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WATER QUALITY OF LAKES LOCATED IN HILLY AREAS CASE STUDY

BY

LOREDANA ANDREEA POPOIU (IMBREA)[*] and CATRINEL-RALUCA GIURMA-HANDLEY

“Gheorghe Asachi” Technical University of Iaşi,
Faculty of Hydrotechnics, Geodesy and Environmental Engineering

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Abstract. The water quality of a lake located in a hilly area is determined by interpreting the results obtained from the biological, physical and chemical analyzes performed in different sections and with a specific frequency of the reservoir lake.

In order to present the water quality of a barrier lake two study models are combined: on the one hand, the model that considers the reservoir a static aquatic ecosystem, and on the other hand the model that considers the reservoir lake a dynamic ecosystem. The first uses the results of biological, physical and chemical analyzes and the second model uses comparative average values of specific quality indicators from a current period over a previous period.

Considering that eutrophication is the most important indicator of ecological status of a barrier lakes, this article looked at the evolution of indicator parameters of water eutrophication for the Podu-Iloaiei reservoir, in the Bahlui catchment basin, the Bahluieț sub-basin.

In terms of nutrients monitoring, the barrier lake Podu-Iloaiei show an improvement of water quality during the study period 2010-2016.

Keywords: ecological potential; nutrients; eutrophication.

[*]Corresponding author: *e-mail*: popoiu_loredana@yahoo.com

1. Introduction

The overall presentation of water quality in lakes is the result of the combination of two study models: on the one hand, "The norms concerning the reference objects to classify surface water quality", where the barrier lake is considered to be a static aquatic ecosystem and uses the absolute values of the results obtained from the analyzes (Minea, 2012), and on the other hand, the model that considers the reservoir lake a dynamic ecosystem, which uses comparative average values of the quality indicators studied from a current period to a previous period (Crăciun, 2003).

The concept of eutrophication was introduced by Weber in 1907, considering that the enrichment supplementation over the limits permitted by specific legislation for waters rich in phosphorus and nitrogen nutrients is the main cause of water eutrophication (Brezeanu, 2002).

Specifically, the eutrophication of barrier lakes can be schematized as follows:

a) a hight amount of nitrogen and phosphorous nutrients reach the barrier lakes;

b) proliferation of phytoplankton and phytobenthos;

c) aerobic descomposition caused by algae bloom;

d) anaerobic descomposition, with the change of water quality in the barrier lake.

Research and studies to date by specialists show that the bioaccumulation of nutrients in a barrier lake increases substantially in depth, from surface to depth, with an annual load bearing limit for barrier lakes.

Table 1
Permissible Annual Loading Limits for Total Nitrogen and Total Phosphorus

Mean depth, [m]	Maximum tolerance of nutrient, [g/m^2]		Lower limit of dangerous load, [g/m^2]	
	N	*P*	*N*	*P*
5	1	0.07	2	0.10
10	1.5	0.10	3	0.20
50	4	0.25	8	0.50
100	6	0.40	12	0.80
150	7.5	0.50	15	1
200	9	0.60	18	1.20

The eutrophication process is maintained when no action is taken to combat this phenomenon.

The main measures to combat the water eutrophication of barrier lakes are:

a) water treatment before being discharged into the barrier lakes;

b) river cleaning;

c) lake basin cleaning;

d) prohibiting of waste storage on the edge of the reservoir;

e) removal marsh vegetation on the contour of the barrier lakes, especially from the areas "dejection cones" at its tail;

f) maintaining the protective curtain, and planting specific trees on the contour of the barrier lake;

g) avoiding the use of fertilizers during rainy periods;

h) application of fertilizers in the optimal periods and in the doses corresponding to the limits established by the legislation in force;

i) artificial aeration of the reservoir water;

j) design and arrangement of water intakes from the lake;

k) reducing the quantity and quality of effluent discharged into the lake;

l) improvement of the wastewater management system of localities located near the barrier lake.

Permanent monitoring of the evolution process of eutrophication of water lakes is the basis for implementing all measures to prevent and combat this phenomenon, in terms of water quality.

The water quality of the barrier lakes located in the Bahlui catchment area is analyzed by interpreting the results obtained from the biological, physical and chemical analyzes of the water samples in sections such as: potable water, middle lake and upstream dam.

The monitoring is carried out with a frequency determined according to the importance of the studied reservoir but also depending on the thermal and pluviometric regime (Administrația Națională "Apele Române").

Considering that eutrophication is the most important indicator of the ecological status of an accumulation lake, this article pursued the evolution of indicator parameters of water eutrophication for Podu-Iloaiei reservoir lake.

2. Case study

The barrier lake Podu-Iloaiei (Fig. 1) is located on the river Bahlueț to a distance of 25 km upstream of the confluence with the river Bahlui.

From the administrative point of view, the barrier lake Podu-Iloaiei is located in the city Podu Iloaiei, exactly 400 m upstream from the town Podu-Iloaiei, Iaşi county. The barrier lake Podu-Iloaiei was made to regulate the flow rate of water, mitigate floods, fishery, irrigation, and flood defense.

Water quality in the barrier lake Podu-Iloaiei is monitored in two sections: middle lake and dam lake.

Monitoring parameters are: on the one hand represented by physico-chemical properties such as transparency, thermal conditions, oxygen, salinity, fresh acidification, nutrient, priority substances and specific non-priority pollutants and on the other hand, biological elements: phytoplankton (for both sections of the study), microfitobentos (for section dam lake), macrophytes and fish fauna.

Frequency of monitoring water from lake Podu-Iloaiei differ, depending

on monitored parameters: on the one hand a quarterly frequency for the two sections (middle lake, reservoir lake) for groups of physical and chemical indicators: transparency, thermal conditions, the oxygen, salinity, acidification status, nutrient, Zn, Cu, Ni, organochlorine pesticides and on the other hand quarterly frequency for phytoplankton, semi-annual and annually for microfitobentos, macrophytes and fish fauna (Administra□ia Na□ională "Apele Române").

When notified accidental pollution or when is discovery the eutrophication of the water in the barrier lake, data collection are performed with a higher frequency, the objective is the removal of this phenomenon.

Fig. 1 –Barrier lake Podu-Iloaiei.

3. Results

Figs. 2 and 3 shows the variation of total nitrogen and total phosphorus in the barrier lake Podu Iloaiei during the period 2010-2014 for two monitoring sections: middle lake and dam lake (processed after data obtained from Water Basinal Administration Prut-Barlad).

If we analyze the values of total nitrogen during the period 2010-2014 in the reservoir Podu- Iloaie (Fig. 2), there is a slight decrease from year to year, the lowest value is determined in 2014 – 2.18 mg/l in the middle section of the lake and 2.20 mg/l in the dam lake section.

Regarding the measured values of total phosphorus for the middle lake section, the values remain constant (Fig. 3) and for the dam lake area the maximum value is determine in 2010 - 0.56 mg/l, then it decreases to 0.20 mg/l in 2014.

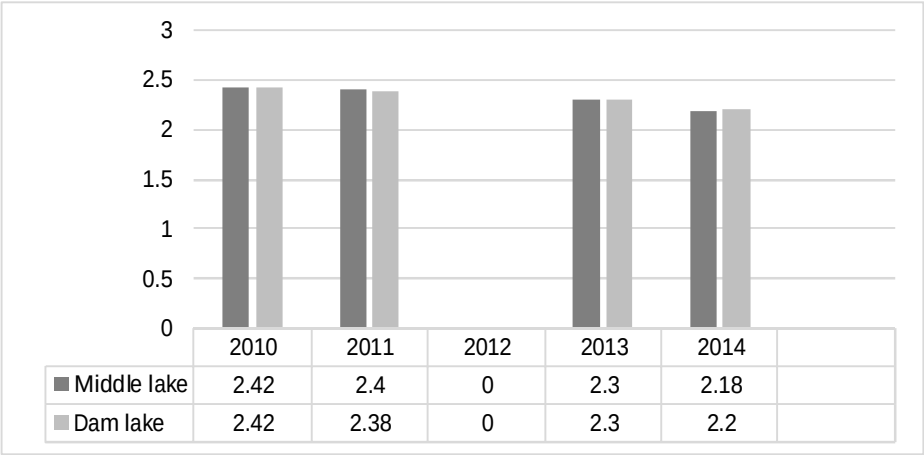

Fig. 2 – Variation of total nitrogen during the period 2010-2014 in lake Podu Iloaiei in two sections monitoring.

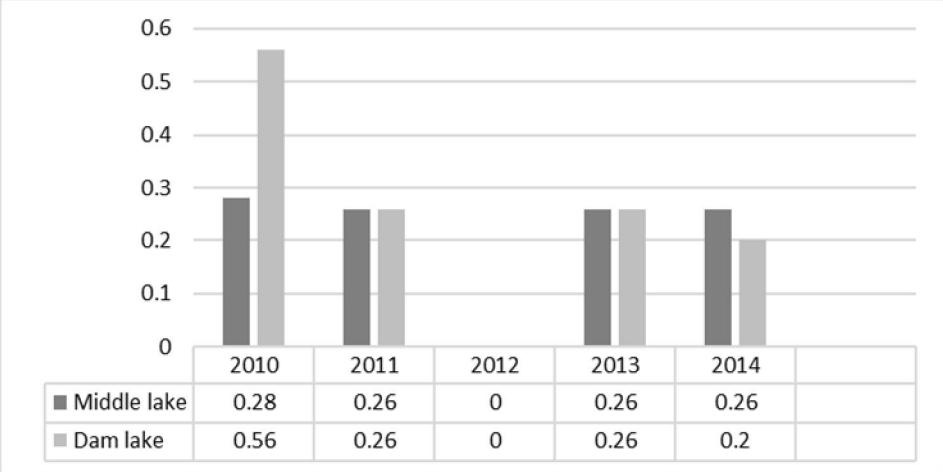

Fig. 3 – Variation of total phosphorus during the period 2010-2014 in lake Podu Iloaiei in two sections monitoring.

Table 2 shows the nutrient regime and chlorophyll "a" for the Podu-Iloaiei reservoir in 2014 (indicators that characterize the ecological potential).

Table 3 shows the variation of the ecological potential for the barrier lake Podu-Iloaiei during the period 2010-2016 according to the nutrient analysis.

If until 2014 the ecologically moderate potential has been maintained, since 2015 an improvement has been found, reaching a good ecological potential.

Table 2

Nutrient and Chlorophyll "a" Regime for Barrier Lake Podu-Iloaiei

Parameters/ 2014	NH_4 mg/l	$N\text{-}NH_4$ mgN/l	NO_2 mg/l	$N\text{-}NO_2$ mgN/l	NO_3 mg/l	$N\text{-}NO_3$ mgN/l
Dam lake	0.74	0.58	0.15	0.04	1.83	0.41
Middle lake	0.68	0.53	0.17	0.05	1.94	0.44
Parameters/ 2014	$N\text{-}NO_3$ mgN/l	N total mg/l	PO_4 mg/l	$P\text{-}PO_4$ mgP/l	P tot mg/l	Chlorophyll "a", [mg/l]
Dam lake	0.41	2.20	0.21	0.07	0.20	104.69
Middle lake	0.44	2.18	0.21	0.07	0.26	104.69

Table 3

Ecological Potential in Terms of Nutrients in Lake Podu Iloaiei During 2010-2016

Year	2010	2011	2012	2013	2014	2015	2016
Ecological potential in terms of nutrients	Moderate	Moderate	–	Moderate	Moderate	Good	Good

4. Conclusions

Qualitative the barrier lake Podu-Iloaiei according the values obtained for the indicators studied, eutrophic characteristics in terms of nitrogen nutrients, regime hypertrophic in terms of phosphorus nutrients and eutrophic for integration of all specific indicators to determine the biological potential; these reasons are mainly due to diffuse pollution with nitrogen and phosphorus nutrients from the entire Bahlui basin.

Analyzing the ecological potential of the reservoir Podu Iloaiei during the period 2010-2016 there was an improvement of the water quality status in terms of nutrients analysis; if from 2010 to 2014 a moderate ecological potential has been maintained, since 2015 there has been found a good ecological potential.

Evolution of the water quality of an accumulating lake can be favorable, especially if it will continue to invest in domestic and industrial water treatment plants, but also if the significant discharge of pollutant waters into the hydrographic network is continuously monitored through which they reach the barrier lakes**.**

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CALITATEA APEI ÎN LACURILE AMPLASATE ÎN ZONE COLINARE
Studiu de caz

(Rezumat)

Calitatea apei unui lac de acumulare amplasat într-o zonă colinară se determină prin interpretarea rezultatelor obținute în urma analizelor biologice, fizice şi chimice realizate cu o frecventă specifică lacului de acumulare studiat.

Pentru prezentarea calității apei unui lac de acumulare se combină două modele de studiu: pe de o parte modelul care consideră că lacul de acumulare este un ecosistem acvatic static şi utilizează valorile absolute ale rezultatelor obținute din analizele biologice şi fizico-chimice, iar pe de altă parte cel în care se consideră lacul de acumulare un ecosistem dinamic, fapt pentru care se utilizează valori medii comparative ale indicatorilor de calitate, dintr-o perioadă presupusă actuală față de o perioadă anterioară.

Având în vedere faptul că eutrofizarea reprezintă indicatorul cel mai important al stării ecologice pentru un lac de acumulare, în acest articol s-a urmărit evoluția parametrilor indicatori ai eutrofizării apei pentru lacul de acumulare Podu-Iloaiei din bazinul hidrografic Bahlui, sub-bazinul Bahlueț.

Din punct de vedere al monitorizării nutrienților, lacul de acumulare Podu Iloaiei prezintă o îmbunătățire a stării de calitate a apei în perioada de studiu 2010-2016.