UNIVERSITY OF BELGRADE
TECHNICAL FACULTY BOR

XXIV International Conference

"ECOLOGICAL TRUTH"

Eco-Ist'16

PROCEEDINGS

Edited by
Radoje V. PANTOVIC
and
Zoran S. MARKOVIC

12 – 15 June 2016
Hotel "Breza", Vrnjacka Banja, SERBIA

XXIV International Conference
"ECOLOGICAL TRUTH" Eco-Ist'16

PUBLISHER:
UNIVERSITY OF BELGRADE - TECHNICAL FACULTY IN BOR, BOR, MAY 2016

FOR THE PUBLISHER:
DEAN: Prof. dr Dragana ZIVKOVIC

EDITOR IN CHIEF:
Prof. dr Radoje PANTOVIC

TECHNICAL EDITOR
Zeljko PAJKIC, MSc.

PRINTED BY:
»Happy Trend« Zajecar

CIP – Каталогизација у публикацији –

Народна библиотека Србије, Београд

502/504(082)
613(082)

INTERNATIONAL Conference Ecological Truth
(24 ; 2016 ; Vrnjačka Banja)
Proceedings / XXIV International Conference
"Ecological Truth", Eco-Ist '16, 12-15 June 2016,
Vrnjačka Banja, Serbia ; [organizer] University of
Belgrade, Technical Faculty, Bor ; edited by Radoje
V. Pantovic and Zoran S. Markovic. - Bor : University,
Technical Faculty, 2016 (Zaječar : Happy Trend). -
XIX, 882 str. : ilustr. ; 25 cm

Tiraž 250. - Bibliografija uz svaki rad. - Registar.

ISBN 978-86-6305-043-3

1. Technical Faculty (Bor)
a) Животна средина - Заштита - Зборници
b) Здравље - Заштита - Зборници

COBISS.SR-ID 223956748

XXIV International Conference
"ECOLOGICAL TRUTH" ECO-IST'16
12 – 15 June 2016, Hotel "BREZA", Vrnjacka Banja, SERBIA

WATER QUALITY AND ECOLOGICAL STATUS OF THE TRIBUTARIES OF WESTERN MORAVA IN THE ČAČAK AND KRALJEVO REGION

Vesna Djurovic[1], S. Tanaskovic[1*], D. Djukic[1], L. Mandic[1], S. Gvozdenac[2], D. Knezevic[3]

[1]University of Kragujevac, Faculty of Agronomy, Cara Dušana 34, Cacak, SERBIA
[2]University in Novi Sad, Faculty of Agriculture, D. Obradovića 8, 21 000 Novi Sad, SERBIA
[3]University of Pristina, Faculty of Agriculture, Kosovska Mitrovica-Lesak, Kopaonicka bb, Kosovo and Metohija, SERBIA

[*]*stanasko@kg.ac.rs*

ABSTRACT

Surface water quality and ecological status assessment of the tributaries of the Western Morava was evaluated. It includes analysis of microbiological and physico-chemical parameters. Analyzed samples were taken at locations Musina River in the village of Adrani, Lađevačka River in the village Lađevci and Bresnička River in the village Mrčajevci, Serbia. The obtained microbiological parameters show that the highest number of all investigated parameters was determined in surface water of Bresnička River and the smallest of Musina River. Based on the physico-chemical parameters and values of ammonium ions (mg NL^{-1}) all three rivers had moderate ecological status and belonged to class III according to national regulations.

Key words: water quality, physico-chemical, microbiological parameters.

INTRODUCTION

Water is the source of life and a resource that will mark the twenty-first century, in a manner as it was the case with oil in the twentieth century. The increase of human population on Earth and the growing need for water, suggests that the Earth is approaching a water deficit [1].

The oldest known wells originate from Mesopotamia (around 4000 years BC) and the first water supply system was built in Jerusalem during the rule of king Solomon, 1000 years BC. That water is a key element in the survival of civilization which was recognized by ancient Egyptians and people of Mesopotamia, which is the reason why they settled near water bodies [2].

Rational utilization of water resources is one of the most important issues of contemporary society. Surface water, water sources or depth layers of hydrogeological systems are used for water supply [3]. The quality of drinking water or food production depends on the origin and quality of raw water, the quality of water sources as well as the number of consumers. Chemical and oil industry, metallurgy, and power industry are

large consumers of water, but also the large amounts of water are spent on irrigation and livestock maintain complex [4]. The development of techniques and technology, industrialization and urbanization have contributed to the quality of life but also a large degradation of nature through the contamination of water, air, soil, destruction of biocenosis and the ozone layer [5]. Contamination of natural waters can be a chemical (heavy metals, pesticides, oil, mineral salts, and detergents), biological (pathogenic microorganisms and viruses), physical (solid waste, noise, and vibration), visual contamination (concreting river banks) and radioactive (nuclear tests, accidents) [6]. Since the industrial revolution, until today the increase of water pollution and contaminants is recorded. Recovery and purification of natural water resources are needed for decades [1]. When we talk about the importance of water for the human consumption, first we think of it physiological, hygienic, eco-biological, toxicological and epidemiological significance [7, 8]. Getting hygienic water becomes a real challenge for a human race. The goal of this work is to show by analysing obtained results for tested parameters, whether the tested water can be used for irrigation.

MATERIAL AND METHOD

Tributaries of the Western Morava i.e. Musina, Lađevačka, and Bresnička River are used for status determination of surface water quality and ecological status assessment. It includes analysis of microbiological and physico-chemical parameters. Microbiological parameters comprehend number of total coliforms, fecal coliforms number-*E.coli*, and the number of fecal enterococci. Physico-chemical parameters include T, pH value, dissolved oxygen, biochemical oxygen demand (BOD_5), total organic oxygen, ammonium ion, nitrate, orthophosphate, total phosphorus and chloride. Water samples were collected at locations Musina River in the village of Adrani (L1), Lađevačka River in the village Lađevci (L2), and Bresnička River in the village Mrčajevci (L3).

Samples were taken in April 2016. The tested parameters were determined by standard methods. The analysis was conducted by Institute for Public Health in Čačak.

Assessment of surface water quality was carried out on the basis of national regulations [9, 10, 11]. National regulation allows the use of water from I to IV classes for irrigation [9].

RESULTS AND DISCUSSION

Microbiological characteristics of water are an important indicator of water quality. Most microorganisms, especially certain types of bacterial and protozoa are essential for biological treatment. However the presence of pathogenic bacteria, some protozoa and viruses is undesirable because they are harmful to human and animal health [12, 13].

Table 1. Results of microbiological analysis

Microbiological parameters for assessment of ecological status	**Unit of measure**	**Obtained value**		
		L1	**L2**	**L3**
Number of total coliform bacteria	MPN/100 mL	6050	12800	26050
Number of fecal coliform bacteria-*E.coli*	MPN/100 mL	<500	500	2600
Number of fecal enterococci	MPN/100 mL	<40	40	476

MPN-the Most Probable Number
< - the absence of microorganisms in units

Based on the obtained microbiological parameters (Table 1) it can be concluded that the largest number of total coliform bacteria, the number of fecal coliforms and fecal enterococci was determined in surface water - L3 and the smallest number in surface water L1. Based on the results of physico-chemical analysis (Table 2) and the value of the ammonium ions expressed in mg NL^{-1} all three rivers had moderate ecological status and belonged to the class III of water quality (limit values for Class III: Ammonium ions = 0.6 mg N L^{-1}) [9]. Special attention was given to the indicator BOD_5 in surface waters - the indicator monitors the concentrations of biochemical oxygen demand (BOD_5) in rivers and provides a measure of the status of surface water in terms of biodegradable organic load. Obtained levels of BOD_5 are expressed in mg O_2L^{-1} and were: 3 at the location (L1) and 2 on locations (L2 and L3). On the basis of the test BOD_5 water belong to the class II ecological status. The limit value for Class II: BOD_5 = 4.5 mg O_2 L^{-1}[9]. The obtained results: ammonium ion (class III), and BOD_5 (II), the total phosphorus and orthophosphates (I-class II), nitrate (I-II) and I chlorides (I) are in accordance with the [14].

Table 2. Results of physico-chemical analysis

No	**Parameters of analysis**	**Unit of measure**	**Obtained value**			**Class of ecological status**				
			L1	**L2**	**L3**	**I**	**II**	**III**	**IV**	**V**
1.	Temperature	°C	13.7	14.1	13.9					
2.	pH value 20.8°C	/	8.4	8.4	8.4	6.5-8.5				<6.5; < 8.5
3.	Dissolved oxygen	mg O_2L^{-1}	12.6	10.7	11	8.5	7.0	5	4	<4
4.	Biochemical oxygen demand (after 5 days)		3	2	2	1.8	4.5	7	25	>25
5.	Total organic carbon	mg L^{-1}	5.6	8.5	1.1	2.0	5.0	15	50	>50
6.	Ammonium ion	mg N L^{-1}	0.2	0.2	0.2	0.05	0.1	0.6	1.5	>1.5
7.	Nitrates		<1	1.5	<1	1.5	3.0	6	15	>15
8.	Orthophosphates	mg P L^{-1}	0.06	0.15	0.1	0.02	0.1	0.2	0.5	>0.5
9.	Total phosphorus	mg L^{-1}	0.07	0.2	0.2	0.05	0.20	0.4	1	>1
10.	Chlorides		12.8	12.4	16.2	50	100	150	250	>250

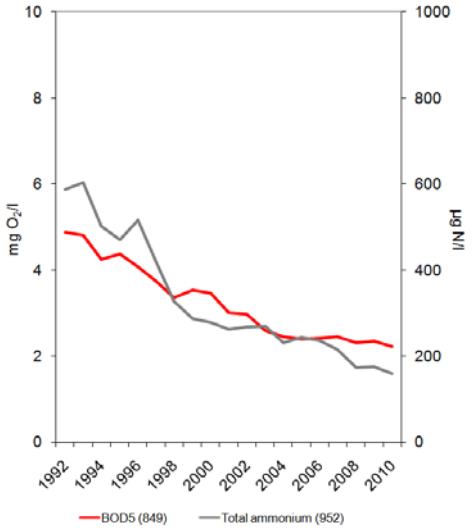

Chart 1. Biochemical Oxygen Demand (BOD_5) and total ammonium concentrations in rivers between 1992 and 2010 (European Environmental Agency) [15]

In European rivers, the oxygen demanding substances measured as BOD and total ammonium have decreased by 55 % (from 4.9 mg L^{-1} to 2.2 mg O_2 L^{-1}) and 73% (from 587 to 159 µg N L^{-1}), respectively, from 1992 to 2010 (Chart 1) [15].

Comparing the data of the European Environmental Agency on the quality of European rivers and data of the Agency for environmental protection of the quality of our rivers date on the basis of parameters BOD_5 (Serbia 2.5 mg L^{-1}, Western European rivers 1.5 mg L^{-1}, Eastern European rivers 3 mg L^{-1}) indicate that the quality of our rivers is better than the Eastern European rivers [16].

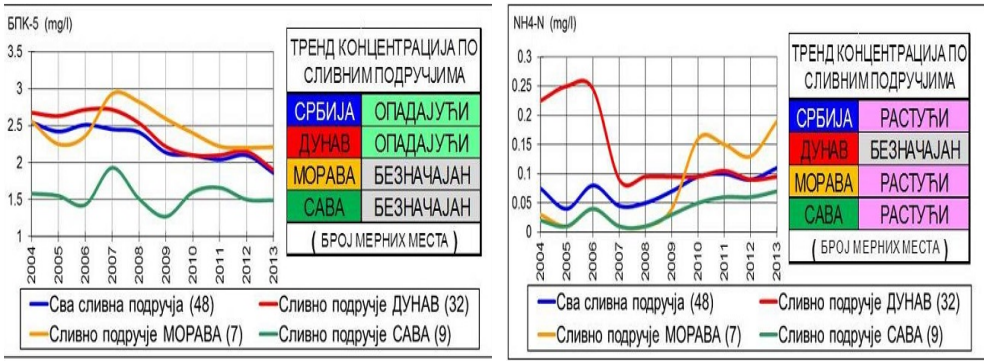

Chart 2. Median concentrations of BOD_5 and ammonium in rivers catchment areas of the Republic of Serbia [16]

The obtained results show that the analyzed water samples can be used for irrigation in order to reduce the effects of drought, and thus achieve high and stable yields and appropriate quality in agriculture. Investigated area represents the region where the grain crops are grown. Also in this area vegetable crops are intensively cultivated. So these data allow the safe use of water from small rivers for irrigation during the summer months because the water becomes necessary. This is especially important because most of farmers use the sprinkler irrigation system, they don't have the drip irrigation system.

Acknowledgement

We express gratitude to Company „Putevi" Čačak for the provided data.
This work is part of Project TR 31092 finaced by Ministry of education, science and technological development.

REFERENCES

1. Todd, D.K.: The Water Encyclopedia, Water Information Center, Port Washington, New York. 597 pag. (1970).
2. Voda-izvor održivog razvoja, inženjeri zaštite životne sredine 2011-Novi Sad, ISBN: 978-86-87145-07-8192 str. (2011).
3. Marjanović, T.: Karakteristike vode za piće sa aspekta zdravstvenog rizika objekta za centralno vodosnabdevanje u Požarevcu za period 2005-2009., Medicinski fakultet, Beograd (2010). (in Serbian).
4. Đukić, A.D., Ristanović M. V.: Hemija i mikrobiologija voda, Stylos, Novi Sad, 447 str. (2005). ISBN-13: 978-86-7473-205-2, ISBN: 86-7473-205-4.
5. Gavrilović, Lj., Lješević, M.: Voda kao uslov života i prirodni resurs, Zbornik radova sa Konferencije, Voda za XXI vek", Udruženje za tehnologiju vode i sanitarno inženjerstvo, Beograd (1999). (in Serbian).
6. Milojković, S. Fizičko-hemijska i mikrobiološka ispravnost vode za piće u seoskim naseljima na teritoriji grada Požarevca, Specijalistički rad, Poljoprivredni fakultet, Univerzitet u Beogradu, 169 str. (2014).
7. Panić, I.: Ispitivanje opštih fizičkohemijskih i radiohemijskih osobina voda Mataruške, Selters i Vrnjačke banje, Diplomski rad, Fakultet za fizičku hemiju, Beograd. (2009). (in Serbian).
8. Rajković, M.B.: Hemijske metode analize, autorizovana skripta, samostalno izdanje (M. B. Rajković), Zemun. (2010). (in Serbian).
9. Uredba o graničnim vrednostima zagađujucih materija u površinskim i podzemnim vodama i sedimentu i rokovima za njihovo dostizanje (Sl. glasnik RS 50/12). (in Serbian).
10. Pravilnik o parametrima ekološkog i hemijskog statusa površinskih voda i parametrima hemijskog i kvantitativnog statusa podzemnih voda, (Sl. glasnik RS 74/11); (in Serbian).

11. Pravilnik o nacionalnoj listi indikatora zaštite životne sredine (Sl. glasnik RS 37/11). (in Serbian).
12. Mašala A.: Bakteriološke osobine vode jezera na području Tuzlanskog kantona Veterinaria 58 (3-4), 219-228, Sarajevo (2009).
13. Nikolić S., Mojović Lj., Nikolić B.,Sekulič Lj., Milovanović D.: Zagađivači i kvalitet vode reka Veliki lug i Kubršnica na teritoriji opštine Smederevska palanka, UDK: 551.482.213/214.Vodoprivreda 0350-0519, 43, 252-254 p. 259-265 (2011) .
14. Rezultati ispitivanja kvaliteta površinskih i podzemnih voda za 2013. godinu: Agencija za zaštitu životne sredine, Beograd, 408 str. (2014).
15. http://www.eea.europa.eu/data-and-maps/indicators/oxygen-consuming-substances-in-rivers/oxygen-consuming-substances-in-rivers-5
16. http://indicator.sepa.gov.rs