

ASSESSMENT OF THE SURFACE WATER QUALITY USING WATER QUALITY INDEX (WQI). CASE STUDY: SOMEȘUL MIC RIVER, CLUJ NAPOCA, ROMANIA

Ioana PIȘTEA¹, Anca UNGUR¹, Carmen ROBA¹, Gabriela POPIȚA¹,
Cristina ROȘU^{1*}

¹ Babeș-Bolyai University, Faculty of Environmental Science and Engineering,
30 Fântânele Street, RO - 400294, Cluj Napoca, Romania

* Corresponding author: cristina.rosu@ubbcluj.ro, Phone: 0040(0)264307030

ABSTRACT. The paper investigates how the anthropogenic activities influence the Somesul Mic River water quality. A total of 194 water samples were collected from various sites along Somesul Mic River course, inside Cluj Napoca town, for seven months (November 2012 - May 2013). The physicochemical parameters such as: temperature, pH, redox potential (ORP), total dissolved solids (TDS), salinity, electrical conductivity (EC), calcium (Ca²⁺), magnesium (Mg²⁺), sodium (Na⁺), ammonium (NH₄⁺), potassium (K⁺), lithium (Li⁺), fluoride (F⁻), chloride (Cl⁻), nitrite (NO₂⁻), bromide (Br⁻), nitrate (NO₃⁻), phosphate (PO₄³⁻) and sulfate (SO₄²⁻) were determined.

In order to assess the Somesul Mic River water quality we had calculated the water quality index (WQI) which had the values between 25 (excellent) and 128 (unsuitable for drinking).

Key words: *surface water, Somesul Mic River, Water Quality Index (WQI)*

INTRODUCTION

For many countries of the world, including our country, as well, water demand in the whole country economy, far exceeds the available stock of their resources (Gruia et al., 1979).

There are waters that even in their natural state have unsuitable characteristics for any use. The industrial development and the demographic explosion have negative impacts on surface water quality. As a result of various socio-economic activities, surface water quality changes quantitatively and qualitatively more and more. The chemical substances that enter into the water produce imbalances in that aquatic environment (Lozan, 2002).

The Somesul Mic River forms at the union of Somesul Cald and Somesul Rece Rivers. It occupies 56.6 % of the Cluj Napoca County and it crosses the Cluj Napoca town from W to E (Stoica et al., 2013). The Somesul Mic River has a surface of 3773 km² and a total length of about 178 km. The main left tributaries are Somesul Cald, Nades and Chinteni and the main right tributaries are Somesul Rece, Fenes, Becas and Zapodie (www.rowater.ro)

The main purposes of the present study were: to provide information about Somesul Mic water quality, to assess the human impact on surface water quality through monitoring the global physico-chemical and chemical parameters.

In order to achieve the intended purposes, water samples were collected from Somesul Mic River, from 14 different points, for seven months (November 2012-May 2013) (figure 1). Each of the water samples was analyzed in the laboratory and the final results were interpreted using Water Quality Index (WQI).

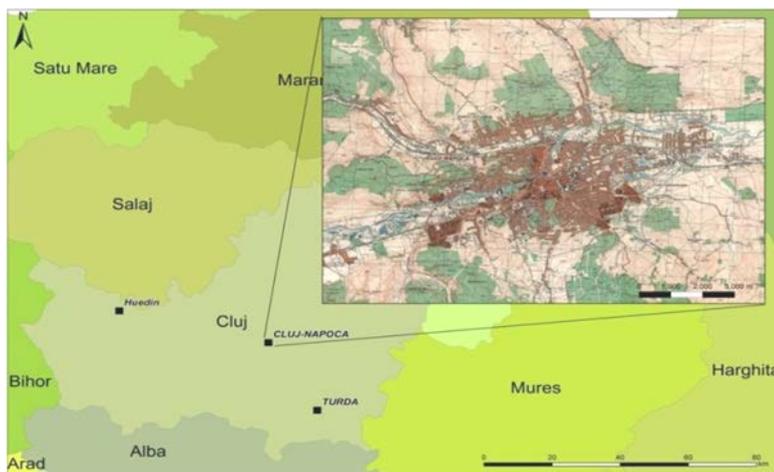


Fig. 1. *The study area*

STUDY AREA

The study area has a total length of about 2 km and it is located inside the Cluj Napoca town (figure 2). This area has been chosen because the human activities conducted in this area have a direct impact on Somesul Mic water quality.



Fig. 2. *The sampling points location*

EXPERIMENTAL

Using a multiparameter WTW inolab 720 we determined the following physicochemical parameters: temperature, pH, redox potential (ORP), total dissolved solids (TDS), salinity and electrical conductivity (EC). Calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), ammonium (NH_4^+), potassium (K^+), lithium (Li^+), fluoride (F^-), chloride (Cl^-), nitrite (NO_2^-), bromide (Br^-), nitrate (NO_3^-), phosphate (PO_4^{3-}) and sulfate (SO_4^{2-}) were analyzed using a ion chromatograph DIONEX ICS 1500.

To assess the Somesul Mic River water quality we had calculated the Water Quality Index (WQI)

Water Quality Index (WQI)

Using Water Quality Index (WQI) we can assess the overall water quality status in a single number (Puri et al, 2011)

In the present study, to calculate the water quality index, we used 10 analyzed water quality parameter like: pH, EC, TDS, Ca^{2+} , Mg^{2+} , Cl^- , NO_3^- , SO_4^{2-} , F^- , Na^+ . Water quality index was calculated using the following formula:

$$\text{WQI} = (\sum_{i=1}^n qiWi / \sum_{i=1}^n Wi)$$

where,

Wi = Weightage factor and it was calculated: $Wi = K/Si$

K = proportionality constant, and his value is 1;

Si = Standard value of the i^{th} water quality parameter;

n = the total number of water quality parameters;

qi = quality rating for the i^{th} water quality parameter and it was determined using the following equation: $qi = \{[(Va - Vi)/(Si - Vi)] \times 100\}$

Va = the value of the i^{th} water quality parameter determinate in laboratory,

Vi = ideal value of the i^{th} water quality parameter obtained from standard tables

Vi for pH = 7 and for the other parameter the Vi value is 0 (Srinivas P. et al., 2011; Yisa, Jimou, 2011; Amadi et al., 2010; Dua, Kumar, 2009).

RESULTS AND DISCUSSIONS

As we can see in figure 3 electrical conductivity doesn't have values higher than the maximum value. The sampling point C1, which is a channel, has the highest values, but not over the maximum admissible value.

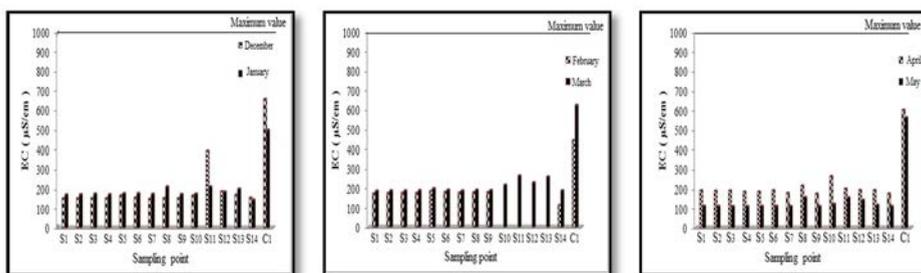


Fig. 3. Monthly fluctuation of Electrical Conductivity

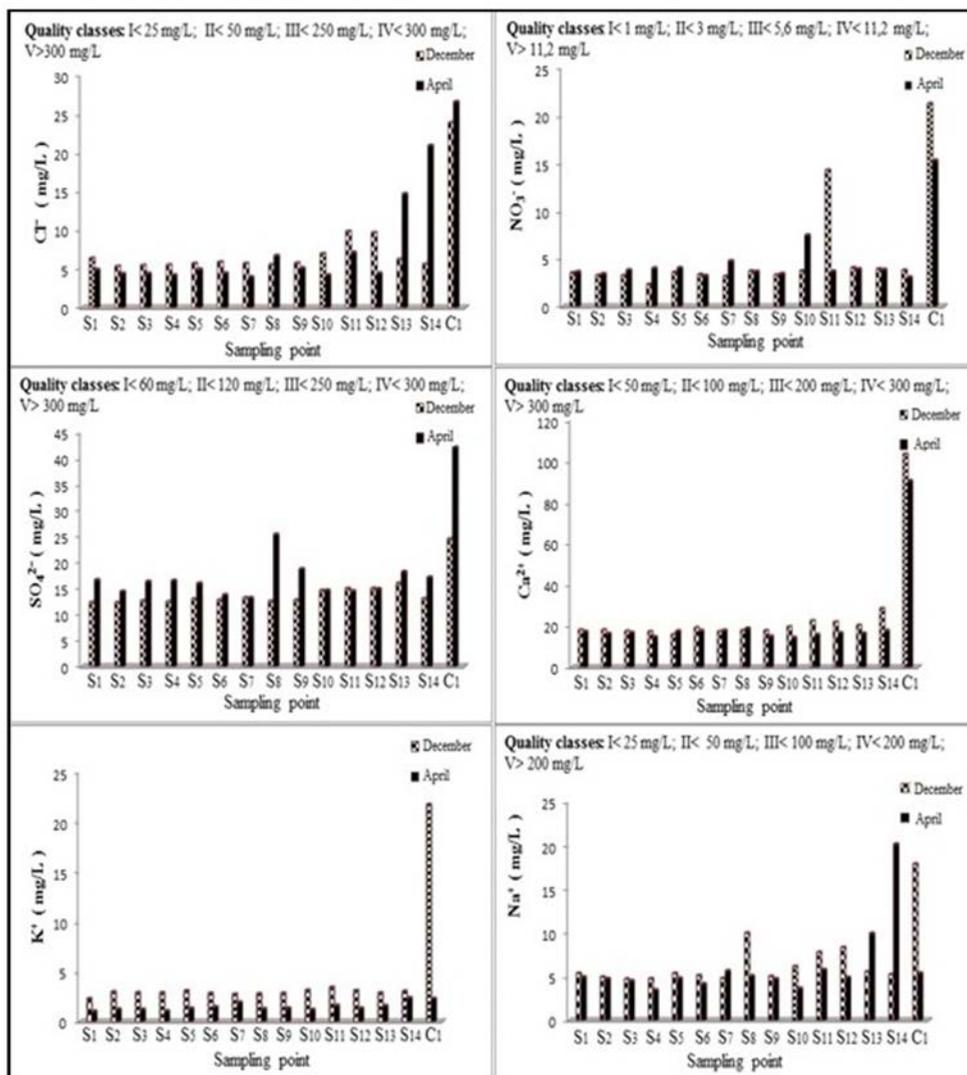


Fig. 4. Comparing Cl^- (mg/L), NO_3^- (mg/L), SO_4^{2-} (mg/L), Ca^{2+} (mg/L), K^+ (mg/L), Na^+ (mg/L) values in December 2012 with their values in April 2013, depending on the sampling point

In figure 4 we can notice that regarding the Cl^- , SO_4^{2-} and Na^+ , Ca^{2+} the water from Somesul Mic River is in Ist quality class, which means a very good quality. In terms of NO_3^- the Somesul Mic River water quality is in IInd quality class (good quality) except the sampling point 10 in April (IVth quality class, poor quality) and the sampling point 11 in December (Vth quality class, bad quality).

ASSESSMENT OF THE SURFACE WATER QUALITY USING WATER QUALITY INDEX (WQI)

After calculating the water quality index (WQI) (table 1 and figure 5), it can be seen that in general the Somesul Mic water quality is good, except the C1 sampling point, the channel, which proved to have very poor quality.

Table. 1. Water Quality Parameters, Standard Values

Parameter	Standard value (Si)	Ideal value (Vi)	Weightage factor (Wi)
pH	7.5	7	0.133
EC ($\mu\text{S}/\text{cm}$)	2500	0	0.0004
TDS (mg/L)	500	0	0.002
Ca ²⁺ (mg/L)	200	0	0.005
Mg ²⁺ (mg/L)	50	0	0.02
Cl ⁻ (mg/L)	250	0	0.004
SO ₄ ²⁻ (mg/L)	250	0	0.004
NO ₃ ⁻ (mg/L)	50	0	0.02
F ⁻ (mg/L)	1.2	0	0.83

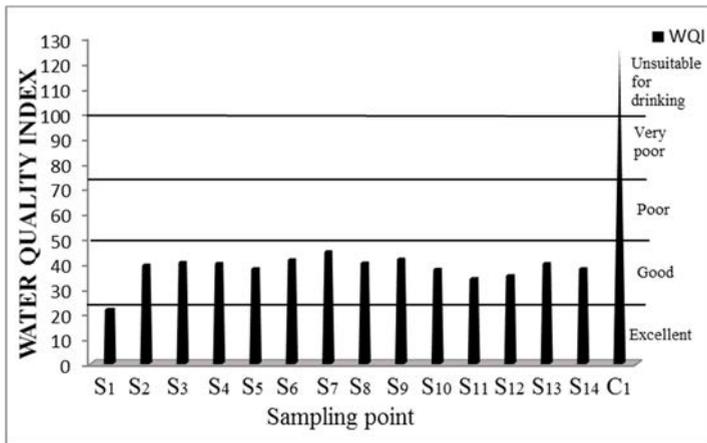


Fig. 5. Water quality index values for collected surface water samples from Somesul Mic River

CONCLUSIONS

As a result of monitoring Somesul Mic River water quality we can conclude that in general the Somesul Mic water quality is good. Only the water from the channel (sampling point C1) has higher concentrations for major ions but the channel flow is quite small and it does not affect the Somesul Mic River water quality.

It is very important to protect the Somesul Mic water quality, if we want to use this water source as a reliable source of water.

REFERENCES

- Amadi A.N., Olasehide P.I., Okosun E.A., Yisa J., 2010, Assessment of the water quality index of Otamiri and Oramiriukwa Rivers, *Physics International*, **2**:116-123.
- Gruia E., Marcoci S., Panaitescu G., Roman P., 1979, *Apa și Poluarea*, Științific and Enciclopedic Publishing, Bucharest, **14**:36-37.
- Kumar A., Dua A., 2009, Water Quality Index for assessment of water quality of river Ravi at Madhopur (India), *Global Journal of Environmental Sciences*, **8**:49-57.
- Lozan R., 2002, *Calitatea chimică a apei din râuri*, Chișinău, p. 5-12 and p. 20-22.
- Puri P.J., Yenkie M.C.N., Sangal S.P., Gandhare N.V., Sarote G.B., Dhanorkar D.B., 2011, Surface water (lakes) quality assessment in Nagpur city (India) based on water quality index (W.Q.I.), *Rasayan J.Chem*, **4-1**:43-48.
- Srinivas P., Pradeep Kumar G.N., Srinivatas Prasad A., Hemalatha T., 2011, Generation of Groundwater Quality Index Map-A case study, *Civil and Environmental Research*, **1 (2)**:9-21.
- Stoica F.S.T., Selagea H., Sarb M., Dulau R., Flood study in the Dej area, using modern computing technology. *Air and Water Components of the Environment*, 170-176.
- Yisa J., Jimoh T., 2010, Analytical studies on water quality index of river Landzu. *American Journal of Applied Science*, **7 (4)**: 453-458.
- www.rowater.ro - accessed on September 27, 2013