order reservoirs, two (Chiriţa and Pârcovaci) are included in the first quality category and two belong to the second or even the third category (according to some chemical indicators, Tansa reservoir, and biological indicators, Podu Iloaiei reservoir). In the future, the situation can be improved, especially through investments in the domestic and industrial wastewater treatment of the cities of Hârlău and Târgu Frumos and through a better monitoring of the economic agents that have the potential of discharging pollutants into the hydrographic network or directly in the reservoirs.

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