CONTAMINATION OF SURFACE AND UNDERGROUND WATERS BY NITROGEN IN SOUTH-WEST OF ROMANIA

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ABSTRACT
Research was carried out in two localities in South-Western Romania, Latunas and Clopodia. The main goal of this research was to study the impact of rainfall in 2009 on nitrate, nitrite and ammonium accumulation in surface and underground waters in Latunas in June. There was the largest amount of nitrate, 209 mg/L because of the large amount of rainfall (111.6 mm). The high values of nitrate in October (115 mg/L), November (120 mg/L) and December (154 mg/L) was caused mainly by rainfall, more than the multiannual mean.
In Clopodia, in May-August 2009, nitrite and ammonium content values were below maximum admitted limit (0/50 mg/L) both in the water samples from drilling and in the water samples from wells, except for the water samples from wells in June 2009 – 2.44 mg/L (Latunas) and 0.72 mg/L (Clopodia). This accumulation was caused mainly by the rainfall above the multiannual mean – 118.6 mm in June 2009.

INTRODUCTION

Any human activity is a potential source of water pollution, be it direct or indirect. Water pollution probably started a few millennia ago, with the establishment of the first cities (KNOX, MOODY, 1991). Water pollution refers to the direct or indirect change of the composition or state of any source of water as a result of human activity: water thus becomes improper for its usual usages and risk to turn into a hazard for man's health and for the integrity of the aquatic ecosystems (BORZA ET AL., 1995).
Pollution by nitrates comes mostly from agriculture. Nitrogen is the main element for life and, when in water, it undergoes numerous chemical and biochemical processes. It thus appears mainly as nitrate, nitrite, ammonium, gas nitrogen and nitrogen fixed in organic compounds – groups between which there are continuous exchanges making up the "nitrogen cycle". Excess nitrogen leads to eutrophication, contamination of aquifers, possible damage of human health (methemoglobinemia in children, gastric ulcer in adults) (ALEXA., 2008).
Nitrate concentration in underground and surface waters is normally low, but it can reach high values as a result of agricultural practices or of soil contamination by human and animal wastes (organic residues). Anaerobiosis conditions favour the persistence of nitrites. The formation of nitrites is the consequence of microbial activity and this process can be intermittent (CUC, 2002).
Water can be very hazardous, if not fatal, particularly for little children. The reason is nitrites; substances resulted from the decomposition of nitrates in the water. The increase of nitrate concentration in the well water is caused mainly by the lack of hygiene (RADULESCU, 2003). The danger of infesting water with this substance is very high when latrines are only 4-5 m

deep and too close to wells. Nitrites are not destroyed by boiling (CUC, LAZUREANU., 2000).
As far as underground water sources are concerned, pollution produces through the infiltration of solid and liquid noxious substances caused by meteoritic waters that wash away the residues on the soil and of sewage waters that penetrate into the soil through pipe leakages (POPOVICIU, 2011).

MATERIAL AND METHOD

The main goal of this paper was to present research results of the impact of rainfall in 2009 on nitrate, nitrite and ammonium in the underground waters of South-Western Romania County. To carry out the research, we sampled on a monthly basis the water in the households of two villages: Latunas and Clopodia.
The small depth well in Latunas is 22 m deep. It belongs to a household and is located in its courtyard. The courtyard is paved with stone, but there are water quality issues because of the water that comes from the inner courtyard sloe. The water is now used only to water the animals and the crops. Water for food preparation and human consumption is taken from a monitored drill 130 m deep.
The well in Clopodia is 25 m deep. It is made up of concrete tubes 0.16 m in diameter. At present, its water is used only to water the animals and the crops. The drill here is 160 m deep, made up of steel pipes and it has a tap. At present, the water from the drill is generally used only as drinking water and to prepare food, and farmers who do not have a well in their courtyards also use it to water their animals.
Analyses for nitrate determination were made in Laboratory for the Measurement of Residues of the Department of Agro-techniques of the U.S.A-V.M.B in Timisoara.
The test used for nitrogen compounds studied from water samples were Spectroquant NITRATE 14 773 for nitrates, SPECTROQUANT NITRIT 14776 for nitrites and SPECTROQUANT AMONIUM 14752 for ammonium. The nitrate, nitrites and ammonium content were read to Spectrophotometer SQ 118 at wavelengths of 515, 525 respectively 690 nm.
Maximum admitted value for NO^-_3 in drinking water according to the Law nr. 458/2002 on drinking water quality modified and completed with Law nr. 311/2004 is 50 mg/L, for nitrite is 0.50 mg/L and 0.50 mg/L for ammonium.

RESULTS AND DISCUSSIONS

Results concerning the contamination of ground water by nitrogen compounds in South-Western Romania are shown in *Figures 1* and *2* and in *Tables 1*, *2* and *3*.
To note the concentrations varying within broad limits due to the volume of rainfall in 2009. In June, when there were 111.6 mm of water from the rainfall, there was the highest nitrate concentration of the year – 209 mg/L (*Figure 1*).
The presence of values above MAQ (50 mg/L) of nitrates at the beginning of the year must have been the result of a certain pollution by nitrogen organic substances, slightly biodegradable, caused by intensive agricultural practices and, implicitly, by the use of organic and mineral fertilisers.
The presence of some high values of nitrates in October (115 mg/L), November (120 mg/L),

December (154 mg/L) was caused mainly by rainfall that was higher than the multiannual mean.

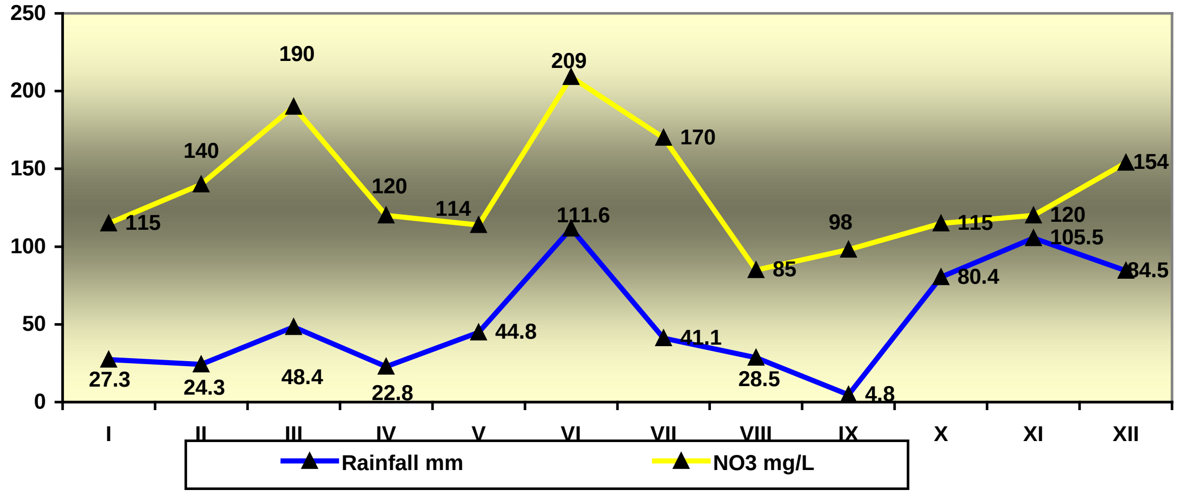

Figure 1. Nitrate content level (mg/L) in Lătunas depending on rainfall in 2009

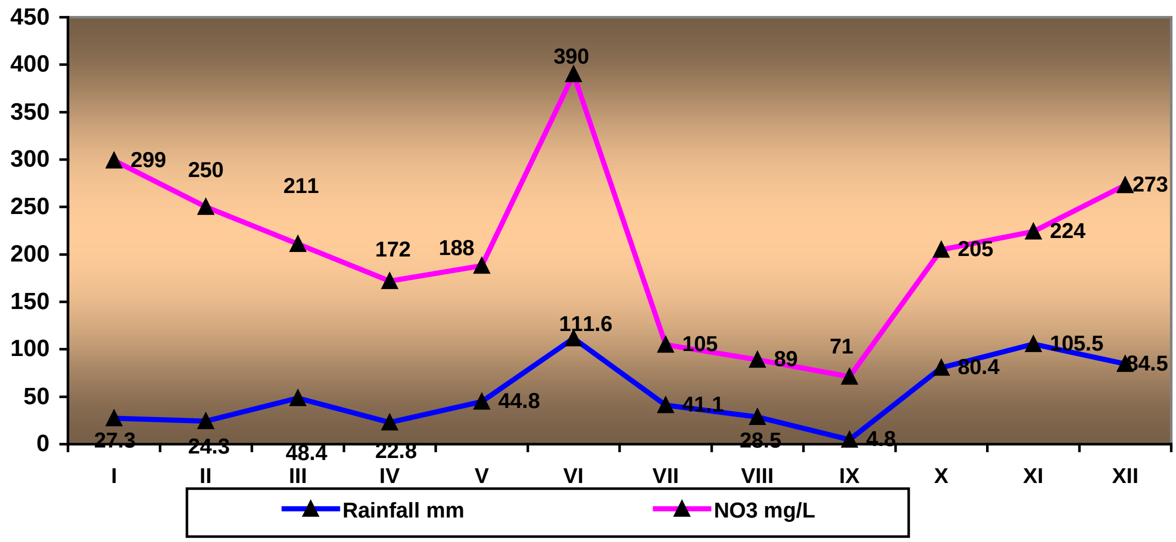

Figure 2. Nitrate content level (mg/L) in Clopodia depending on rainfall in 2009

The highest nitrate concentration was in June (390 mg/L), when the rainfall also reached their maximum level, and the lowest concentration was in September (71 mg/L) correlated with a precipitation volume of 4.8 mm (*Figure 2*).

Nitrate and ammonium content determined in January, February, March and April 2009 in the samples we analysed was not above the maximum admitted limit of 0.50 mg/L in neither of the two localities we monitored (*Table 1*).**Table 1. Contamination of surface and underground waters by nitrites and ammonium (January–April 2009)**

Sampling points	**January 2009**		**February 2009**		**March 2009**		**April 2009**	
	Nitrites mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L
Drilling Latunas	0.10	0.134	0.12	0.136	< 0.02	<0.1	< 0.02	<0.1
Well Latunas	0.22	<0.1	< 0.02	<0.1	0.03	<0.1	0.03	0.130
Drilling Clopodia	0.41	<0.1	< 0.02	<0.1	< 0.02	<0.1	< 0.02	<0.1
Well Clopodia	< 0.02	<0.1	0.28	<0.1	< 0.02	0.162	0.07	<0.1

Table 2. Contamination of surface and underground waters by nitrites and ammonium (May – August 2009)

Sampling points	**May2009**		**June 2009**		**July 2009**		**August 2009**	
	Nitrites mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L
Drilling Latunas	0.04	<0.1	0.11	<0.1	0.03	<0.1	< 0.02	<0.1
Well Latunas	0.35	<0.1	2.44	<0.1	0.15	<0.1	0.19	0.103
Drilling Clopodia	< 0.02	<0.1	0.19	<0.1	0.05	<0.1	0.15	<0.1
Well Clopodia	< 0.02	<0.1	0.72	0.203	0.28	0.209	0.21	0.115

During the period May-August 2009, the values of nitrite and ammonium content was below maximum admitted limit of 0.50 mg/L in both drilling water and in well water (*Table 2*), except for the samples from wells in June 2009 – 2.44 mg/L (Latunas) and 0.72 mg/L (Clopodia).

This accumulation was caused mainly by the rainfall, higher than the multiannual mean of 118.6 mm in June 2009. Rainfall during this period had no influence whatsoever on the quality of the water samples from drilling in the monitored area; in exchange, the values of the ammonium content in mg/L were higher in December than in the previous months, but without being above the maximum admitted limit of 0.50 mg/L (*Table 3*).

Table 3. Contamination of surface and underground waters by nitrites and ammonium (September – December 2009)

Sampling points	**September 2009**		**October 2009**		**November 2009**		**December 2009**	
	Nitrites mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L	**Nitrites** mg/L	**Ammonium** mg/L
Drilling Latunas	0.12	<0.1	0.10	<0.1	0.06	0.096	0.06	<0.1
Well Latunas	0.17	<0.1	0.09	0.03	0.19	0.413	0.25	0.404
Drilling Clopodia	0.03	<0.1	0.02	<0.1	< 0.02	<0.1	< 0.02	<0.1
Well Clopodia	0.02	<0.1	0.16	0.145	0.38	0.359	0.03	0.281

CONCLUSIONS

- To note the concentrations that varied within broad limits because the water samples came from different localities and from different sources. The values of organic substances above the maximum admitted limit of 50 mg/L involve the presence of a certain degree of pollution by nitrogen organic substances that are easy biodegradable.
- The concentration of nitrates in surface waters and, therefore, in underground waters, largely depends on the local surplus of rainfall and particularly on the value of this excess water. On the one hand, the danger of pollution by nitrates can be low in the years with abundant rainfall but with a low or very low level of nitrates in the soil due to their rapid dilution.

In addition, if in areas with high concentrations of nitrates the rainfall level is low, the risk of infiltrations is high.

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*** Romanian Government Law nr. 458/2002 on drinking water quality.