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ASSESSMENT OF NITRATE POLLUTION IN FIZES WATERSHED

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Abstract: River streams together with the adjacent riparian zones constitute essential multifunctional elements of the ecological network worldwide. Water Framework Directive demands a concerted approach towards the goal of achieving a good ecological state for all water bodies across Europe. Nitrate pollution is an issue that all Member States confront. It can be asserted that the sources of nitrate pollution are diffusing (multiple such discharges which are difficult to locate), while the main polluters (farms) are sensitive to everything that affects their economic viability.
Fizes watershed, tributary of Somes catchment is located in the northern part of Romania and covers a surface of approximately 562 km^2, with an average altitude of approximately 400 m. Nitrate concentration, together with other species of mobile nitrogen were measured in surface water along the Fizes watershed. The main pollution sources are represented by sediments generated by erosional processes and transported in the water bodies, and diffuse pollution sources originated from agricultural activities and the improper septic systems of the localities
Through its features of relatively low antropic pressures and with little structural changes, Fizes watershed represents a natural laboratory for designing and implementing programs of restorations of watersheds in agricultural landscapes.

INTRODUCTION

River streams together with the adjacent riparian zones constitute essential multifunctional elements of the ecological network worldwide [1]. Water Framework Directive demands a concerted approach towards the goal of achieving a good ecological state for all water bodies across Europe. According to the Water Framework Directive (WFD), the water bodies should be managed on the basis of river basin districts and it is necessary to draw up a water management plan for each one of them. These plans have to demonstrate how to achieve the aim of the WFD of gaining a good status for all waters by December 2015.

Nitrates Directive is concerned with the protection of Community waters against pollution caused by nitrates from agricultural sources. According to this directive, Member States must identify surface waters or ground water affected or liable to be affected by pollution, in accordance with the procedure and criteria of the Directive – namely when nitrate concentrations in ground water or surface waters exceeds 50 mg/l, as well as vulnerabele zones which contribute to pollution.

Producing an adequate quantity of healthy food without polluting the environment is a formidable challenge for future agriculture in the world [2]. About 260 million tones of atmospheric nitrogen are being fixed every year globally. The global mean N use efficiency is estimated to be about 50% [3]. The remaining quantity of nitrogen is lost into the environment. A large proportion of this nitrogen gets converted into nitrate which, being soluble in water and not retained by soils, gets leached into water bodies. Leaching of nitrate from agricultural land and from other sources to groundwater is a global phenomenon. The diffuse nature of nitrate pollution makes it difficult to evaluate existing or planned measures to reduce it. Tools have therefore been developed to assess this pollution, ranging from simple indicators to complex models.

The aim of this paper is to assess nitrate pollution in Fizes watershed.

Fizes catchment is part of Somes catchment tributary of Tisa watershed located in the northern part of Romania and covers a surface of approximately 562 km^2, with an average altitude of approximately 400 m (Figure 1). The general water flow is directed west from the hilly region of Transylvania Plain. Yearly average precipitation is approx. 600 mm. The main land use is agricultural, and due to terrain structure the step slopes are subjected to erosion processes. The area is characterized by a mosaic of broad interfluves generally occupied by grass and occasionally forests, step hillsides with agricultural land and forests and broad stream corridors occupied by arable land and marshes. A distinctive feature is the presence of ponds, some natural and some man made, mainly used for pisciculture. Natural lakes constitute valuable natural resources and benefit of protected status. The total population of the studied area is approx 21,884 inhabitants in 46 localities. The population density is distributed equality on the area. Most of the localities are not equipped with a sewage system in order to retain the pollutants generated by domestic activities. Economic activities are based mainly on agriculture and sheep and cattle raising. The main land use of the studied area is agricultural, 71.7% (39.8% arable and 31.3% pastures). The main pollution sources are represented by sediments generated by erosional processes and transported in the water bodies, and diffuse pollution sources originated from agricultural activities and the improper septic systems of the localities.

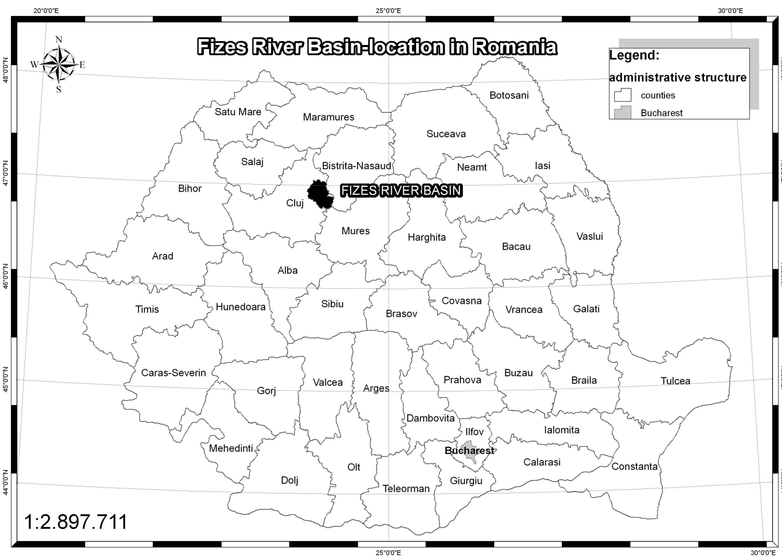

Figure 1

Location of Fizes watershed in Romania

Fizes catchment, through its features of relatively low antropic pressures and with little structural changes, represents a natural laboratory for designing and implementing programs of restorations of watersheds in agricultural landscapes.

In such a context, chemical analysis is usually employed to identify the aquatic system characteristics including the assessment of inputs, distribution of various chemical species and characterization the outputs generated by the physical, chemical and biological processes developed within the water bodies.

MATERIALS AND METHODS

Water samples were collected from 14 sampling points located in Fizes watershed (Table 1).

The method procedure used to determine the nitrate concentration was molecular absorption spectrometry according to SR ISO 7980-3:2000 - Water quality. Determination of nitrate. Part 3: Spectrometric method using sulfosalicylic acid.

All the chemicals used were of AR grade (Merck). Ultrapure water with a 0.05 μS/cm conductivity was utilized for solutions preparation as well as for sample dilution, being obtained from a Direct Q 3UV Smart (Millipore). All solutions were stored in polyethylene bottles which had been thoroughly rinsed with ultrapure water. The collected water samples were passed through a 0.45 μm membrane filter (Millipore) and each sample was analyzed in triplicates. The samples with nitrate concentrations exceeding the calibration range were diluted accordingly and re-analyzed. For solution preparation and for samples dilution was used freshly prepared (Direct Q 3UV Smart, Millipore) ultrapure water. Standard working calibration solutions were prepared from „*Nitrate 1000 mg/l*” (Merck) standard. Analyses were performed on a UV-VIS Spectrometer Jasco type V 530. Ion-96.3 and LGC6020 certified reference materials were used for validation. Measurement uncertainty (k=2): 2.5%.

Table 1

Sampling points – Fizes watershed

No.	*Sampling point*	*Code*	*Coordinates*
1.	Camaras Valley, intersection bridge - DN 109C	P1	N: 46°47′58,59″ E: 24°11′2,71″
2.	Camaras Valley - downstream confluence Samboleni Valley	P2	N: 46°48′55,70″ E: 24°8′24,24″
3.	Catina Lake – downstream dam evacuation	P3	N: 46°50′43,03″ E: 24°7′19,70″
4.	Tau Popii Lake– downstream dam evacuation	P4	N: 46°50′58,60″ E: 24°6′16,31″
5.	Sf. Florian Lake– downstream dam evacuation	P5	N: 46°51′7,77″ E: 24°5′29,18″
6.	Geaca I Lake– downstream dam evacuation	P6	N: 46°51′22,76″ E: 24°5′14,26″
7.	Geaca II Lake– downstream dam evacuation	P7	N: 46°52′2,63″ E: 24°4′55,97″
8.	Geaca III Lake– downstream dam evacuation	P8	N: 46°52′58,23″ E: 24°5′10,76″
9.	Sucutard I Lake – downstream dam evacuation	P9	N: 46°53′20,26″ E: 24°4′35,48″
10.	Sucutard II Lake– downstream dam evacuation	P10	N: 46°54′15,31″ E: 24°4′1,98″
11.	Taga Mare Lake– downstream dam evacuation	P11	N: 46°56′16,31″ E: 24°4′9,45″
12.	Taga Mica Lake – downstream dam evacuation	P12	N: 46°56′22,85″ E: 24°3′25,66″
13.	Fizes river - upstream confluence Somesul Mic – reference point	P13	N: 47°2′43,46″ E: 23°55′40,09″
14.	Stiucii Lake – downstream lake evacuation	P14	N: 46°58′1,37″ E: 23°54′6,42″

RESULTS AND DISCUSSIONS

In Table 2 are presented the obtained results for all 14 sampling points.

Table 2

Synthesis of obtained results for Nitrates indicator in Fizes watershed

Sampling point	Code	Det. no.	Nitrate (mg N/l)								
			Min.	Max.	STDV	Average		Percentile			
						Val.	Class.	Val. (50%)	Class.	Val. (90%)	Class.
Camaras V.	P1	16	0.77	5.27	1.68	2.46	II	1.97	II	4.85	III
downstream cf. Samboleni V.	P2	16	2.52	5.85	1.29	3.98	III	3.96	III	5.50	III
Catina Lake	P3	16	0.28	3.70	1.28	1.70	II	1.18	II	3.54	III
Tau Popii Lake	P4	16	0.00	2.96	0.92	0.99	I	0.59	I	2.03	II
Sf. Florian Lake	P5	16	0.00	3.17	1.28	1.21	II	0.95	I	2.93	II
Geaca I Lake	P6	16	0.00	4.70	1.38	2.06	II	1.74	II	3.56	III
Geaca II Lake	P7	16	0.00	4.93	1.83	1.88	II	1.57	II	4.24	III
Geaca III Lake	P8	16	0.36	5.60	1.76	2.23	II	2.08	II	4.29	III
Sucutard I Lake	P9	16	0.00	2.37	1.07	1.15	II	1.17	II	2.31	II
Sucutard II Lake	P10	16	0.00	1.98	0.75	0.81	I	0.75	I	1.71	I
Taga Mare Lake	P11	16	0.00	4.79	1.62	1.88	II	1.58	II	3.63	III
Taga Mica Lake	P12	16	0.00	4.54	1.80	1.77	II	1.36	II	4.16	III
Fizes River	P13	16	0.00	4.81	1.26	2.57	II	2.41	II	3.95	III
Stiucii Lake	P14	16	0.00	3.74	1.32	1.31	II	1.16	II	3.07	III

The values are situated in the range 0.0 and 5.85 mg N/l (Camaras Valley downstream confluence Samboleni Valley, March 2007).

Admitted values according to Ordin no. 161/2006 are: 1 mg N/l (quality class I) ; 3 mg N/l (quality class II) ; 5.6 mg N/l (quality class III); 11.2 mg N/l (quality class IV); >11.2 mg N/l (quality class V).

Analyzing the nitrate concentration variation at the lakes surface from Fizes watershed it has been found that the highest values have been recorded in Geaca III (2.23 mg N/l) and Geaca I (2.06 mg N/l) and the lowest in Sucutard II (0.81 mg N/l) and Tau Popii (0,99 mg N/l) lakes. Generally it has been ascertained an increase of nitrate concentration from upstream to downstream, with a slightly diminution in the case of Tau Popii, Sf. Florian, Sucutad I and Sucutard II Lakes. The intense sedimentation process, that is in the reed thickets and others macrophites, represents the essential factor that decreases the nitrate content in the mentioned lakes.

In the reference point, P13 – Fizes upstream confluence Somes Mic, the values were between 0.0 and 4.81 mg N/l (March 2007). Nitrate monthly concentrations varied between 0.068 mg N/l (September 2005) and 7.27 mg N/l (May 2007) with a standard deviation of 0.96. For comparison are presented the multiannual values (2001–2007) in control section Fizes River upstream confluence Somesul Mic (Fizesul Gherlii) (Figure 2).

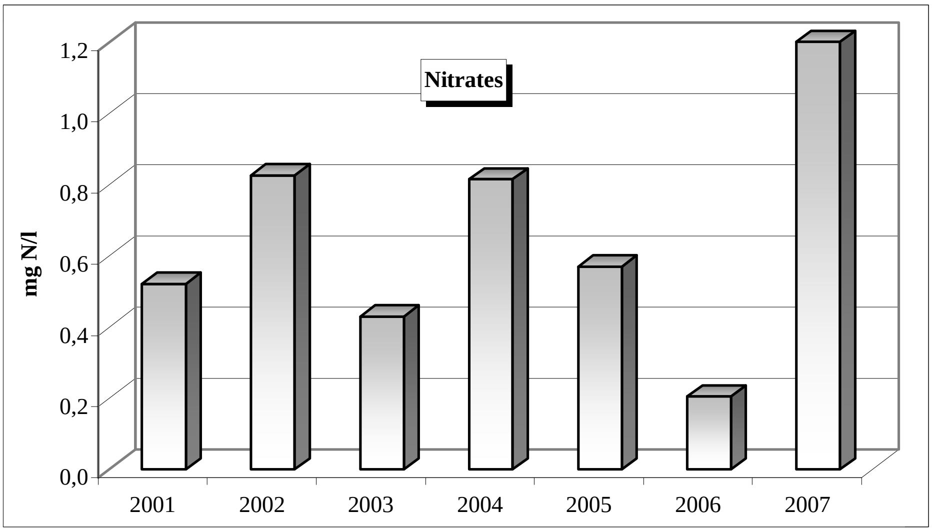

Figure 2

Nitrate indicator dynamics (annual average values, 2001-2007)in control section Fizes river upstream confluence Somesul Mic (Fizesul Gherlii)

CONCLUSIONS

The study revealed some threats on the environment:

- degradation of aquatic and terrestrial habitat;
- impacts of development on agricultural land, rural character, open space and environmentally sensitive areas;
- impairment of surface and groundwater waters from suspended solids, nitrates, pathogens and other contaminants;

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