COMPARATIVE ANALYSIS OF THE CURRENT SITUATION OF FRESHWATER QUALITY IN THE MOUNTAIN AREA OF SUCEAVA COUNTY

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Abstract

The problem of freshwater quality is a topical one, not only in the mountain regions but in the world. At the same time, in the regional report, the quality is defined differently, the characteristics of natural sources being contrasting from a mineralogical point of view but also from the perspective of the content of other elements that deteriorate the water quality level. In order have a balanced assessment, in the case of Suceava County, four water quality monitoring stations in the mountain area and four stations outside the mountain ATUs were used, each parameter being analyzed under the Romanian legislative framework. Concurrently, based on the data provided, using the Water Quality Index Calculator, the results obtained indicate that the discrepancies are not so big between the mountain areas and the adjacent ones.

Keywords: *freshwater quality, WQI Calculator, turbidity, pH, nitrates, mountain ATUs*

INTRODUCTION

The quality of freshwater water is characterized by the value and level of the organoleptic, mineralogical, and physicochemical parameters that it possesses. Water quality is determined based on mineral or organic substances that are closely related to various particles, gases, or even microorganisms that distort the ideal state of this element which has a particularly important role in an ecosystem. Water supports and contributes radically to the proper maintenance and development of plant and animal diversity, but above all, maintains human life and activities at optimal operating parameters.

The area of Suceava County is strongly anthropized, which is correlated with an oscillating quality level. Human actions directly or indirectly affect the properties of natural waters. Thus, even if the freshwater cannot contain all types of impurities simultaneously, some parameters can be decisive when a water source is integrated into a class of a lower quality level. It is important to note that radioactive substances can be discharged into the natural water circuit and thus the thresholds can be exceeded. The freshwater quality can be affected. Industrial activities affect the entire hydrographic network, through various pollutants along with the urban agglomerations that are big consumers.

In Romania, the legislative framework of water quality is given by Law no. 458/2002 (republished) on drinking water quality, adapted, supplemented, and subsequently amended by Law no. 311/2004 and Government Ordinance no. 11/2010 respectively no. 1/2011.

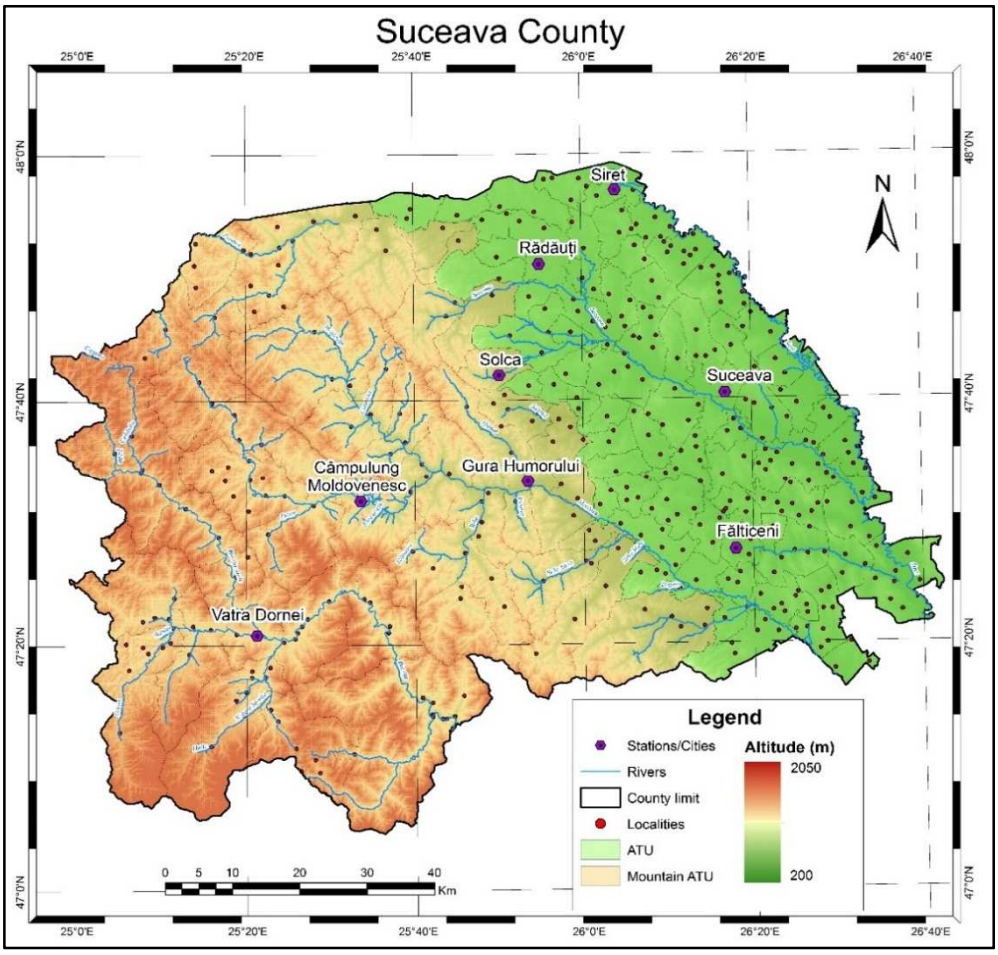

Fig. 1. Location of water quality monitoring stations in Suceava County

Located in northern Romania, in the eastern part of Maramureș County, northeast of Bistrița Năsăud County and on the border with Ukraine, Suceava County is part of the historical province of Bucovina and has its county seat in Suceava. It has an area of 8355 km^2, holding 3.6% of the country's surface, and is the second-largest, after Timiș County. It is crossed by the parallel of 47°34′48″ north latitude and by the meridian of 25°45′36″ east longitude, the shape of the amphitheater being its characteristic.

From the point of view of the areas where the water quality indicators are measured, reported, and calculated, the references are assigned to the 8 natural water quality monitoring stations, as follows: Vatra Dornei, Campulung Moldovenesc, Gura Humorului, and Solca located in the area mountain range of Suceava county, respectively Suceava, Radauti, Falticeni and Siret located in the non-mountainous area of the county.

MATERIALS AND METHODS

Primary data were provided by ACET S.A. SUCEAVA, the company that manages and supply the water resources at the county level. It permanently analyzes quantitatively, the relevant parameters in order to establish the water quality, for the eight different points for Suceava County.

Through the information and data published on the website www.acetsv.ro, it is specified that "the monitoring of drinking water quality is carried out according to the operational monitoring programs targeted by the Public Health Department of Suceava, under Law no. 458/2002 with subsequent amendments and completions and H.G. no. 974/2004 with subsequent amendments and completions. The physical-chemical and bacteriological analyzes are performed according to the standards".

This study considers the analysis of the following parameters: turbidity, pH, conductivity, total and minimum hardness, amount of ammonium, nitrates, nitrites, free residual chlorine and coliform bacteria (*Escherichia coli* (*E. coli*), *Enterococci*, no. of colonies at 22ºC and no. of colonies at 37ºC), according to www.water-research.net (Monitoring the Quality of Surface Waters (WQI Calculator)).

The parameters used as input were: turbidity, amount of nitrates, and pH, the rest of the elements, regardless of their weight, were inserted at values below the maximum allowable concentration because they are missing from the quality report of water issued by ACET S.A. SUCEAVA. In this way, using the optimal values, the water quality index is modified by the parameters for which there are primary data.

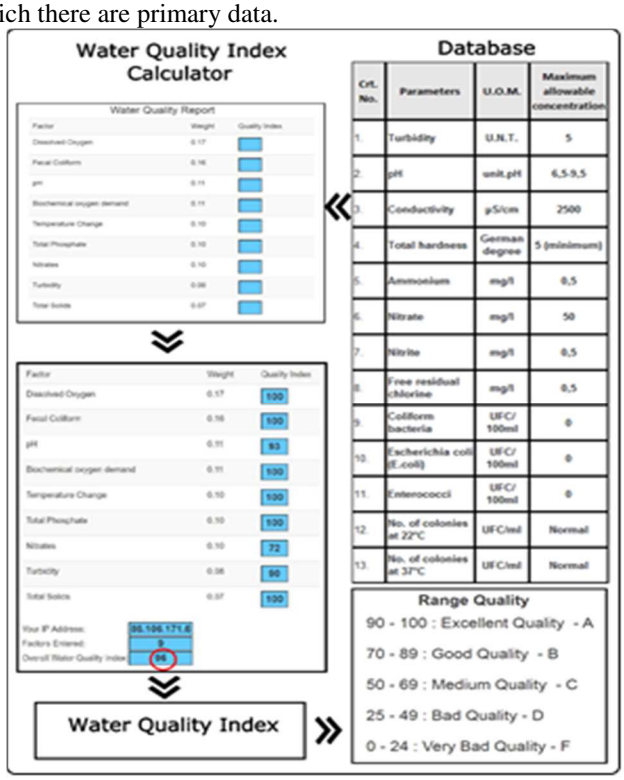

Fig. 2. Methodological scheme for calculating the Water Quality Index

The Water Quality Index calculator is an application that automatically generates a water quality indicator, based on the values of specific parameters, taken from the database of each reference point (the 8 stations). The weight of the parameters varies depending on the level in which the presence of an element influences as much as possible the degree of qualitative deterioration of natural waters. Their weight is 7% for solid elements and up to 17% for the amount of dissolved oxygen.

Finally, based on the results of the quality indicator, the class to which each sample belongs, the quality classes (A-F), varies from the attribute "Excellent" to "Very poor". The qualitative waters have a final coefficient of over 70/100.

The primary data (pH, turbidity, and nitrates) and the resulting water quality indicator were statistically verified using IBM SPSS Statistics. *Fisher's F-test* was initially applied to determine if the variances were equal or unequal. Depending on this, the second statistical test was performed, the *student's T-test* - with equal variances for nitrates and unequal for the other parameters. In all four situations, the results indicate that the means are homogeneous (t<t critical) and there are no statistical differences between the means in the mountainous area and those in the non-mountainous area.

Table 1

The elements quantified within the 8 monitoring stations from Suceava County

Crt. No.	Parameters	U.O.M.	Maximum allowable concentration	Vatra Dornei	Gura Humorului	Câmpulung Moldovenesc	Solca	Suceava	Fălticeni	Rădăuți	Siret
1.	Turbidity	U.N.T.	5	3,15	0,4	0,22		0,31	0,53	0,26	0,91
2.	pH	unit.pH	6,5-9,5	7,47	7,53	7,38		7,64	7,11	7,34	7,09
3.	Conductivity	µS/cm	2500	301	580	361		480	566	493	740
4.	Total hardness	German degree	5 (minimum)	5,41	16,28	10,4		12,67	13,59	11,93	20,4
5.	Ammonium	mg/l	0,5	0	0	0		0	0	0	0
6.	Nitrate	mg/l	50	3,89	10,46	6,98		4,22	23,75	9,97	30,56
7.	Nitrite	mg/l	0,5	0	0	0		0	0	0	0
8.	Free residual chlorine	mg/l	0,5	0,41	0,28	0,42		0,33	0,11	0,25	0,45
9.	Coliform bacteria	UFC/ 100ml	0	0	0	0	0	0	0	0	0
10.	Escherichia coli (E.coli)	UFC/ 100ml	0	0	0	0	0	0	0	0	0
11.	Enterococci	UFC/ 100ml	0	0	0	0	0	0	0	0	0
12.	No. of colonies at 22°C	UFC/ml	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
13.	No. of colonies at 37°C	UFC/ml	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal

RESULTS AND DISCUSSIONS

Following the analysis of the parameters available in the 8 monitoring stations and the introduction of the parameters available on the website: https://www.water-research.net/ index.php/.

The parameters recorded for the 8 stations have oscillating values. Regarding turbidity, the range is between 0.22 (Campulung Moldovenesc) and 4.72 (Solca), higher values being recorded in the mountain area (3.15 Vatra Dornei, 4.72 Solca). For the adjacent areas, the values do not exceed the threshold of 1 at the Siret station the turbidity value of 0.91 N.T.U. (nephelometric turbidity units) is reached. The maximum value allowed under the legislation is

5 N.T.U. However, the weight of 8% of the calculation model, turns the turbidity into an important parameter, but not decisive in the qualitative determination of natural waters.

Table 2

Water Quality Report - Results obtained from the use of the Water Quality Calculator

Water Quality Report	Quality Index							
Factor	**Vatra Dornei**	**Gura Humorului**	**Câmpulung Moldovenesc**	**Solca**	**Suceava**	**Fălticeni**	**Rădăuți**	**Siret**
Dissolved Oxygen	100	100	100	100	100	100	100	100
Fecal Coliform	100	100	100	100	100	100	100	100
pH	7,47	7,53	7,38	7,18	7,64	7,37	7,34	7,09
Biochemical oxygen demand	100	100	100	100	100	100	100	100
Temperature Change	100	100	100	100	100	100	100	100
Total Phosphate	100	100	100	100	100	100	100	100
Nitrates	3,89	10,46	6,98	9,21	4,22	24,05	9,97	30,56
Turbidity	3,15	0,4	0,22	4,72	0,31	0,44	0,28	0,91
Total Solids	100	100	100	100	100	100	100	100
Factors Entered	9	9	9	9	9	9	9	9
Overall Water Quality Index	96	94	95	93	96	92	94	91

In the case of nitrate values, the minimum is recorded in Vatra Dornei (3.89), in the mountain area, while the maximum is highlighted in the case of Siret station (30.56), outside the mountain area. High values are also found in the case of Falticeni station (24.05), the maximum allowed concentration regulated by Law no. 458/2002 is 50 mg/l. Variability of the pH is not large, oscillates between 7.09 and 7.64; the accepted value gap is 6.5-9.5 pH units.

The value of the water quality index is between 91 (Siret) and 96 (Suceava and Vatra Dornei), the lower values being given by the high values of nitrates and turbidity, overall, the average value for the mountain area is 94.5, and for the area bordering 93.25

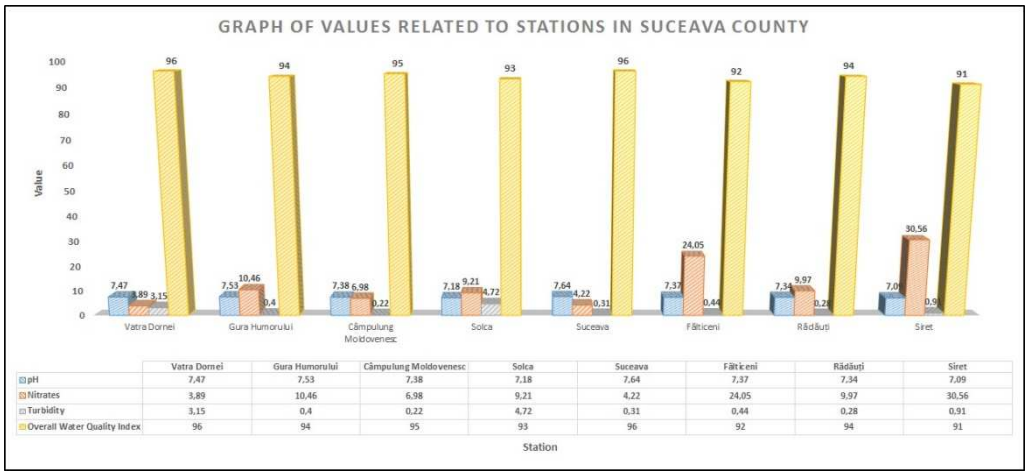

Fig. 3. Graph of values for the main parameters analyzed for Suceava County

CONCULSIONS

According to the indicators, the water quality level in Suceava County is high. The next step will be taken towards the efficient management of the planned measures to maintain and improve the water quality at the county level.

The values of the Water Quality Index show minor differences between the mountain area and the localities outside the mountain ATUs, the average WQI being 94.5 compared to 93.25. This demonstrated fact can demystify the idea of superior natural waters in the mountainous area, compared to the lower areas. Overall, compared to each parameter individually, higher quality values are observed in mountain areas, especially regarding the presence of nitrates; concentrations are low, although the statistical differences are not significant, the values of the indicators being homogeneous.

The next step in water management is to focus efforts in order to reduce organic and inorganic pollutants, to protect human health and the environment. "The population has increased, the need for water to produce goods and services has increased proportionally, the amount of water can not be separated total from the qualitative factor "(BOYD, 2015). It is essential for all mountain communities to properly manage this vital element.

The pollution-free areas in the mountain area ensure a balanced mineral content of the water, which is primarily due to the stability of the aquifers. At the same time, in the non-mountainous area, there is an intensification of land use for agriculture which can negatively change the quality parameters of the water, to the detriment of the mountainous area, where agricultural areas are less developed. "The effects of land use on water quality can be quantified in test basins, but at the regional level further investigations are needed" (LINIGER, 1995). Also, in mountainous areas, high rainfall values, densification of the hydrographic network or forest vegetation, can condition existing water resources and implicitly limit the pollution of underground sources, hydrological activity being lower in non-mountainous areas.

Integrated river basin management can generate equitable distribution and efficient use of freshwater.

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