

## Correlations between rainfall and accumulation of nitrate in water samples from shallow wells of Timis County in 2009-2010

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**Abstract** Ground water provides drinking water for more than one-half of the earth population and is the only source of drinking water for many rural communities and some large cities. In order to determine the influence of rainfall on nitrate accumulation were monitored shallow wells in Timis county during 2009-2010. Analyses for nitrate determination were made with Spectroquant NITRATE 14 773 to Spectrophotometer SQ 118 at wavelengths of 515 nm. The quantity of precipitation in the 12 months of 2009, had oscillating values in most of the months, September 2009 was particularly dry being recorded only 4.8 mm, June, October, November and December 2009 were characterized by abundant precipitations, all this leading to accumulation of high nitrate values in all the 3 sampling points monitored. In 2010, it is noted months as May and June with abundant rainfall, which go far beyond yearly averages registering a nitrate content of 131.3 mg/L respectively 118 mg/L above maximum admitted limit of 50 mg/L. In autumn and winter months, concentrations of nitrogen compounds have maximum values and are due to frequent rainfall recorded during this time of year.

### Key words

nitrate, water, rainfalls, shallows

Ground water provides drinking water for more than one-half of the Nation's population and is the sole source of drinking water for many rural communities and some large cities [8].

A variety of chemicals, including nitrate, can pass through the soil and potentially contaminate ground water. Nitrate comes from nitrogen, a plant nutrient supplied by inorganic fertilizer and animal manure. Another nonagricultural source of nitrate includes lawn fertilizers, septic systems, and domestic animals in residential areas [5].

Beneath agricultural lands, nitrate is the primary form of nitrogen. It is soluble in water and can easily pass through soil to the ground-water table. Nitrate can persist in ground water for decades and accumulate to high levels as more nitrogen is applied to the land surface every year [2].

Can be mention that nitrate is not dangerous as itself ( $\text{NO}_3^-$ ), but nitrite ( $\text{NO}_2^-$ ) which derives from it, as well salts of nitric acid. This conversion reaction occurs in the digestive tract of man and animals, as well as storage prolonged by products of vegetable origin. In addition to nitrite, a deleterious influence on the body exerts secondary amines and nitro amines [7]. All these combinations being in higher amounts than the dose allowed in drinking water or fresh products, lead to destruction of hemoglobin in the blood, forming also meta hemoglobin. The last is particularly dangerous for children ("baby blue" syndrome or cyanosis) and young animals too. Nitro amines and

nitro amides have a carcinogenic, mutagenic and toxic effect over the embryo [1]. The maximum dose of nitrate accepted as safe for humans is about 5 ml of 1 kg of body weight [9].

Nitrites are intermediate compounds derived by oxidation of ammonia or by nitrate reduction by denitrifying bacteria. Nitrification is the biological oxidation of ammonia to nitrite ( $\text{NO}_2^-$ ) and then in nitrate ( $\text{NO}_3^-$ ) [4].

### Material and Method

In order to determine the influence of rainfall on nitrate accumulation in shallow wells in Timis county were taken monthly water samples in 2009-2010 in following points Padureni, Jamu mare and from a farm of KM6, near Timisoara.

Fountain from Padureni is dug to a depth of 16 m, is built of stone walls. Fountain of Jamu Mare is dug to a depth of 17 m and is located near the former farm Comtim in which were grown pigs. Well from Km 6, has 22 m depth, the well is used very rarely, only in case malfunctions occur to pumps from drilling.

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 nitrates from water samples was Spectroquant NITRATE 14 773. The determination is made based on colour reaction obtained by the reaction

of nitrate in the presence of concentrated sulphuric acid with the formation of a nitro derivative Nitrospectral with strong red colour. The nitrate values were read to Spectrophotometer SQ 118 at wavelengths of 515 nm. Minimum detection limit for nitrate according to the

method is: 1 mg / l. In concentrated sulphuric acid, nitrate ions react with benzoic acid and nitro compounds turns red, which is determined photometrical.

Table 1

Analytical quality of method according ISO 8466-1 [10]	
Parameters	Values
Standard deviation procedure	$\pm 0,21 \text{ mg/l NO}_3^-$
Coefficient of variation	$\pm 1,9\%$
Range accuracy.	$\pm 0,5 \text{ mg/l NO}_3^-$
Sensitivity	$0,10 \text{ mg/l NO}_3^-$
Accuracy	$\pm 0,7 \text{ mg/l NO}_3^-$

Maximum admitted value for  $\text{NO}_3^-$  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**.

### Results and Discussions

The obtained experimental results are shown in figures 1-6.

The quantity of precipitation in the 12 months of 2009, had oscillating values in most of the months, September 2009 was particularly dry being recorded only 4.8 mm, June, October, November and December 2009 were characterized by abundant precipitations.

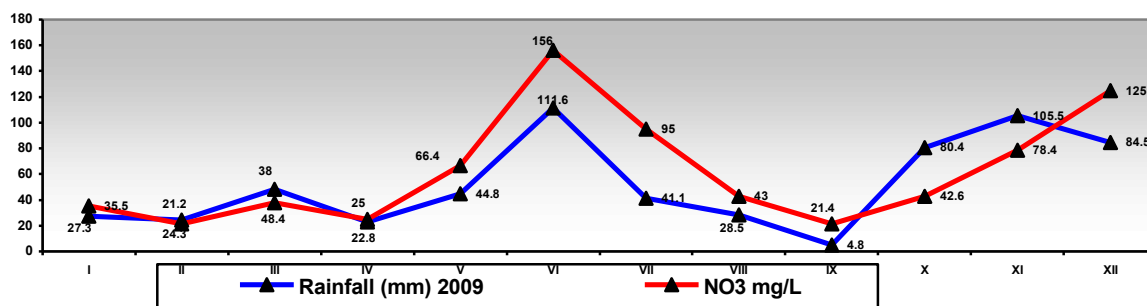


Fig. 1. Nitrate content level mg/L (Km 6) depending on rainfall in the year 2009

Was registered a direct influence of precipitation fallen in 2009 on the accumulation of nitrate in water samples from Km6 point. Therefore to a volume of 111.6 mm rainfall in June corresponds to a nitrate concentration of 156 mg/L, 3 times higher than the maximum admissible concentration of 50 mg/L (figure 1). The lowest nitrate concentration was registered in September 2009 (21.4 mg / L) when the amount of precipitation was only of 4.8 mm (figure 1), then, in

the following months October, November, December, with the increasing of the rainfall volume was growing also the nitrate concentrations (42,6 mg/L, 78,4 mg/L, respectively 125 mg/L) (figure 1) [6].

Fountain at Km 6 point, near Timisoara, has a depth of 22 m, is built with brick, the water level is 6 m deep. Water is used very rarely, only in case malfunctions occur from drilling pumps.

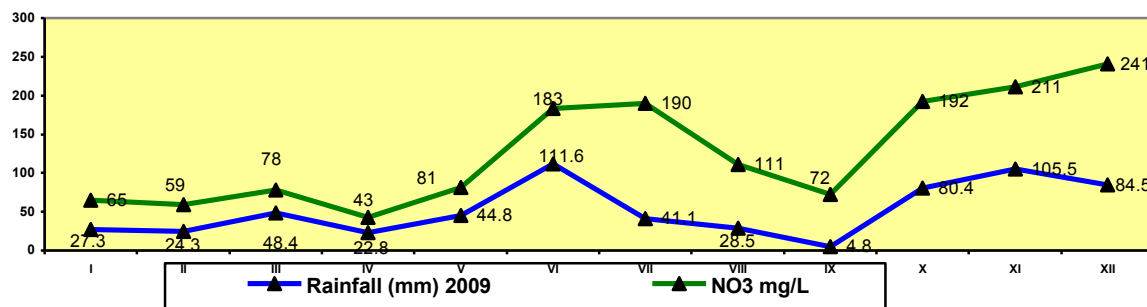


Fig. 2. Nitrate content level mg/L (Padureni) depending on rainfall in the year 2009

Between nitrate concentrations recorded during the year 2009, in water samples from the Padureni area, there are direct correlations so that to a lower amount of precipitation in the first half of the year (January-May) corresponds to nitrate values

below maximum admitted limit of 50 mg/L, but then, the high rainfall in June (111.6 mm), October (80.4 mm), November (105.5 mm) and December (84.5 mm) influence directly the accumulation of nitrate above the maximum allowed limit (figure 2).

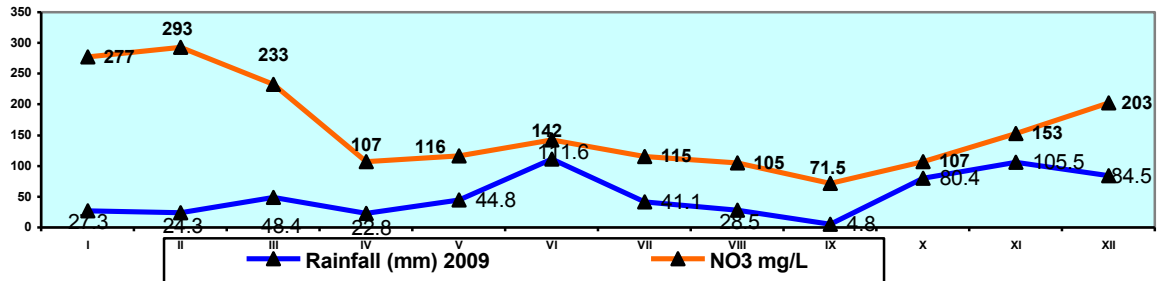


Fig. 3. Nitrate content level mg/L (Jamu mare) depending on rainfall in the year 2009

The fountain monitored in the locality Jamu Mare is 17 m deep, is located inside a household near the animal shelter. Water is used only to irrigation, laundry and animal consumption.

Nitrate values registered in 2009, varies in wide values, ranging from 71.5 mg / L (September) - 293 mg / L (February) (figure 3). Presence of high concentrations of nitrates, but no ammonia and nitrite, indicates the existence of an older process of organic pollution leading to contamination of water samples studied.

It is noted very high concentrations of nitrates in studied water samples, all over maximum limit allowed

(MAL) of 50 mg/L, the high rainfall having a contribution to those accumulation, but the greatest influence it has the sampling point location, near a animal shelter, whose manure can seep into the aquifer layer, polluting thus the fountain [6].

In 2010, it is noted months as May and June with abundant rainfall, which go far beyond yearly averages registering a nitrate content of 131.3 mm respectively 118 mm above maximum admitted limit of 50 mg/L (figure 4).

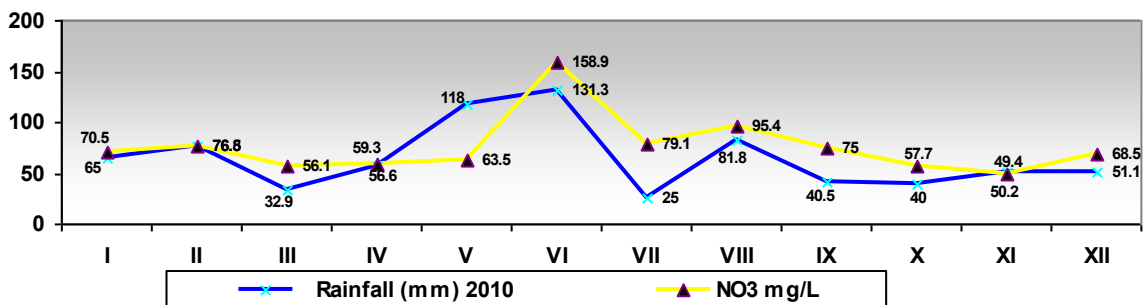


Fig. 4. Nitrate content level mg/L (Km 6) depending on rainfall in the year 2010

In 2010, water samples analyzed from Km 6 sampling point, register nitrate content values, higher than in 2009, a great influence on it having the higher volume of precipitation, fallen during the monitored months. The highest nitrate concentration was determined in June, when rainfall was 131.3 mm, resulting nitrate

accumulation in the surface underground waters of 158.9 mg / l (Figure 4).

2010, had extremely arid months, and excessively moist months, hence varies considerably also the risk of nitrate infiltration in shallows [6].

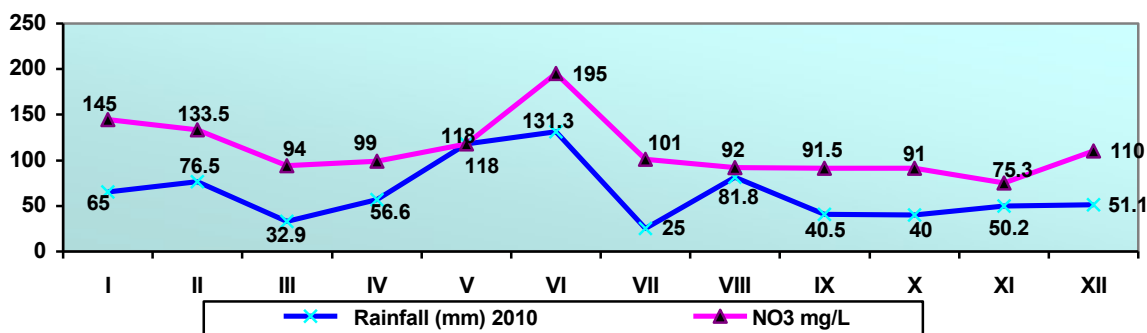


Fig. 5. Nitrate content level mg/L (Pădureni) depending on rainfall in the year 2010

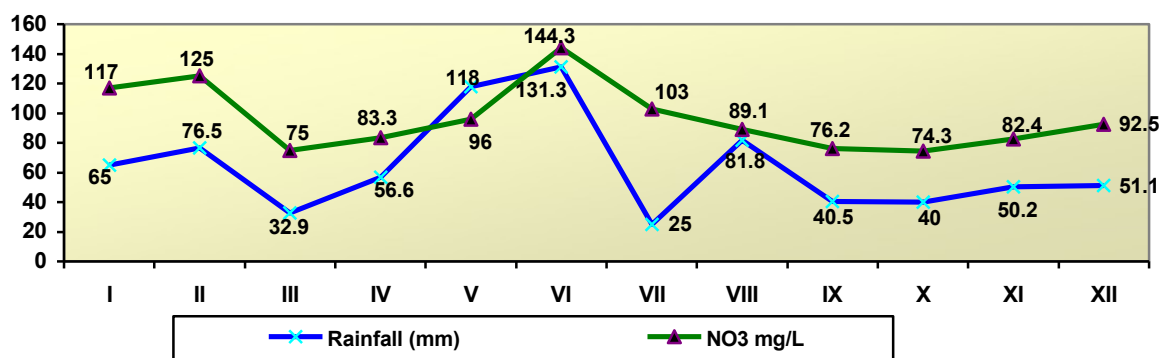


Fig. 6. Nitrate content level mg/L (Jamu Mare) depending on rainfall in the year 2010

In the localities Padureni (figure 5) and Jamu mare (figure 6) the quantities of rainfall in 2010, influenced largely the accumulation of nitrates in underground water and monitored shallow wells. The highest nitrate concentrations were determined in samples of Padureni, June (195 mg / L) (figure 5) and Jamu mare, June (144, 3 mg/L) (F\figure 6), month in which has fallen a maximum volume of precipitation (131.3 mm) [6].

Previous research achieved by *Cuc L., in 2000* and *Cozma A., in 2006*, in Timis county showed that water from shallow wells can be very dangerous, even fatal, especially for babies. Reason: nitrites, some substances resulting from the decomposition of nitrates in water. Increasing nitrate concentrations in well water is caused primarily by lack of hygiene. Nitrates are not destroyed by boiling [3; 4].

## Conclusions

- Nitrates in unpolluted surface water are in generally below 1 mg/L, sometimes up to 5 mg/L. In *under groundwater may reach 1000 mg/L*. Above 100 mg/L the water has a bitter taste and can be harmful causing methemoglobinemia to children.
- *Maximum admitted value for NO<sub>3</sub> 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.*

- In autumn and winter months, concentrations of nitrogen compounds have maximum values and are due to frequent rainfall recorded during this time of year.
- Unlike the 2009, year 2010, had extremely arid months, and excessively moist months, hence varies considerably also the risk of nitrate infiltration in shallows
- The quantity of chemical compounds leached into groundwater also depends on the geomorphological characteristics of the analyzed area. Structure and inclination of soil determine the groundwater layer movement. Leaching intensity increases once with the fraction of sands and gravels from soil, being instead stopped by clayey-silty soil layer, which occur in combination with chernozem soils in places where the underground water is gather in permeable aquifers horizons [1].

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