INFLUENCE OF ANTHROPIC ACTIVITIES ON GROUND WATER IN BOLDUR, TIMIS COUNTY, ROMANIA

Laura ȘMULEAC, Silvica ONCIA, Anișoara IENCIU, R. BERTICI, A. ȘMULEAC, V. MIHĂIESC

Banat University of Agricultural Science and Veterinary Medicine from Timisoara, Faculty of Agriculture
laurasmuleac@usab-tm.ro

Abstract: *Water is the most widespread natural resource on Earth: it participates in all physical, chemical, and biological processes. Thus, water is present mainly in the evolution of life on our planet and in the evolution and the continuous change of the terrestrial crust. For the humans, water plays an exclusive role in all economic fields. In these conditions, water should be protected and carefully monitored. Yet, human activities bring about environmental pollution that is increasingly frequent, intense, complex, and long lasting. Pollution has become a serious issue and, as far as ground waters are concerned, it is even more serious, at least for two main reasons: it is the main source of drinking water also used in the food industry and, when polluted, the phenomenon lasts for long periods. If, not long ago, industry was considered the main cause of pollution, rural activities have started to draw specialists' attention because of their negative impact on the environment. The use of chemical fertilisers in agriculture is an active source of pollution of the water table with ammonia, nitrates, nitrites, phosphorus, etc.; animal farm complexes that release ammonia, urea, sulphured hydrogen, acids, and other substances into the soil add to the pollution. The lack of water treatment plants and the uncontrolled storage of wastes increase the risk of contamination of underground waters. In these conditions, it is necessary to establish the quality of ground waters, to identify pollution sources, and to establish measures to reduce pollution effects. The goal of the paper is to establish the quality of the ground waters in Boldur, Timis County, Romania. The authors monitored it through three drills. Water was sampled in June and November for the period 2010-2012. The main quality indices they determined were content of dissolved oxygen, nitrate content, nitrite content, ammonia content, content of total phosphorus, content of total nitrogen, and chloride content. Results show the type of impact of agricultural works on the quality of ground water in the area.*

Key words: *ground water, oxygen regime, nutrient regime, impact of anthropic activities*

INTRODUCTION

Continuous population growths, the development of anthropic activities, irrigation of agricultural lands have lead to a speedy increase of demands for and consumption of water from both surface and ground sources. At present, water sources are relatively well known both quantitatively and qualitatively, while ground water sources – though locally studied and researched in detail – have not been evaluated as hydric balance based on the hydro-geological potential of the basin (GIURMA, PĂCURARIU).

Ground waters are known as an ecological and economic value asset, and as a strategic resource; the measures that need to be taken aim at their proper use and at the maintenance of their natural quality (STRUCK ET AL., 2005).

The limited volume of ground water resources, the increasing demand for water and the appearance of very stable pollutants ask for a radical improvement of the management of all categories of water to ensure a balance between availabilities and demands (DOMĂȘNEANU, 2009). Ground waters can actually supply about 380 m^3/s of water from phreatic water layers and 80 m^3/s of water from deep waters. Ground water resources are less known: in general, they have low values of between 6 and 11 billion m^3/year.

In these conditions, water should be protected and carefully monitored. Yet, human activities bring about environmental pollution that is increasingly frequent, intense, complex, and long lasting. Pollution has become a serious issue and, as far as ground waters are concerned, it is even more serious, at least for two main reasons: it is the main source of drinking water also used in the food industry and, when polluted, the phenomenon lasts for long periods. If, not long ago, industry was considered the main cause of pollution, rural activities have started to draw specialists' attention because of their negative impact on the environment. The use of chemical fertilisers in agriculture is an active source of pollution of the water table with ammonia, nitrates, nitrites, phosphorus, etc.; animal farm complexes that release ammonia, urea, sulphured hydrogen, acids, and other substances into the soil add to the pollution. The lack of water treatment plants and the uncontrolled storage of wastes increase the risk of contamination of underground waters. In these conditions, it is necessary to establish the quality of ground waters, to identify pollution sources, and to establish measures to reduce pollution effects.

MATERIAL AND METHODS

The present paper aims at establishing ground water quality in Boldur, Timiș County, Romania.

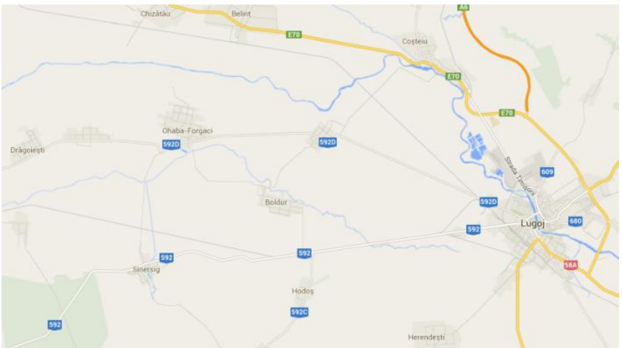

Figure 1. Location of Boldur, Timiș County, Romania

Water was sampled from three wells located on three different farms near the commune of Boldur. Water was sampled in June and November for the period 2010-2012.

The main indices we monitored were: pH, according to the SR ISO 10523-97, permanganate (SR EN ISO 8467-01), ammonia (SR ISO 7150/1-01), nitrate (SR ISO 7890/1-98), nitrite (SR ISO 6777-96), total phosphorus (SR EN ISO 6878-05), total nitrogen (SR ISO 10048-01), phenol (SR ISO 6439-01) and chloride salts (SR ISO 9297-01).

The results were interpreted and compared to the physical and chemical quality standards given in the Official Journal of Romania PART I, NO 511/JUNE 13TH, 2006 that establish five classes of water quality (I-V).

RESULTS AND DISCUSSION

Water samples from the **drill no. 1**, *in 2010*, had the following features: pH = 6.8 in June and 7.0 in November (figure 1); permanganate, 3.6 mg O_2/l in June and 4.7 mg O_2/l in November (figure 2); ammonia (figure 3) reached 0.2 mg/l in summer, much below the limit of the 1st quality water, and 0.6 mg/l (2nd quality class) in November; nitrate content (figure 4) was 0.25 mg/l in June and 1.00 mg/l in November, ranking the water 1st quality class; nitrite content (figure 5) ranked water 3rd quality class in June and 4th quality class in November; total phosphorus (figure 6), total nitrate and phenol below the limit of the 1st quality water in both months.

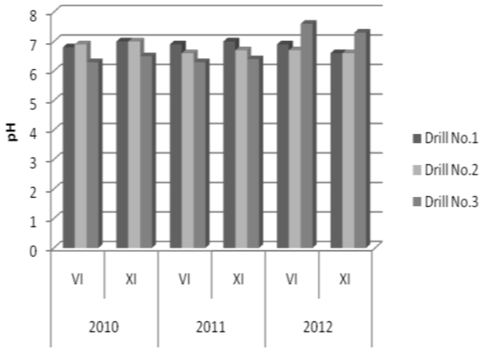

Figure 1. Evolution of pH

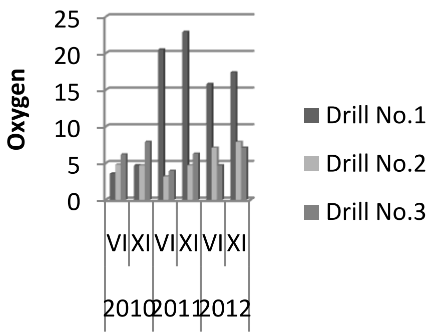

Figure 2. Evolution of oxygen content

In the experimental year 2011, water pH was 6.9 in June and 7.0 in November; permanganate content was much higher than in 2010, i.e. 20.5 in June and 22.9 in November; ammonia content was 2.0 mg/l in June, ranking water 4th quality class, and 0.8 mg/l in November (2nd quality class); as for the nitrate content, water ranked 1st quality class in June (1 mg/l) and 2nd quality class in November (3 mg/l); nitrite content was much higher than in 2010, i.e. 0.08 mg/l in June and 1 mg/l in November, ranking water 4th quality class; total phosphorus and phenol content were below the limit of the 1st quality in both months; total nitrogen content was 1.84 mg/l (2nd quality class) in June and 1.40 in November (1st quality class); chloride salt content increased from 30.17 mg/l in June (2nd quality class) to 71.00 mg/l in November (3rd quality class).

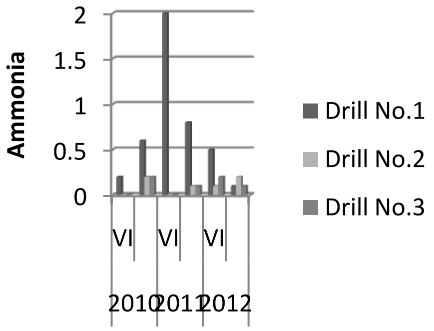

Figure 3. Evolution of ammonia content

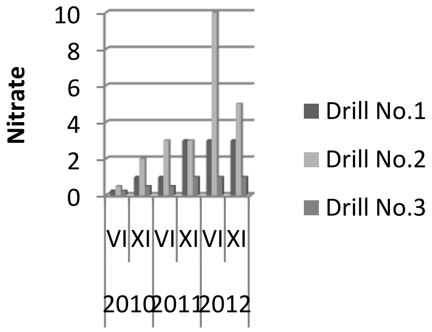

Figure 4. Evolution of nitrate content

In 2012, water pH was 6.9 in June and 6.6 in November; permanganate index increased from 15.8 in June to 17.4 in November; ammonia content decreased from 0.5 mg/l in June (2nd quality class) to 0.1 mg/l in November (1st quality class); nitrate content maintained constant (3 mg/l), ranking water 2nd quality class; nitrite content increased from 0.012 mg/l in June to 0.02 mg/l in November (2nd quality class in both months); total phosphorus had very low values in both months; chloride salt content was 49.7 mg/l in June (2nd quality class) and it increased to 60.4 mg/l (3rd quality class) in November.

The 2nd drill had a pH similar to that of the 1st drill *in 2010*, i.e. 6.9 in June and 7 in November; permanganate index was 4.8 in June and kept constant (4.7) in November; ammonia content was very low, much below the limit of the 1st quality class; nitrate content was 0.5 mg/l in June (1st quality class) and it increased to 2 mg/l (2nd quality class); nitrite content ranked water 3rd quality class in both months (0.04 mg/l in June and 0.06 mg/l in November); total nitrogen, total phosphorus and phenol index were all below the limit of the 1st quality class in both months.

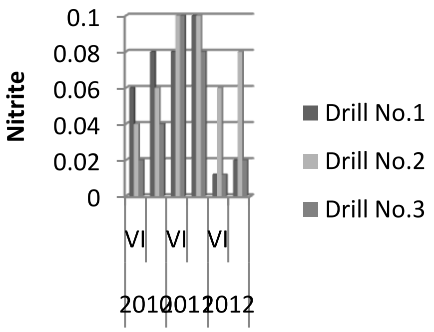

Figure 5. Evolution of nitrite content

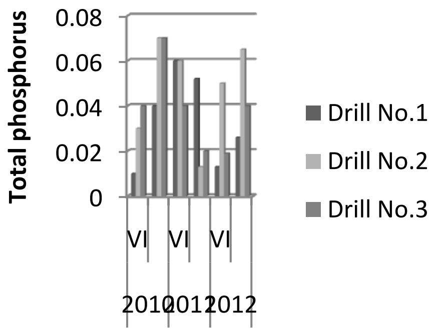

Figure 6. Evolution of total phosphorus content

In 2011, water pH was 6.6 in June and 6.7 in November; permanganate index was 3.2 in June and it increased to 4.7 in November; ammonia content was below 0.01 mg/l in June and it increased to 0.10 mg/l in November, remaining below the limit of the 1st quality class; nitrate content was constant in both months, ranking water in the 2nd quality class; as far as the nitrite content is concerned, water ranked 1st quality class in both months; total nitrogen, total phosphorus and phenol index were below the limit of the 1st quality class in both months; chloride salt content was constant in both months, i.e. about 30 mg/l, ranking water in the 2nd quality class.

In the experimental year 2012, water pH remained constant – 6.7 in June and 6.6 in November; permanganate index was higher than in the preceding years, i.e. 7.1 in June and 7.9 in November; ammonia content was below the limit of the 1st quality class in both months; nitrate content was maximum in June, i.e. 10 mg/l (4th quality class) and decreased to 5 mg/l in November (3rd quality class); nitrite content was high, i.e. 0.06 mg/l in June (3rd quality class) and 0.08 mg/l in November (4th quality class); total phosphorus had insignificant values in both months; chloride salt content had the highest values in the three drills and in the three years, i.e. 136.7 mg/l and 138.5 mg/l, ranking the water 3rd quality class from this point of view.

Analysis of the water samples from the **3rd drill** pointed out that, *in 2010*, water was slightly acid – its pH was 6.3 in June and 6.5 in November; permanganate index increased from 6.2 to 7.9 in November; ammonia and nitrate contents were very low, much below the limit of the 1st quality class; nitrite content ranked water 2nd quality class in June and 3rd quality class in November; total nitrogen, total phosphorus and phenol index were below the limit of the 1st quality class in both months.

In the experimental year 2011, water pH remained slightly acid in both months, i.e. 6.3 in June and 6.4 in November; permanganate index increased from 3.95 mg O_2/l in June to 6.3 mg O_2/l in November; ammonia and nitrate contents maintained low this year too, below the limit of the 1st quality class; nitrite content decreased from 0.1 mg/l in June to 0.08 mg/l in November, with values ranking water in the 4th quality class; as in the preceding year, total phosphorus had very low values, total nitrogen maintained below 1 mg/l and phenol index maintained below 0.1 mg/l; chloride salt content ranked water in the 1st quality class in June (24.85 mg/l) and it increased a little above the value of the 1st quality class, reaching 30.2 mg/l.

In 2012, water pH became slightly basic, i.e. 7.6 in June and 7.3 in November; oxygen content increased from 4.7 (3rd quality class) in June to 7.1 mg/l in November (2nd quality class); ammonia content maintained at low levels, and nitrate content remained constant, below the limit of the 1st quality class (1 mg/l); nitrite content increased from 0.012 mg/l to 0.02 mg/l, ranking the water in the 2nd quality class; chloride salt content was constant in both months, i.e. 35.5 mg/l, ranking the water 2nd quality class.

CONCLUSIONS

In the case of the 1st drill, water pH was neuter to slightly basic in the three study years. Oxygen content was low only in the first year, while in the years 2011 and 2012, water was 1st quality from this point of view. Ammonia content oscillated between 1st quality and 2nd quality in the years 2010 and 2012, reaching 4th quality in 2011. If, from the point of view of the nitrate content, water ranked 1st quality class, from the point of view of nitrite content it was much more loaded. In general, total nitrogen content, total phosphorus and phenol index were below the limit of the 1st quality class. Chloride salt content increased ranking the water 2nd quality and 3rd quality.

Water samples from the 2nd drill pointed out a slightly acid pH, a low content of water oxygen (3rd quality class), and an ammonia content below the limit of the 1st quality class in the three experimental years. Nitrate content maintained at the level of the 2nd quality class, except for the year 2012, when the values ranked the water 3rd and 4th quality classes. Except for 2011, nitrite content had high values – 3rd and 4th quality classes. Total nitrogen, total phosphorus, and phenol index were below the limit of the 1st quality class. Chloride salt content increased from the level of the 2nd quality class in the experimental year 2011 to the level of the 3rd quality class in 2012.

In the case of the 3rd drill, water pH changed slightly from slightly acid to slightly basic in the three experimental years; oxygen content increased from values ranking the water in the 3rd quality class to values raking it 2nd quality class; ammonia and nitrate contents maintained in this drill too below the limit of the 1st quality class; nitrite content fluctuated from the level of the 2nd quality class to the level of the 4th quality class; total nitrogen, total phosphorus and phenol index were below the limit of the 1st quality class; chloride salt content was constant, below the limit of the 1st and 2nd quality classes.

In general, drill water was good quality; the highest values above maximum admitted limits were in nutrient regime because of the fertilisers applied on agricultural lands and because of domestic waste waters.

BIBLIOGRAPHY

1.ASAFTEI B., 2012 România rămâne fără apă, Econtext, www.econtext.ro
2.DOMĂȘNEANU ANDREEA, 2009 – Hidrologie generală, Ed. Marineasa, Timișoara
3.GIURMA I., CRĂCIUN I, GIURMA CATRINEL, 2003 – Hidrologie și hidrogeologie, Ed. Gh. Asachi, Iași
4.PĂCURARIU P., CĂRĂBEȚ A., SCHIMEK V., 1994 – Hidrologie și hidrogeologie, Ed. Universității Tehnice Timișoara
5.SMULEAC LAURA, SILVICA ONCIA, 2012, Resurse de apă și protecția lor, Ed. Agroprint Timișoara,
6.STRUCK W., RUBI Y., 2005 – Ground water: reservoir for a thirsty planet?, Ed. EartH Science for Society
7.*** Official Journal of Romania, Part I, No 161/ 2006