THE QUALITY OF WATERS FROM JIU RIVER BASIN AS INFLUENCED BY HUMAN ACTIVITY

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Abstract

The paper presents the quality indicators of Jiu River in 2011 and 2012 years as infuenced by human activity, especialy fertilizers and manure aplication in 33 communes within Jiu River basin. The fertilizer quantity applied on a hectare varied between 22.5 and 68.5 kg/ha and the nitrogen quantity from manure ranged between 3 and 20 kg/ha; a certain ammount of these applied fertilizers and manure have been leached into soil profile or have been subject of surface runoof. In 2011 there was analized the water from Jiu River by taking water samples at 6 dates (14.01; 09.03; 03.05; 06.07; 09.09 and 10.10) and there was determined that the NO_3, NO_2, Nt and Pt contents were over MAC (Maximal Admissible Content) because of industrial spill and urban sewage slurry as well as of chemical fertilizers and manure. At water supplying stations from Jiu River basin all water quality indicators show a very good quality of water. In 2012 year the NO_3, NO_2, Nt and Pt contents were over MAC and the heavy metals content was under MAC, excepting Cu which overpasses MAC.

Key words: water quality indicators, Jiu River, fertilizers, manure

The pollution of waters can be defined as the phenomenon by which negative qualitative changes of natural properties unfold and have as a result the partial or total inutility of them. After the nature of sources that produce waters pollution it can be divided as follows: artificial, caused by the spill into waters of pollutants; natural, produced without man intervention, being caused by factors and phenomena with a random distribution and intensity. In order to maintain and improve the quality of waters there has been issued the Water Directive 2000/60/EC of European Parliament and of Council from 23.10.2000 called The Water Frame Directive. This directive is based on the economic realities and its objectives for water bodies are established in function on the user's necessities (Owen, 2011).

The objective of this directive is to set up a frame for inland waters protection, of transition waters, coastal waters and underground waters in order to ensure sufficient supply with water of good quality for sustainable, balanced and equitable use and a significant reduction of underground and surface waters pollution (Mocanu, 2013).Within a river basin the factors that determine the nutrient load are: industry, urban sewage, atmospheric deposits, agriculture and the natural system (Simon, 2000).

MATERIAL AND METHOD

Within Jiu River basin there was researched the quality of the Jiu River that is the main drinking water for 5 places: Craiova, Filiasi, Facai, Dabuleni, Isalnita) from Dolj District by taking water samples at 6 dates of determination during every year (2011 and 2012) and there were analyzed the following indicators: dissolved O_2, $N-NH_4$, $N-NO_3$, $N-NO_2$, Nt and Pt. The determination of these indicators has been made according with STAS 4706/1988.

The quality of water from this river basin has, also, appreciated by correlation with the quantity of fertilizers that was applied in the area per a hectare in the communes next to the River Jiu that, obviously determine nutrient losses into the running waters or leaching into the underground waters.

The Jiu River basin is located in S-W Romania at $43^0 45'$ - $45^0 30'$ Nordic latitude and $22^0 34'$ - $24^0 10'$ Eastern longitude. The altitude is 1,649 m in North and 24 m in South, at joint with Danube. The surface of the basin is 10,080 km^2 (4.2% of country total surface) of which 4,896 km^2 is arable land, with a length of 260 km, the average width being of 60 km in the upper part and 20 km in the lower part.

RESULTS AND DISCUSSIONS

The human population from Jiu River basin is 1,461,661 inhabitants (6.6% of country populace). The rocks from this area are silicate,

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lime of piocene and quaternary age. The water resources of the area are 4,059 million m^3/yr of which useable are 2,109 million m^3/yr . Within Jiu River basin there are 67 water accumulations with an useful volume of 147.61 million m^3/yr and 69 lakes and paddles. The main soil types are: chernozem, clay illuviated soils, stagnosoils, alluvial soils and sandy soils.

The using of fertilizers within communes nerby Jiu River basin

There have been analyzed all communes from Jiu River basin in the respect of fertilizer quantity applied; these data are presented below:

Table 1

Quantities of fertilizers applied in communes within Jiu River basin in 2011 year

Commune	Quantity of fertilizer, kg a.i./ha	Nitrogen fertilizer Kg/ha	Nitrogen quantity from manure, kg/ha
Almăj	54.1	37.5	4
Argetoaia	32.6	24.8	0
Bechet	42.0	33.5	12
Brădești	35.2	23.4	13
Bâlta	22.5	17.4	3
Braloștița	24.5	18.3	3
Bratovoiești	45.2	33.7	1
Breasta	40.1	29.5	5
Bucovăț	26.4	18.5	13
Călărași	45.0	34.5	11.5
Cotofeniidin Dos	32.3	24.6	8
Coțofenii din Față	29.4	21.2	4
Dobrești	38.5	24.8	7
Drănic	42.1	29.6	8
Filiași	33.6	24.5	6
Gângiova	37.2	25.6	7
Ghercești	37.7	28.2	6
Gighera	28.4	21.2	4
Ișalnița	68.5	51.4	1
Malu Mare	48.4	31.2	20
Ostroveni	36.1	25.4	5
Podari	41.5	30.8	9
Rojiște	31.5	24.3	7
Făcăi	24.2	17.9	1
Popoveni	30.4	21.8	1
Mofleni	25.6	19.4	2
Răcarii de Sus	31.3	22.8	2
Sadova	41.3	31.9	10
Scăiești	26.4	18.6	4
Șimnicu de Sus	37.4	21.3	7
Teasc	42.2	35.4	6
Țuglui	29.3	19.5	5
Valea Stanciului	35.6	22.5	6

The quality of Jiu River water

Within Jiu River basin, during 2011 year there have been determined water quality indicators at 6 dates: 14.01; 9.03; 3.05; 6.07; 9.09 and 10.10. There were, also, analyzed the drinkable waters from water supplying stations from Isalnita, Dabuleni, Calarasi and Facai (Craiova) at 03.05.2011 because the main source of water of these places is the Jiu River.

Table 2

Jiu River water quality indicators in 2011

Date	Indicators	MAC according with Document 161/16.02.2011	Values at		
			Racări	Podari	Malu Mare
14.01.2011	disolved O_2	9.0	11.28	11.60	8.91
	N-NH$_4$	0.4	0.131	0.435	0.298
	N-NO$_3$	1.0	1.173	1.125	3.075
	N-NO$_2$	0.01	0.028	0.029	0.012
	Nt	1.5	3.7	3.2	4.1
	Pt	0.015	0.048	0.033	0.240
9.03.2011	disolved O_2	9.0	12.08	11.76	10.18
	N-NH$_4$	0.4	0.126	0.236	0.263
	N-NO$_3$	1.0	1.188	1.297	2.175
	N-NO$_2$	0.01	1.016	0.022	0.027
	Nt	1.5	2.3	0.3	3.1

	Pt	0.015	0.083	0.050	0.012
3.05.2011	disolved O_2	9.0	9.81	9.03	7.16
	$N-NH_4$	0.4	0.382	0.195	0.341
	$N-NO_3$	1.0	1.487	1.332	2.114
	$N-NO_2$	0.01	0.015	0.024	0.018
	Nt	1.5	2.29	1.86	2.97
	Pt	0.015	0.049	0.051	0.093
6.07.2011	disolved O_2	9.0	8.78	8.09	7.73
	$N-NH_4$	0.4	0.392	0.347	0.273
	$N-NO_3$	1.0	1.126	1.173	2.516
	$N-NO_2$	0.01	0.012	0.024	0.036
	Nt	1.5	1.84	1.85	3.39
	Pt	0.015	0.031	0.041	0.066
9.09.2011	disolved O_2	9.0	7.28	7.61	6.90
	$N-NH_4$	0.4	0.316	0.181	0.850
	$N-NO_3$	1.0	0.917	1.652	2.354
	$N-NO_2$	0.01	0.022	0.023	0.044
	Nt	1.5	1.51	2.23	3.81
	Pt	0.015	0.078	0.058	0.113
10.10.2011	disolved O_2	9.0	9.44	9.70	10.01
	$N-NH_4$	0.4	0.205	0.138	0.269
	$N-NO_3$	1.0	1.012	1.211	1.785
	$N-NO_2$	0.01	0.023	0.023	0.031
	Nt	1.5	1.49	1.62	2.50
	Pt	0.015	0.047	0.058	0.091

MAC – Maximal Admissible Concentration

The dissolved oxygen overpasses the MAC value of 9 mg/liter in all three places of determination in January and March, with values between 10.18-12.08 mg/liter and in May the quantity of oxygen begins to dwindle (7.16-9.81), a little over MAC, recording values under MAC in July and September yet since October the oxygen quantity starts to increase again over passing MAC (9.44-10.01 mg/liter) due to temperature increasing that favors the microbiological processes from water.

The N-NH4 content is under MAC with all determination data and in all places of determination. The $N-NO_3$ overpasses the MAC of 1 mg/liter with all determinations, being between 1.17 and 2.35 mg/liter.

The $N-NO_2$ overpasses the MAC of 0.01 mg/liter with all determinations, having values between 0.016 and 0.036 mg/liter. The Nt and PT contents overpass the MAC with all analyzes.

The NO_3, NO_2, Nt and Pt record values over MAC due to industrial spill, sewage slurry from Craiova and Targu Jiu cities as well as due nutrient runoff losses from Jiu River basin. These nutrients are collected, especially from slope terrains, from zones where husbandries are not controlled and throw the manure near streams.

The situation of water supplying at the main stations along Jiu River basin as regard the quality is presented in the table below:

Table 3

Water quality at the main supplying stations along Jiu River basin

Supplying Station	Indicator	Unit	Value	Maximal values according with 458/2002 Law
Simnic	$N-NH_4$	mg/l	Absent	0.5
	$N-NO_2$	mg/l	Absent	0.5
	pH	U.I. pH	7.31	6.5-9.5
	$N-NO_3$	mg/l	3.97	50
Făcăi	$N-NH_4$	mg/l	0.24	0.5
	$N-NO_2$	mg/l	0.019	0.5
	pH	U.I. pH	7.20	6.5-9.5
	$N-NO_3$	mg/l	13.82	50
Işalniţa	$N-NH_4$	mg/l	0.2	0.5
	$N-NO_2$	mg/l	0.043	0.5
	pH	U.I. pH	7.71	6.5-9.5
	$N-NO_3$	mg/l	4.75	50
Bechet	$N-NH_4$	mg/l	0.4	0.5
	$N-NO_2$	mg/l	0.004	0.5
	pH	U.I. pH	7.51	6.5-9.5
	$N-NO_3$	mg/l	46.37	50
Călăraşi	$N-NH_4$	mg/l	1.8555	0.5
	$N-NO_2$	mg/l	0.008	0.5
	pH	U.I. pH	7.56	6.5-9.5
	$N-NO_3$	mg/l	2.25	50

There can be observed that the NH_4, NO_2 and NO_3 ions are under MAC and, sometimes absent, so the quality of drinkable water from the main water supply stations is good. Also, the water reaction comply with the 458/2002 law regulations.

In 2012 there have been made the following physical and chemical analyzes to water from Jiu River: temperature,, pH, dissolved oxygen regime, conductivity, alkalinity, main nutrients (N, NO_3, NO_2, NH_4, total phosphorus content, phosphates content, potassium, calcium, magnesium, iron) and heavy metals (copper, zinc, chrome, cadmium, lead and mercury) that are soluble in water.

The analyses of these indicators from Jiu water at 4 dates of determination have revealed the following aspects: the pH in all places and at all dates of determination had values between 6.55 – 7.61 that are within normal limits; the oxygen regime has been under MAC at the entrance of Jiu River in Dolj District (Filiasi) and in Malu Mare point and it decreased in July and September; the nitrates and nitrites content overpass the MAC at all dates and places of determination, the same with total nitrogen content yet the ammonia nitrogen content is under MAC; the phosphates content is under MAC with all dates and points of determination; the total phosphorus content is very high in comparison with MAC with all dates and points of determination; the potassium, calcium and magnesium contents are within normal limits;
- the heavy metals content is under MAC with all dates and in all points, excepting Cu that overpasses the MAC; there was recorded a decrease of the quality indicators since February till September due rainfall that dilute the load;

In general, the nutrient contents from Jiu River water decrease from the entrance in Dolj District (Filiasi) to middle point (Malu Mare). The heavy metals content increases because of sewage slurry of Craiova city (*tab. 4*).

Table 4

Jiu River water quality indicators in 2012

indicators	Unit	MAC	Filiasi				Podari				Malu Mare			
			Feb	Apr	July	Sept	Feb	Apr	July	Sept	Feb	Apr	July	Sept
Temp	^{0}C	-	3.2	10.5	25	20	2.8	10.5	24.0	21	2.1	9.2	25	22
pH	UI	6.5-8.5	7.60	7.61	7.40	7.62	7.75	7.69	7.16	7.53	7.46	7.42	6.55	7.25
$O_{diz.olvat}$	mg/l	9.0	11.60	9.03	8.09	7.61	11.28	12.08	8.78	7.28	8.91	4.10	6.96	7.73
Conductiv	µS/cm	-	443	259	359	276	323	336	238	317	337	329	415	390
Alcalinit.	mmol/l	-	1.96	1.76	1.96	2.93	2.16	2.18	1.64	1.68	3.24	232	246	2.54
NH_4^+	mgN/l	0.40	0.13	0.38	0.39	0.31	0.43	0.23	0.34	0.18	0.29	0.26	0.85	0.27
NO_3	mgN/l	1.0	1.17	1.48	1.12	0.91	1.12	1.29	1.17	1.65	3.07	2.17	2.35	2.51
NO_2	mgN/l	0.01	0.02	0.15	0.01	0.22	0.03	0.02	0.02	0.02	0.012	0.03	0.04	0.04
Nt	mgN/l	1.50	3.10	2.29	1.84	1.51	3.10	0.31	1.85	2.23	4.06	3.10	3.81	3.39
PO_4^{3-}	mgP/l	0.10	0.03	0.03	0.03	0.56	0.02	0.028	0.03	0.04	0.17	0.05	0.09	0.05
Ptotal	mgP/l	0.015	48	0.05	0.04	0.08	0.03	0.05	0.04	0.06	0.24	0.09	0.11	0.07
K^+	mg/l	-	5.70	1.6	2.40	2.80	22.0	2.00	1.80	2.30	3.90	2.20	2.10	3.20
Ca^{2+}	mg/l	50	40.28	36.90	38.50	48.35	43.0	55.43	43.80	28.96	59.78	45.90	48.60	43.8
Mg^{2+}	mg/l	12	8.06	7.40	7.66	9.57	8.62	11.10	15.10	5.79	11.96	9.19	9.73	7.86
Fe^{3+}	mg/l	0.3	0.07	0.11	0.33	0.12	0.06	0.20	0.15	0.21	0.13	0.03	0.15	0.12
Zn	µg/l	15	10.00	7.80	5.90	3.20	10.0	4.20	5.60	3.10	9.14	3.70	3.50	5.50
Cu	µg/l	1.3	5.90	7.30	5.90	2.60	8.7	1.10	6.30	2.80	9.4	4.20	4.30	4.90
Cr	µg/l	2.5	1.20	1.50	1.60	0.74	1.4	1.10	1.30	1.20	9.1	1.30	1.00	1.40
As	µg/l	7.2	2.30	2.10	2.00	2.20	2.1	2.20	2.10	2.00	2.0	2.00	2.00	2.00
Cd	µg/l	1.0	0.20	0.20	0.20	0.20	0.2	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Pb	µg/l	1.7	0.42	0.31	0.40	0.33	0.69	0.30	0.30	0.30	3.1	1.00	0.30	0.57
Hg	µg/l	1.0	0.12	0.12	0.11	0.10	0.14	0.11	0.12	0.10	0.14	0.13	0.15	0.13

CONCLUSIONS

During 2011 year, in the Jiu River basin the NO_3, NO_2, Nt and Pt contents were over MAC because of industrial spill and urban sewage slurry from Craiova and Targu Jiu cities. At water supplying stations from Jiu River basin all water quality indicators show a very good quality of water.

In 2012 year the NO_3, NO_2, Nt and Pt contents were over MAC and the heavy metals content was under MAC, excepting Cu which overpasses MAC.

REFERENCES

Mocanu, R., Dodocioiu, Ana Maria, Dobre, M., 2013 – *Managementul nutrienților*, Editura Sitech, Craiova.

Owen, R., 2011 – *Experience from the Water Frame Directive,* Aarhus University, Denmark.

Simon,J.C., Grignoni, C., 2000 – *Typologie des billons d'azote de divers types d'exploitation agricole: reserche d'indicateurs de functionment,* Agronomie 20, pag. 175-179.