

LIVESTOCK FARMING IN THE NEMUNAS RIVER BASIN: THE RECENT TRENDS AND THE IMPACT ON THE WATER BODIES

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In accordance with the contemporary sustainable water resources use policy in the European Union, it is important to assess the impact of the agricultural sector – one of the most important sources of pollution – upon the implementation of the objectives stipulated by the Water Framework Directive. The research therefore aims at analyzing the influence of the agricultural sector on the pollution of the Nemunas river basin. It was the transboundary pollution that forced the research to cover both Lithuanian and Belorussian territories. The paper analyzes legal aspects of the strategic management of water resources, estimates the livestock density and dynamics thereof, and identifies the most polluted territories in Lithuania and Belarus. Research results indicate that more intensive animal farming is maintained in the Belarusian part of the Nemunas catchment and has the tendency to increase. At the other end of spectrum, LSU per hectare is two times lower and has the tendency to decrease in Lithuania.

Keywords: livestock farming, Nemunas catchment, water pollution.

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Introduction

The sustainable use of water resources is fostered at various levels. At the European Union (EU) level, the European Water Framework Directive (European Parliament, 2000) establishes a framework for the protection of all waters (including inland surface waters, transitional (estuarine) waters, coastal waters and groundwater) which: (i) prevents further deterioration, protects and enhances the status of water resources; (ii) promotes sustainable water use; (iii) aims at enhancing protection and improvement of the aquatic environment through specific measures for the progressive reduction of discharges; (iv) ensures the progressive reduction of pollution of groundwater and prevents its further pollution; and (v) contributes to mitigating effects of floods and droughts. Overall, the directive aims at achieving good water status for all waters by 2015 (Borja, 2004; Dzemydienė, 2008).

As for the Baltic Sea region, the Krakow Agreement, adopted in 2007, stipulates the need for mitigation of pollution in the Baltic Sea region (HELCOM, 2007; Karczmarczyk, 2007). Lithuania is also a reporting country. Indeed, the largest river basin in Lithuania, namely the Nemunas catchment, is subject to transboundary pollution. This paper, thereafter, pays attention to water pollution in both Lithuania and Belarus by analyzing the recent statistical data on the trends of livestock farming which, in turn, constitutes a source of water pollution. In general water bodies face

the following factors influencing their state: pollution from non–point sources, pollution from point sources, hydromorphological alterations, and hydroelectric power stations. This study is mainly focussed on the first option and, particularly, the impact of livestock farming.

Indeed, diffuse agricultural pollution is one of the most important and significant factors affecting the quality of water bodies in the Nemunas river basin. The impact of agricultural activities on water bodies of the Nemunas river basin depends mainly on the intensity of agricultural activities. Although the impact of livestock farming on environmental pollution was analyzed by Mikaliūnienė and Česonienė (2011), the Belorussian part of the Nemunas catchment remained unconsidered. It is, therefore, necessary to further these studies by analyzing impacts of livestock farming and water pollution in the whole Nemunas catchment, which constitutes an important nutrient input for the Baltic Sea.

1. Management of the nutrient leakage in the Nemunas river basin

Geographic location. The Nemunas River Basin covers the territories of Belarus, Lithuania, Russian Federation (Kaliningrad Region), Latvia (only about 100 km²), and Poland (the total basin area constitutes 97928 km²). The Lithuanian part of the basin covers the area of 46626 km², Belarusian – 46587 km². The longest and the largest (by their catchment size) tributaries of the Nemunas in Lithuania are Merkys, Neris, Nevėžis, Dubysa, Šešupė, Jūra, and Minija. The main tributaries of the Nemunas in Belarus are Berezina, Viliya and Shchara. The names of these rivers are also the names of sub-basins within the Nemunas River Basin.

Strategic management. The Government of the Republic of Lithuania adopted The Nemunas River Basin Management Plan (2010) and the Programme of Measures for achieving water protection objectives within the Nemunas River Basin District (2010). These strategic documents implement the regulations of both Law on Water of the Republic of Lithuania and the EU Water Framework Directive. The Programme covers the period of 2010–2015. Specifically, the Programme defines the two groups of measures to be taken viz. basic measures and supplementary measures. The *basic measures* include the implementation of all the measures, actions and programmes which have already been envisaged in water legislation and financed or included in financing programmes (construction of wastewater treatment facilities in agglomerations with a population equivalent (PE) of more than 2000, installation of manure storage facilities on large farms, compliance with recommendations of good agricultural practice, solution of drinking water quality problems etc.). Noteworthy, the basic measures should increase the share of animals kept on farms with manure storage facilities up to 48% in the Nemunas river basin district. Meanwhile, the *supplementary measures* are proposed for those water bodies where the basic measures are not substantial to achieve the good status. Supplementary measures cover the improvement of the operation of the existing wastewater treatment facilities, mandatory and voluntary (optional) measures aimed at reducing adverse effects of agricultural activities, research intended to specify pollution sources and/or the environmental ef-

fect of the measures being implemented, feasibility studies examining pollution causes, as well as legal, educational, remedial and other measures.

The Programme is to be updated every six years. Therefore it is important to develop and maintain the livestock farming monitoring system which would enable to implement effective strategic decisions regarding the mitigation of nutrient leakage from agriculture and, particularly, livestock farming. Livestock farming-related information is especially important for prioritization of the prospective managerial measures for the Nemunas catchment.

According to National Strategy of the Sustainable Development of the Republic of Belarus one of the most important tasks of water policy making is “the implementation of international cooperation on transboundary waters, including the development of interstate and national legal instruments for the monitoring of pollution and the implementation of international projects to develop Schemes on integrated water resources management of river basins”. In accordance with Water Code of the Republic of Belarus, the main task of the development of river basin management plans is to secure the future needs of the population and economic activities related to water, ensure the rational water use and protection of water, as well as to mitigate water pollution.

The Water Code also stipulates that the strategic purpose of protection and rational use of water resources is to provide the population with water necessary sanitary quality and in sufficient quantities, while preserving the hydrological, biological and chemical functions of ecosystems. Accordingly, the schemes on integrated water resources management of river basin Neman was developed in 2009–2010. It contains the following sections: (i) general characteristics of the river basin; (ii) assessment of the ecological status and major issues in the basin; (iii) target parameters, including indicators of water quality in water bodies and key performance indicators to reduce the negative effects of floods and other harmful effects of water; (iv) water balances of river basins under various conditions of water availability; (v) limits of use (withdrawal) of water from surface water and groundwater sources, as well as limits on wastewater discharges; (vi) list of water management and other activities.

Another important element of the strategic management system of the water resources of the Republic of Belarus is the water Strategy. Under the Water Strategy of the Republic of Belarus for the period till 2020 (2011) the strategic target in the field of preservation of water potential of the river basins consists in increase of efficiency of use and improvement of quality of the water resources balanced with requirements of a society and possible climate change. For achievement of this purpose the complex approach to the decision of organizational, legal and financial and economic problems of water use and protection of water is required. Realization of mainstems of water resources management assumes:

- development of system of paid water use on the basis of an ecologic-economic assessment of water resources;
- universal introduction progressive power- and the resource-saving technological processes providing decrease of specific water consumption, and also transition to water low consumption and waterless production technologies;

- introduction of complex nature protection permissions for nature users, carrying out ecologically dangerous activity;
- introduction of the best technical methods for complex prevention and environmental contamination control;
- the analysis and the account of influence of the spontaneous hydrometeorological phenomena and possible climate change on water resources;
- introduction of technologies on improvement of quality of removal water.

Data availability. In Lithuania data on number of livestock are collected on the basis of reports from all agricultural entities. Agricultural entities are farmers' farms, agricultural companies, cooperative companies (cooperatives) and other enterprises registered under a procedure established by law, as well as other users of agricultural land engaged in the production of marketable agricultural products. All of agricultural companies and enterprises submit statistical reports. Data are presented at the national level as well as across counties and municipalities. Data are collected and published by Statistics Lithuania.

The data on animal farming are collected annually from the three types of entities by the virtue of the data survey in the Republic of Belarus. These types are: (i) agricultural enterprises (industrial complexes), (ii) private farms, and (iii) households. Regarding the first two sources, amounts of livestock units per agricultural enterprises are collected and aggregated at the rayon level in National Statistical Committee of the Republic of Belarus. These data are not gridded to map with reference of location of agricultural enterprises. During the periodical survey in households the following information about various aspects of animal production household activities is collected under the *Questionnaire about presence and movement of livestock and poultry by quarterly periodicity*.

2. Prevalence of the agricultural activities across the Nemunas sub-catchments

Following the data on the area of declared utilised agricultural area in Lithuania, agricultural land in the Nevėžis and Šešupė sub-basins constitute as much as half of the total area of each sub-basin. In the Dubysa and Jūra sub-basins, agricultural land accounts for more than 40% of the area, meanwhile in the Šventoji, Nemunas Small Tributaries and Minija sub-basins as well as in the Lithuanian Coastal Rivers and Prieglius basins agricultural lands occupy 30–40% of their total area. The smallest share of agricultural land is found in the Žeimena, Neris Small Tributaries and Merkys sub-basins – only 17–22%.

Nemunas catchment plays an important role in Belarusian industry and agriculture. Indeed, virtually all of the main industry centres are located in this catchment. The Nemunas catchment covers almost 53% of the total land area. The land structure is as follows: arable land – 38%, meadows and pastures – 14%. Additionally, Neris (Vilija) catchment occupies 44.5% of UAA, out of which 31.4% – arable land, 14.1% – meadows and pastures. There are 182 organizations engaged in agriculture, public utilities, and industry. The Nemunas catchment covers four rayons, namely those of Grodno, Brest, Vitebsk, and Minsk. The Minsk rayon is the largest one, with some 88 organizations and farms engaged in agricultural activity. The latter rayon-

covers 600 thousand ha, out of which 400 thousand ha are arable lands. In Brest rayon, there are 58 agricultural enterprises; the rayon covers 222 thousand ha, out of which 150 thousand ha are arable lands. Vitebsk rayon is the smallest one and covers 30 thousand ha, out of which 16 thousand ha are arable lands. Animal farming is the main activity in the catchment. It constitutes 60% of total production. Livestock, pigs, and poultry are the main directions of animal farming.

3. Estimation of livestock intensity in the Nemunas sub-basins

The total number of cattle in Belarus has increased from some 3.5 million heads in 2001 to 3.9 million in 2011. Meanwhile, the number of cows grew from 1.2 million in 2001 up to 1.3 million in 2011. Indeed, some 37% of cattle were located in the Nemunas catchment. The number of pigs has also increased by 38% up to 2.95 million, whereas poultry farming grew by 52% during 2001–2011. These data, however, cover solely the activities of the agricultural enterprises.

In order to obtain comparable livestock units (LSU), we employed the following coefficients: cows – 1, other cattle – 0.57, pigs – 0.5, horses – 0.8, and poultry – 0.007. Therefore, the scope of animal farming went up by over 17% in both Belarus and the Nemunas catchment during 2001–2011 (Table 1). The total number of animals (in LSU) located in the Nemunas catchment constituted some 39% of the total number of livestock in Belarus throughout 2001–2011.

The data on land structure exhibited the decrease in agricultural land area of some 4% possibly caused by the increased land use for urban purposes.

Table 1. Livestock units (LSU) and density in Belarus and the Belarusian part of the Nemunas catchment

	2001	2006	2010	2011
1. LSU, thousand				
Belarus	3861.84	3996.54	4394.06	4532.89
Nemunas catchment	1503.50	1609.90	1741.95	1777.67
2. Agricultural land, thousand ha				
Belarus	9257.7	9011.5	8926.9	8897.5
Nemunas catchment	3094.8	3094.8	3094.8	3094.8
3. Livestock density, LSU/ha				
Belarus	0.42	0.44	0.49	0.51
Nemunas catchment	0.49	0.52	0.56	0.57

The livestock density was higher in the Nemunas catchment if compared to the respective indicator value for Belarus during 2001–2011. As of 2011, the mean livestock density was 0.57 LSU/ha in the Nemunas catchment, whereas it remained equal to 0.51 LSU/ha for the whole Belarus.

After reaching a peak in 2007, the number of livestock has been declining in Lithuania since 2008 (Table 2). Meanwhile, the area of agricultural land reached 2.68 million ha in 2010. The livestock density, therefore, fluctuated around the rate of 0.35 LSU/ha, which is rather low value particularly in terms of the European Union Member States. Table 2 does not split the data into different figures for the whole Lithua-

nian territory and the Nemunas catchment, given most of Lithuanian territory falls under the Nemunas catchment.

Table 2. Livestock units and density in Lithuania

	2005	2006	2007	2008	2009	2010
LSU	1007364	1018824	1033497	972207.1	943411	926461.2
Agricultural land, th ha	2837019	2790648	2695910	2672075	2688971	2683768
Density	0.36	0.37	0.38	0.36	0.35	0.35

The highest livestock density is observed in the Neris Small Tributaries and Miniija sub-basins, where it totals to 0.4 LSU/ha. In the Nemunas Small Tributaries, Šešupė and Jūra sub-basins, the livestock density is a little lower – 0.37 LSU/ha, in the Dubysa, Žeimena, Nevėžis, Merkys sub-basins, Lithuanian Coastal Rivers Basin and Prieglius Basin – 0.3–0.33 LSU/ha, meanwhile the density in the Šventoji Sub-basin is the lowest viz. 0.28 LSU/ha.

Therefore a more intensive animal farming is maintained in the Belarusian part of the Nemunas catchment. The animal farming is mainly concentrated in rayons of Grodno, Brest, and Minsk oblasts. Indeed, the Grodno region is located near the borders of the neighbouring states, namely Lithuania and Poland, and thus offers favourable conditions for exports of the agricultural production.

Animal farming is concentrated in the North-West Lithuania. As of 2010, there were some 596 thousand livestock units (LSU) in Lithuanian farms, whereas pig share accounted for 187 thousand LSU. Indeed, the cattle farming is mainly located in the western Lithuania and swine CAFOs are spread across the both North and Middle Lithuania (take, for instance, counties of Marijampolė, Panevėžys, Kaunas, and Šiauliai). According to the environmental standards, the manure from CAFOs is spread in the neighbouring areas. The poultry farming is found in the East Lithuania, namely county of Vilnius. The resulting manure is sold as the fertilizer and hence does not contribute to the water pollution in the region of origin.

Conclusions

1. The agricultural activity is rather intensive in Nemunas catchment and therefore plays an important role both in Lithuanian and Belarusian. For diffuse agricultural pollution constitutes one of the most important and significant factors affecting the quality of water bodies in the Nemunas river basin.

2. The analysis implies that the transboundary nutrient leakage is a topical issue in the Nemunas catchment. Hitherto, there is a need for further development of the international monitoring and decision support system aimed at implementing measures as outlined by both the Water Framework Directive and the Krakow Agreement.

3. Research results indicate that more intensive animal farming is maintained in the Belarusian part of the Nemunas catchment and has the tendency to increase. At the other end of spectrum, LSU per hectare is two times lower and has the tendency to decrease in Lithuania.

4. The further research should address the issue of multi-criteria prioritization of regions covered by the Nemunas catchment in terms of pollution and water quality indicators. Suchlike assessments would enable to quantify and mitigate the prospective risk and thus ensure sustainable use of the water resources. Indeed, the benchmarking methodology should be employed to ensure reasonable rates of fertilizing across the regions of the Nemunas catchment.

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GYVULININKYSTĖ NEMUNO UPĖS BASEINE: DABARTINĖS TENDENCIJOS IR ĮTAKA VANDENS TELKINIAMS

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Atsižvelgiant į Europos Sąjungos subalansuotą vandens išteklių naudojimo politiką, yra svarbu įvertinti žemės ūkio sektoriaus – vieno iš didžiausių taršos šaltinių – įtaką Vandens direktyvos tikslų įgyvendinimui. Tyrimo tikslas – nustatyti gyvulininkystės sektoriaus įtaką Nemuno upės baseino užterštumui. Dėl tarptautinės taršos tyrimas apėmė Lietuvos ir Baltarusijos teritorijas. Šiam tikslui pasiekti išnagrinėti strateginio vandens išteklių valdymo teisiniai aspektai, įvertintas gyvulių tankis ir jo dinamika, identifikuotos labiausiai užterštos vietovės Lietuvoje ir Baltarusijoje. Tyrimo rezultatai leidžia teigti, kad gyvulininkystė yra intensyviau plėtojama Baltarusijoje esančioje Nemuno baseino dalyje. Lietuvoje esančioje Nemuno baseino dalyje gyvulių tankumas yra beveik dvigubai mažesnis ir pasižymi mažėjimo tendencija. Atlikto tyrimo rezultatai gali būti panaudoti racionalizuojant Baltijos jūros regiono vandens išteklių valdymo politiką.

Raktiniai žodžiai: gyvulininkystė, Nemuno baseinas, vandens tarša.

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