CONSEQUENCES OF INDUSTRIAL LIVESTOCK ACTIVITY ON THE QUALITY OF WATERCOURSES IN AREAS ADJACENT TO FARMS

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***Abstract**: Ensuring increased amounts of animal origin food has been made possible by passing to the practice of intensive animal husbandry in industrial farms. The maintenance of the hygienic-sanitary conditions corresponding to a very large number of animals in the shelters determined the introduction of the hydraulic manure evacuation system. Thus, the mixture of feces, urine, fodder residues and bedding material is discharged from the shelters with the help of washing water, becoming wastewater. The wastewater management, for volumes on average 6-8 times higher than the actual amount of manure, raises particular issues regarding the maintenance of water quality in the adjacent watercourses. The pollutant potential of wastewater is due to both its composition and its volume. The paper presents the consequences of the wastewater discharge into the adjacent watercourses. The research aims at the dynamics of the nitric water level in the watercourses located in the area adjacent to the location of some industrial animal farms or are connected to them by large drainage channels. The influence of industrial animal husbandry activity in Timiş County on the quality of surface water was achieved on the Bârzava, Timiş and Bega Veche watercourses, as a result of the discharge of livestock wastewater, whose pollutant potential increases proportional to the number of farm animals. In relation to the territorial location of the animal breeding farms, the control sections were chosen, one upstream and one downstream of the pig breeding farms. Thus, the chosen control sections were: for the river Bârzava-Gătaia and Partoş, for Timiş -Lugoj, Şag, Grăniceri and for Bega-Veche -Pişchia and Cenei. The assessment of water quality is monitored in terms of nitrate and nitrite content, depending on the quality category required for the watercourse in the respective control section (GD 1146/2002). Nitric loading of surface water was assessed by comparing the nitrate and nitrite content, its monthly dynamics being pursued for two consecutive years in the monitored control sections. The usefulness of the paper consists in preventing the depreciation of the watercourses quality, watercourses located near the industrial farms of animal breeding which, as a result of wastewater discharge, can reach from severely depreciated to irreversibly polluted. The importance of the obtained results lies in knowing how to take some measures of wastewater recovery which, depending on their volume, composition and appropriate ground watering norm, can be used at the same time for fertilization and irrigation of soil.*

***Keywords**: industrial livestock activity, livestock wastewater, adjacent watercourses, nitrate-nitrite content, nitric depreciation.*

INTRODUCTION

In order to ensure important quantities of animal origin food by obtaining a large increase in production in the shortest possible time has led to changes in the traditional system of animal husbandry and the emergence of the intensive system of raising them in industrial complexes (1,4,5). Maintaining in the shelters the best hygienic-sanitary conditions and at the same time saving the work sheet determined the introduction of a hydraulic manure removal system. Thus, the mixture of manure, urine, food residues, bedding material is diluted with washing water becoming wastewater. The resulted wastewater has an average volume 6-8 times greater than the actual amount of the resulted manure. The polluting potential of wastewater resulting from animal husbandry complexes is due both to their composition and especially to their volumes, depending on the animal numbers (1,5,6). Frequent the wastewater

management of the resulted wastewater unfolds by discharging them into the adjacent watercourses flowing in the area adjacent to the location of the industrial animal farm or are connected to them by large drainage channels. As a result of the discharge of livestock wastewater, whose pollutant potential increases proportional to the number of farm animals, depreciation of the watercourses quality, can reach from severely depreciated to irreversibly polluted (1,4,6,8). In relation to the territorial location of the animal breeding farms, the control sections are to be chosen, one upstream and one downstream of the pig breeding farms. A possibility to asses water quality is to pursue the nitrate and nitrite content, depending on the quality category required for the watercourse in the respective control section (6,7,9,10). In order to establish the main reason of nitrate contamination of adjacent watercourses flowing in the area next to the location of the industrial animal farm, is to examine the influence of waste water composition and volume provided by the animal husbandry complexes. Assessing nitric loading of surface water requires the monthly dynamics of nitrate and nitrite content, pursued for several consecutive years in the monitored control sections. The importance of the obtained results lies in knowing how to take some measures of wastewater recovery which, depending on their volume, composition and appropriate ground watering norm, can be used at the same time for fertilization and irrigation of soil.

MATERIAL AND METHODS

The influence of industrial animal husbandry activity in Timiş County on the quality of surface water, watercourses flowing in the area adjacent to the location of the industrial animal farms or connected to them by large drainage channels, was achieved on the Bârzava, Timiş and Bega Veche watercourses, as a result of the discharge of livestock wastewater, whose pollutant potential increases proportional to the number of farm animals. In relation to the territorial location of the animal breeding farms, water samples were collected from the chosen control sections, one upstream and one downstream of the pig breeding farms. The chosen control sections were: for Bârzava river -Gătaia and Partoş, for Timiş river -Lugoj, Şag, Grăniceri and for Bega-Veche river -Pişchia and Cenei. Nitric loading of surface water was assessed by comparing the nitrate and nitrite content, namely the monthly dynamics pursued for two consecutive years in the monitored control sections. The nitrate content (STAS 3048/1-77 SR ISO 7890/1-98) was determined by spectrophotometry at 538 nm using the GRIESS method (SR EN 12014-7:2001). The assessment of water quality is monitored in terms of nitrate and nitrite content, depending on the quality category required for the watercourse in the respective control section (G.D. 1146/2002). The obtained results are discussed regarding the level of nitrates and nitrites in surface water, upstream and one downstream of the pig breeding farms, depending on the number of farm animals and the discharge of livestock wastewater. The meaning of the research results indicates a depreciation of the watercourses quality downstream of the pig breeding farms, required for the watercourse in the respective control section (G.D. 1146/2002), by exceeding the admitted nitrate and nitrite content.

RESULTS AND DISCUSSION

The polluting potential of wastewater resulting from animal husbandry complexes is due both to their composition (nitrogen/nitrate content) and especially to their volumes, depending on the animal numbers. The obtained research results show a directly proportional dependence between the wastewater volume, amount of nitrogen, nitrate content and the capacity of the farm, respectively the number of animals. (table 1).

Table 1

The correlation between the capacity of intensive livestock farms and the resulting nitric pollutant impact of wastewater

Farm/Animal number	Resulted wastewater		
	Volume (m^3/day)	Nitrogen content (N t/year)	Nitric nitrogen content ($N\text{-}NO_3$ t/year)
Beregsău Mare/171500	7250	2304	68,02
Birda /160000	4500	1794	63,02
Gătaia /68000	1560	707	26,62
Parţa / 35000	1080	408	13,82
Banloc /34000	950	149	0,19

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The water quality of the Bârzava river was assessed in terms of nitrates and nitrites content changes, the monthly dynamics being followed for two consecutive years and the chosen control sections were Gătaia (required water quality category: I) and Partoş (required water quality category: III). The values determined in the Gătaia control section exceed the requirements imposed on the water from quality category I. The situation is explained as a result of the wastewater discharged in Bârzava river by the Gataia industrial animal farm in the area. In the Partos control section, whose waters must correspond to quality category III, the values of nitrate content remain high as a result of wastewater discharges from the Banloc and Birda industrial animal farms (table 2, table 3).

Table 2

Annual nitrate dynamics in the water of Bârzava river

Year	Control section	Nitrate content(mg/l)											
		Month											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
I research Year	Gătaia	14,4	13,2	14,0	10,0	7,76	7,38	6,30	7,73	5,76	14,36	62,1	16,2
	Partoş	14,5	12,9	13.3	11,6	6,69	8,17	3,76	9,49	5,46	14,6	12,6	13,3
II research Year	Gătaia	12,5	4,79	22,5	18,7	9,07	10,2	44,5	50,5	45,6	9,89	12,9	11,8
	Partoş	15,2	15,7	14,3	17,2	8,32	7,50	6,65	1,35	21,0	13,1	15,8	11,9

Table 3

Annual nitrite dynamics in the water of Bârzava river

Year	Control section	Nitrite content(mg/l)											
		Month											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
I research Year	Gătaia	1,05	0,25	0,23	0,13	0,26	0,14	0,27	0,27	0,21	0,20	0,63	0,13
	Partoş	0,51	0,10	0,27	0,20	0,19	0,38	0,16	0,28	0,09	0,31	0,12	0,16
II research Year	Gătaia	0,23	0,51	0,20	0,15	0,16	0,64	0,29	0,28	0,25	0,28	0,12	0,30
	Partoş	0,12	0,21	0,16	0,27	0,19	0,24	0,48	0,34	0,47	0,19	0,21	0,30

The analysis of the Timiș River water quality, from the county entrance to the border with Serbia, was determined during three control sections, respectively Lugoj, Șag and Grăniceri. The sampling points were chosen upstream and downstream of the industrial animal farms along the river. In Lugoj, the values regarding the content of nitrates and nitrites in the water of Timiș are low, they fall within the requirements imposed by the water quality category I. On the Lugoj-Șag control section, there is an increase in the nitrate content due to the confluence with the Șurgani stream, which takes over a part of the wastewater from the Bacova farm.

Table 4

Annual nitrate dynamics in the water of Timiș river

Year	Control section	Nitrate content(mg/l)											
		Month											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
I research Year	Lugoj	4,03	3,89	1,71	3,16	1,96	2,90	1,9	1,09	2,02	3,76	1,67	3,06
	Șag	5,10	5,27	2,35	3,93	2,37	3,26	3,3	4,30	1,20	4,00	7,50	5,73
	Grăniceri	5,89	5,37	2,02	3,75	2,85	3,67	4,0	13,0	1,96	4,76	17,5	7,10
II research Year	Lugoj	7,30	6,39	4,33	2,80	4,11	4,20	3,9	2,11	2,05	2,57	3,33	3,14
	Șag	8,60	7,44	5,30	3,02	4,48	3,76	3,8	1,77	0,61	4,53	4,84	4,79
	Grăniceri	8,50	7,57	5,71	4,86	6,50	7,00	6,0	4,50	5,40	6,20	3,90	5,14

The highest values of nitrate content were determined in the Sag- Grăniceri control section, as a result of the discharge of untreated or insufficiently treated wastewater from the zoo technical farms in the area. The Timiș River, downstream of the confluence with Lanca-Birda, is qualitatively affected by discharges of untreated or insufficiently treated wastewater from the Gătaia, Birda and Voiteni industrial animal farms (table 4). The annual dynamics of nitrites in the water of the Timiș River was performed on the same control sections, based on the monthly values of the nitrite content. The registered values show the increase of the nitrite content along the river from the county entrance to the border. The highest values were determined at the Grăniceri checkpoint, but they do not exceed 0.41 mg NO_2^-/ l, meeting the quality requirements for water category III, required for the river at the Grăniceri checkpoint located at the border (table 5).

Table 5

Annual nitrite dynamics in the water of Timiș river

Year	Control section	Nitrate content(mg/l)											
		Month											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
I research Year	Lugoj	0,03	0,04	0,04	0,04	0,05	0,04	0,03	0,04	0,03	0,07	0,04	0,02
	Șag	0,16	0,08	0,06	0,12	0,07	0,08	0,06	0,29	0,12	0,09	0,18	0,12
	Grăniceri	0,10	0,13	0,29	0,07	0,06	0,09	0,30	0,09	0,41	0,15	0,20	0,14
II research Year	Lugoj	0,03	0,05	0,03	0,03	0,08	0,05	0,04	0,05	0,08	0,04	0,05	0,01
	Șag	0,07	0,07	0,08	0,03	0,07	0,05	0,09	0,06	0,06	0,06	0,08	0,07
	Grăniceri	0,16	0,09	0,12	0,06	0,18	0,04	0,03	0,03	0,17	0,21	0,09	0,08

The Bega Veche watercourse is practically a wastewater collection channel coming mainly from the industrial animal breeding complexes, which discharge untreated wastewater. The comparative analyzes carried out in two consecutive years, highlight a similar dynamics of nitrates throughout the year, the dynamics imprinted by the intermittent wastewater discharge from animal complexes, having the highest values mainly in autumn and winter. There are relatively low values determined at the control point Pişchia, a point located upstream of the animal breeding complexes and values reaching 28,9 mg / l at Cenei, located downstream of them (table 6). The dynamics of nitrites in the water of the Bega Veche River is mostly uncertain, although at the Cenei checkpoint the values are significantly higher than at Pişchia. Values reaching 0,78 mg / l have been determined at the control point Cenei, located downstream of the animal breeding complexes (table 7).

Table 6

Annual nitrate dynamics in the water of Bega Veche river

Year	Control section	Nitrate content(mg/l)											
		Month											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
I research Year	Pişchia	6,37	6,48	1,01	0,98	6,83	6,24	5,28	3,29	1,96	3,25	2,89	0,09
	Cenei	25,5	23,8	14,7	11,2	13,8	7,50	5,80	8,82	10,5	10,0	16,8	17,2
II research Year	Pişchia	10,3	9,35	5,09	2,33	17,7	4,50	6,10	1,96	1,94	2,41	9,67	10,9
	Cenei	28,9	26,1	23,2	18,5	9,30	4,30	5,50	9,80	9,70	11,2	14,5	17,9

Table 7

Annual nitrite dynamics in the water of Bega Veche river

Year	Control section	Nitrite content(mg/l)											
		Month											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
I research Year	Pişchia	0,05	0,02	0,08	0,05	0,12	0,07	0,06	0,05	0,05	0,04	0,06	0,07
	Cenei	0,20	0,37	0,50	0,38	0,57	0,69	0,25	0,18	0,06	0,21	0,75	0,78
II research Year	Pişchia	0,15	0,12	0,04	0,05	0,37	0,26	0,72	0,08	0,08	0,08	0,10	0,05
	Cenei	0,17	0,28	0,35	0,32	0,12	0,12	0,16	0,17	0,29	0,37	0,39	0,47

CONCLUSIONS

The monthly dynamics of the nitrate content in the Bârzava river water, in the two consecutive years analyzed, shows an average variation of the water quality from quality category II to III, both for the Gătaia and for the Partoş control section. Accidentally, in July, August and September, the registered values placed the water quality in Gătaia in the quality category IV, due to the discharge, in addition, of the industrial and urban wastewater. The dynamics of the nitrite content places the water of the Bârzava river mainly in quality category III, both for the Gătaia and for Partoş control point, where occasionally the water quality category reaches IV.

The Timiş river is affected by the totally inadequate quality of the Lanca-Birda course as well as, periodically, by the quality of the Şurgani course, polluted by the discharges from the Bacova farm. The monthly dynamics of the nitrate content in the water of the Timiş River, in the two consecutive years analyzed, denotes a category I of water quality in Lugoj, the transition to quality II for the Şag control point and the maintenance of the quality in the Grăniceri control point. However, for the Grăniceri control section, the nitrate content values are increased with occasional trends in quality category III. The dynamics of nitrites for the

three control points highlights the classification of water in quality category II, with occasional increases of their concentration for the Grăniceri control section and the transition of water to quality category III.

Among the surface water sources, the most affected watercourse is the Bega Veche river, which, from the first quality category, passes into the degraded category after the first farm on the course (Sânandrei farm). The monthly dynamics of nitrate content in the water of the Bega Veche River, in the two consecutive years analyzed, indicates on average a category II water quality in Pişchia and the transition to water quality category III at the Cenei control point, with some exceeds of the limit and the occasional transition to quality category IV. The monthly dynamics of nitrite content is similar to the evolution of nitrate content. Thus, if on average the water quality category in Pişchia is II, in the control point of Cenei there is a transition to quality category III and occasionally even IV.

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