Monitoring of nitrogen compounds long ways Timis River basin

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Abstract The purpose of this paper is to monitor the content of nitrogen compounds (nitrates, nitrites and ammonium ions) of surface water taken from the Timis river. Were collected quarterly water samples from six checkpoints on the main course of the river, Slatina - Timis Caransebes, Lugoj, Gavojdia, Cebza, Graniceri points uniformly distributed between the springs and the exit point of the river, namely the border with Serbia. Framing control points on the river Timis river in quality classes highlights 3 superior sections qualitatively corresponding to I category quality. Control points Slatina- Timis, Lugoj and Caransebes shows low levels of nitrogen compounds which indicates high water quality on this section. Control points Gavojdia and Cebza register values of nitrogen compounds within the tolerances level of quality I, II and III. This section shows the trend of average pollution coming from diffuse pollution and from the natural sources. Graniceri checkpoint that collects wastewater from livestock represents the Timis river section with the highest level of nitrogen.

Key words
nitrates, nitrites, ammonium, Timis river

In the context of socio-economic development, water resources are subject to a strong process of decay, with adverse consequences on the environment and human health. Surface water quality does not remain constant over time, but may vary depending on natural or artificial sources of contamination, which requires permanent control on the concentrations of pollutants and to identify agricultural and industrial sources of pollution. Nitrogen is essential for life and in the water undergoes many chemical and biochemical processes. Nitrogen occurs mostly as nitrate, nitrite, ammonia, nitrogen and the fixed one into organic compounds which have continuous transformation groups, forming “nitrogen cycle” [10]. The presence of nitrogen compounds in water is normal and necessary, the existing concentrations after adjustment mechanisms functioning in natural and semi-natural ecosystems.

Water pollution with nitrogen compounds can cause damage to living and terrestrial organisms and aquatic ecosystems, endangering people's health, impairing the natural environment of the utilities and water damage [11]. Nitrates, nitrites and ammonia are formed in water, especially in decomposition and protein compounds mineralization that enter in surface waters with sewage or industrial waste from coke factories, benzene, slaughtering plants dairy products or fertilizers. Indirect various forms of nitrogen may reach in surface and groundwater water as a result of diffuse pollution from agriculture (intensive application of fertilizers) and livestock (animal breeders). The existence of ammonia in water and lack of nitrates indicates recent contamination of water. When water contains both ammonia and nutrient pollution is assumed that past a certain time. The lack of ammonia, but the presence of nitrates and nitrites implies that contamination occurred a long time. So, in this time, the water was auto cleaned. Drinking water with a higher content of nitrogen can cause methemoglobinemia to children, while the presence of high amounts of nitrates in water can have harmful effects on the body indirectly by lowering the general resistance and infections accompanied by favouring the production of respiratory and digestive affections. Currently in Romania surface waters are evaluated according to Normative 161/2006 which is achieved through surface water classification of ecological and chemical point of view [9]. Ecological status is evaluated based on biological quality elements, microbiological and physical-chemical and chemical status is evaluated based on contamination by hazardous substances (heavy metals and organic micro pollutants). River evaluation from ecological point of view led to the definition of five ecological status of quality:
• Class I - very good status, color coded blue;
• Class-II - good status, color coded green;
• Class-III - moderate status, color coded yellow;
• Class IV - poor status, color coded orange;
• Class VI - bad status, color coded red [9].

Quality objective to be achieved is class II of quality, very good status is attributed to a background reference [7]. Changes in water quality of natural causes can be significant over time. Variations depend largely on the hydrological regime of that surface water and the origin and physical-chemical and biological behavior of various constituents. For rivers, the largest and typical temporal variability is flow. This variation causes significant changes in the concentration of ions and other dissolved substances transported. On the one hand, it can be observed a decrease of some ion concentration once with flow increasing when diluted, on the other hand can be highlighted a small increase in concentration with increasing flow, in case of organic materials and nitrogen compounds which water runoff washes them off the ground and take them into the river. [10] Previous research made on the river Jiu [7] Aries [8] or Mures [6] reported a nutrient pollution (nitrogen and phosphorus) generated by the discharge of untreated wastewater from urban agglomerations and livestock farms. Also, groundwater surface monitoring in Timis County indicated a nitrogen load that exceeds the maximum limits generated by intensive agriculture, landfills and domestic animal farms in the adjacent area [1-5]. **Timis River**, the richest water resource of Banat Area River basin drains an area of over 5677 km², totaling a length of 244 km. Timis river provides water supply to municipalities Caransebes Lugoj and through Timis-Bega channel (Costei Hydro-technical node) supplemented Bega River stock to ensure water requirement of Timisoara [12].

In this study aim is to monitor water quality on the river Timis in Slatina Timis-Graniceri section, regarding the nitrogen content (nitrate, nitrite and ammonium) in the period 2011-2012. Also, based on the values obtained, was achieved the classification rate in different water quality classes according to Normative 161/2006.

**Material and Methods**

Timis river water quality was monitored quarterly in six control points on the main course of the river, Slatina-Timis Caransebeș, Lugoj, Gavojdia, Cebza, Graniceri, points evenly distributed between the springs and the exit point of the river, namely border with Serbia. Disposing of sampling points of the Timis river surface water is shown in Figure 1.

![Fig. 1 Sampling points on the river Timis](image-url)
**Collecting point Slatina-Timis (1)** is positioned on the superior course of the Timis river and can be considered as a reference point, control, being located upstream of potential sources of pollution point like Caransebeș, Lugoj towns and some factories and animal farming complexes.

**Collecting point Caransebeș (2)** is situated near water catchments socket for potable water in Plant no. 2 Caransebeș. Timis river water is used to supply the five infiltration basins (S = 1800 m² each) basins that supplement the underground flow of the 15 wells that provide 25% of the municipal water of Caransebeș rest of water being provided by Plant no. 2 that takes water from accumulating Zervesti.

**Collecting point Lugoj (4)**
The sampling point is located downstream of the Cebza point, at the intersection of parallel 45 °41’ north latitude and the meridian of 21°53' east longitude. Timis river go through approx.4 kilometres, divining the Lugoj city in two parts.

**Collecting point Gavojdia (3)** is located downstream of the confluence points of the Timis rivers and Nădrag Spai creek and with Bistra River, possible polluted affluents of Timis, but before of Lugoj city, an important possible source of pollution. At a short distance, about 10-15 km downstream can be found Plant no. 2 of potable water of Lugoj Municipality.

**Collecting point Cebza (5)** is situated downstream of the derivation Timis-Bega, downstream of waste water discharge from Lugoj Municipality, downstream of the discharge sewerage channel Bega-Timis and downstream of the confluence of creeks Surgani (going through Buzias) and Poganis, all possible sources of pollution.

**Collecting point Border (6)** is positioned close to the border with Serbia, about 7 km downstream of the confluence with the Lanca-Birda creek that collects wastewater from livestock farm belonging Ciocova locality and also downstream of the pig farm Peciu Nou which discharging manure directly into the Timis river.

Sampling and storage of water samples was made in accordance with ISO 5667-10, ISO 2852. Were collected medium water samples in the plastic material receptacles of approximately one liter.

The nitrate, nitrite and ammonium content was done from water after spectrophotometer detection using the rapid tests AQUA MERCK and the Spectrophotometer SQ 118 at a wavelength of 515, 525 and 546 nm for nitrate, nitrites and ammonium [13].

**Results and Discussions**

The experimental results regarding the nitrogen compounds content on the Timis river, being monitored in six sampling points and over two years (2011, 2012) are shown in Figures 2-7.

Ammonium content of the analyzed samples increases over the Timis river and classification of surface water quality in categories differ both from one sampling point to another and depending on the season. The lowest value corresponding to Class I surface water quality (<0.4 mg / l N-NH₄) is found in the sampling points Slatina-Timis, Lugoj and Caransebeș located upstream of sources of pollution, in the first and fourth trimester of years 2011.

The point with the maximum ammonium content (2 mg / l), corresponding to the lower quality class IV, is located near the border Serbia Graniceri and downstream livestock complexes from Peciu Nou. Was register variations regarding the ammonium content in collecting point Gavojdia with a maximum value of 0.38 mg / l in first trimester and minimum values of 0.20 to 0.21 mg / l corresponding to quality class I, during trimester III-IV.

**Collecting point Cebza** register maximum values (0.53 mg / l) in II trimester corresponding to the class of quality II with a tendency to decrease until the minimum value of 0.35 mg / l corresponding to maximum allowable level for surface water with I quality class (figure 2). Figure 2 shows the growing trend of ammonium load in surface water in the sampling points downstream from pollution sources.
In 2012 is preserved ascending profile of ammonium ion concentrations from downstream to upstream with maximum values recorded in Graniceri sampling point, where was registered a maximum of 1.67 mg / l ammonia-N, corresponding to a quality class IV. Sampling points Slatina, Caransebes and Lugoj fits into I class quality limit the values not exceeding 0.4 mg / L. In Gavojdia, Cebza and Graniceri points the values registered in the second trimester correspond to class II of quality and corresponding values to winter months (I trimester) with high rainfall levels, correspond to quality class III (0.85 mg / l Gavojdia 1 03 mg / l Cebza) (figure 3).

Nitrite content is low in surface water taken from Timis river, frame in I or II grade assigned according to Norm 161/2006 in superior water quality point of view, except for values recorded in the first trimester at Graniceri (0.062 mg / l). The trend is to increase the level of chemical compounds based on nitrogen from downstream to upstream with maximum values recorded at the exit point of Timis in Romania (Graniceri). Can be observed a decrease trend of nitric content in the second time of year when rainfall is lower (Figure 4). The values registered in 2012 in regarding the nitrite content in Slatina Timis, Gavojdia and Graniceri points, are below values registered in 2011, while in Caransebes and Lugoj points values in 2012 are compared with the previous year. Except Graniceri sampling point in trimester IV, falling in terms of nutrient content in category III of water quality, remaining sampling points correspond to surface water quality I or II with values ranging from 0.005 to 0.03 mg / l (figure 5).
Nitrate content determined in surface water of the Timis river is low and corresponds to I class grade (below 1 mg / L nitrate nitrogen), except Graniceri sampling point with a maximum of 2.01 mg N-NO3 / L corresponding to class II quality. In this case confirms the increasing trend of nitrogen content in the first decade of 2011 (Figure 6). In 2012, with the exception of Graniceri sampling point located downstream of pollution sources and the register values above 1 mg / L nitric nitrogen corresponding to quality class II, other sampling points correspond to surface waters classified in class I in terms of nitrate content (figure 7).

Fig. 4 Nitrite content (μgN / l) in water samples taken from the Timis river in 2011

Fig. 5 Nitrite content (μgN / l) in water samples taken from the Timis river in 2012

Fig. 6 The content of nitrates (mgN / L) in water samples taken from the river Timis in 2011
Based on experimental data obtained regarding the concentration of nutrients (ammonium, nitrite, nitrate) on Timis River has been tried the classification of surface water quality compared to general indicators according to Normative 161/2006. The framing of the control points on Timis river in quality classes highlight 3 sections qualitatively superior corresponding to quality category I. The control points Slatina-Timis, Lugoj and Caransebes shows low levels of chemical indicators which indicate high quality water on this section. The control point 2 corresponds water catchment socket to provide potable water for Caransebes, Timis river water is used for feeding the five infiltration basins with an area of 1800 square meters Every basins which themselves supplements the underground flow of the 15 wells that provide 25% of the Caransebes municipal water. In the case of control point 3, belonging to Lugoj municipality source of drinking water is also noted the absence of pollutants and indicators framing in the quality category class I.

The control points Cebza and Gavojdia register nitrogen compounds values within the tolerances quality levels of II and III category class of water quality. This section shows the trend of average pollution coming from diffuse and natural pollution sources.

The control point 6 situated near the Graniceri village, Timis County, represents the section with the highest pollution levels framing in quality class IV regarding the content of ammonium content, quality class III regarding nitrite content and class II for nitrate, which corresponds an overall assessment of quality class III regarding the content of nitrogen compounds. This section is the last on the Timis river before the border with Serbia. Surface water retains a certain state of ecological degradation caused by the contribution of wastewater to the Timis river and Lanca Birda creek that Timis confluence to about 7 km from Graniceri section. Creek Lanca Birda collects wastewater from livestock farms belonging Voiteni and Birda localities and the slow course and stagnant of manure cause deterioration of water quality.

Of the total length of watercourses in Timis hydrological basin supervised in 6 sections, has been calculated the percentage of the stream corresponding to the 5 quality categories of water depending on the content of nitrogen compounds.

In 2011 water share in quality category I in terms of of nitrate content is 86.66%, 38.33% depending on the nitrite content and 23.33% depending on the ammonia content.

Water quality in 2012, correspond to a Class I quality classification in 95% of the total length of Timis river, from the nitrate content point of view, of 45% depending on the nitrite content and 31.66% depending on the ammonium ion content.

Conclusions

• Surface water of Timis river taken from upstream points of possible sources of pollution such as cities Caransebes, Lugoj or some factories and animal farming complexes are included in Class I of quality.
• Collection points situated downstream of wastewater discharge from sewage and downstream of the confluence with the surrounding creeks that collects wastewater from livestock sector shows a high load of nitrogen compounds (nitrate, nitrite and ammonium ions) leading to an overall evaluation of studied water samples in II or III quality classes.
• Variations regarding the nitrogen compounds concentrations in water depend on the hydrological regime of the respective surface water and the origin and physical-chemical and biological behaviour of various constituents.
• In order to protect surface water quality monitoring measures are required to key indicators pollutants and effective management of waste from industry, livestock and agriculture activities.
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