THE INFLUENCE OF WATER ACCUMULATIONS EXISTING ON CRISUL REPEDE RIVER' MIDDLE COURSE ON HYDROLOGY AND QUALITY OF WATER

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Abstract
The paper presents the influence of the hydropower works of Lesu, Lugas, and Tileagd on Crisul Repede River hydrology and quality of water.
The values of main representative physical and chemical indicators were set in order to asses the quality class of water between January 2009 and September 2010, characterised by the some extreme weather phenomena.
The research assesses the impact that the above mentioned water accumulations have on the water use in the area contained between Bulz commune and Oradea City.

Key words: salinity, nutrients, eutrophication, oxygen condition, thermal condition, polluters.

INTRODUCTION

The Crisuri hydrographical area, formed by the following rivers: Ier, Barcau, Crisul Repede, Crisul Negru, and Crisul Alb totals a basin surface amounting to 25.537 sq km out of which 14.860 sq km, on Romania's territory. From East to West the profile of Crisuri hydrographical area encloses three geomorphologic areas, namely: 22.4% mountains, 29.2% hills, 48.4% plains, with a descending altitude in the same direction from 1849 m-Bihor Peak to 85 m- Crisul Alb Plain (Atlasul cadastral al apelor din România, 1992).

From petro-graphic and function of ground profile, the Crisuri basin' systems of beds belong to crystal lattice of Mesozoic age within mountain area on top of which the Mesozoic and Permian settlements lays in plains area. The western Romania' plain area is heavily shoaled with diorite sands, adobes, sands and with gravel dating back from Miocene and Pliocene ages . Crisul Repede River throughout its 2.517 km hydrographic basin located within Romanian soil out of the total of 3.024 km^2, and through its length of its course within our country of 150 km out of the total 209 km, represents the second river in size within Crisurilor basin. The basin has an asymmetrical shape

, the tributary streams streaming-down from the left bank out of the Gilau -Vladeasa, and Padurea Craiului Mountains having larger sizes and flow capacities than the ones streaming from Plopis (Ses) Mountains (Gâştescu P., Resursele de apă ale bazinelor hidrografice din România, Ed. Terra, anul XXXI (L1), vol.1-2, Bucureşti, 2002).

The Mesozoic formations of Piatra Craiului Mountains, developed on calcareous stone sub-layer, stimulated the formation of an highly interesting carst formation on the middle course of Crisul Repede River in the area of Suncuius-Vad Gorge.

From climate point of view, the Crisul Repede basin is classified as temperate - continental climate with some western – oceanic and Mediterranean - influences. Out of the data provided by the weather stations located at Sacueni, Oradea, Salonta, Borod, Stana de Vale, and Vladeasa, it outcomes that the average multi-annual temperature varies from 10°C (at the level of weather stations located in plains area), to 1°C (at the level of weather stations located in mountain area). Depending of ground profile and altitude, the amount of precipitations varies from 500-600 mm, in plains area, and 800-900 mm, in the hills, and wold areas, and 1400-1500 mm, in mountains areas. The average wind speed varies from 1-3 m/s in plain areas, and 6-7 m/s, in higher areas (Măhăra Gh. şi colab.,1999).

In order to preventing flood (Pop Gr., 1992, Sorocovschi V., 2002), during ’70s, on the middle course of Crisul Repede River and on its left bank tributary streams the following hydro-graphic reservoirs were arranged: Draganului Valley, Lesu, Lugas, and Tileagd.

Embankments and water storage dam arrangements, as well as the expanding of the localities and agricultural systems in the detriment of forest steppe they all caused soil and water polluting with pesticides and fertilizers (Pârvu C.,2001).

Simultaneously, the biodiversity was also affected, both in terms of biologic cycle and the evolution of samples number, and the frequency and dominance reports of its animal and vegetal living components (Dalea A., 2003).

MATERIAL AND METHODS

In order to asses the water quality condition, as against the complex use of the water course, we have monitored the evolution of physical and chemical indicators in the 5 sections, treated as fundamental: Section 1 - upstream of Lesu water storage dam, Section 2 - Bulz, downstream Lesu water storage dam, Section 3 - downstream Suncuius, and Vadu Crisului, Section 4 - Alesd, upstream Lugas water storage dam, Section 5 – upstream Tileagd water storage dam.

The measurements were performed between January 2009 and September 2010 during the periods where the demand pressure was at maximum for all water intended purposes (Anuarul hidrologic, Direcția Apelor Crişuri Oradea, 2000-2004).

A number of 5 sets of measurements (Mănescu S., 1994) were performed each year for each control (monitoring) section. The values showed in Table no 1 represent the average of measurements.The works methods are stipulated in the 161/2006 Standard – Quality of surface waters.

Tabel no.1

The values of parameters

Parameter	UM	valoare					
		section 1	section 2	section 3	section 4	section 5	NTPA-013 [6]
physic data							
volume	mc/s	-	8,6	12,4	16,5	23,1	-
temp.	°C	11,2	9,30	11,80	13,80	14,10	25
pH		8,20	8,10	8,30	8,30	8,20	6,5-8,5
MS	mg/l	6,80	9,70	7,30	8,00	9,80	25
oxygen condition							
OD	mgO/l	10,66	11,53	11,97	11,78	11,00	-
CBO5	mgO_2/l	2,44	2,17	4,03	2,68	2,71	<7
CCO	mgO/l	1,44	1,47	1,85	1,47	1,18	30
nutrients							
azotați	mgN/l	0,488	0,590	0,583	0,530	0,474	-
N-total	mgN/l	0,718	0,820	1,000	0,875	0,813	-
N Kjeldahl	mgN/l	0,225	0,226	0,421	0,380	0,332	3
$N\text{-}NH_4$	mgN/l	0,017	0,025	0,070	0,035	0,022	2
P-total	mgP/l	0,0238	0,0290	0,0332	0,0350	0,0338	-
$P\text{-}PO_4$	mgP/l	0,0053	0,0077	0,0130	0,0068	0,0136	0,4
salinity							
conductivity	µS/cm	88,80	133,33	209,17	197,75	234,75	1000
rez.filtrabil	mg/l	72,80	107,50	148,00	138,70	166,40	-
chlorine	mg/l	-	-	5,70	4,30	6,50	200
sulfate	mg/l	-	-	13,30	12,00	17,50	250
toxics polluters							
Cu	µg/l	1,36	1,93	2,25	5,95	4,13	50
Fe total	mg/l	0,04	0,10	0,13	0,12	0,17	1,0
Mn total	mg/l	0,013	0,032	0,020	0,020	0,043	1,0
Zn	µg/l	5,00	8,50	6,33	8,00	5,67	500

RESULTS AND DISCUSSIONS

From the weather and climate point of view, the 2 years contained in the current research are different, the 2009 being a droughty year, characterised by high temperatures and a low level of precipitations while the first 8 months of 2010 were reach in precipitations above the average and temperature has showed high fluctuations.

While analysing the indicators, one have noticed the following:

The annual average temperature has a linear raising trend from upstream to downstream, correlated with decrease of altitude and increase of water surface. The drop by 2 °C, within Bulz section as against the upstream Les water storage dam, is explained by the influence of free-discharges, involving the contribution of some large amounts of waters at 4°C temperature.

The pH level shows constant values at all sections.

The content of suspended matter shows a 10-30 percentage increase in all sections, located downstream from a water storage dam.

OD shows values relatively steady in all sections.

CBO5 shows a single significant raise in section 3, probably due to the low performance of Suncuius waste-water purifying plant which raises the bacteria charge of water.

Chemical consumption of oxygen, by both methods, show steady values on all sections.

Nitrates content show maxim values in sections 2 and 3, most likely due to the lack of an efficient purifying system, as well as to agricultural activities.

Nutrients (N, P, PO_4) content rises steadily from upstream to downstream.

The salinity rises homogeneously and significantly by up 250% in case of conductivity indicator.

The heavy metal content: Cu, Fe, Mn raise significantly from upstream to downstream, as a consequence of human related activities.

CONCLUSIONS

The set values do not overcome the maximum admitted limits imposed by NTPA-013/2002, throughout all sections of Crisul Repede River which water is classified in the first quality class.

Free-discharges, which temperate the high-waters (outrushes) and secure the downstream water flow capacity, modifies the thermal condition by its contribution consisting in 4°C water, a fact which impacts on the biological and feed condition of hydrobionts (Brezeanu. Gh. & Simion-Gruița Al.,2002).

Water stagnation in reservoirs (accumulations) determines the nutrients concentration, a fact leading to an increased water eutrophication and may influence its use downstream.

The large amount of water collected in dams induces a strong mineralisation, a fact leading, at its turn, to high salinity values.

The accumulation of matter in suspension modifies the water clearness and favours the development of some aphotic organism which, in the moment of discharge, has a qualitative impact on downstream ecosystem.

In their natural flow condition the water debits, measured upstream Tileagd water storage dam, show values varying from 13.8 - 23.6 m^3/s.

The role of water accumulations in high-waters' attenuation and debits containment is shown by the fact that at the level of upstream sections the maximum debits recorded were the following: 66.7 m^3/s - Bulz section, 30.3 m^3/s – Suncuius section, and 91.5 m^3/s-donwstream Tileagd section.

Taking into consideration the hydropower words planned to be deployed throughout above mentioned sections, starting with 2010, the continuation of our research work is a must (Planul de management al spațiului hidrografic Crişuri, Administrația Bazinală de Apă Crişuri Oradea, 2009).

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