

Climate Change and Diffuse Water Pollution in Lithuania

Otilija Miseckaite, Arvydas Povilaitis

Vytautas Magnus University, Faculty of Water and Land Management, 53361, Kaunas, Lithuania

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ABSTRACT

Climate change affects many economic sectors, and agriculture is one of the most directly dependent on climatic factors. Lithuania historically is an agricultural country: agricultural land (% of land area) in Lithuania was reported approx. 48 % in 2019, approx. 7.8 % employers, crop production 52% of total land (mainly winter wheat), the value of agricultural production amounted to 2.22 EUR billion in 2018 (3.0 % GDP) (Lithuania, 2019).

The average temperature in Lithuania in July is about 17°C, while in winter it is about –5°C. Global warming expected to lead to a more vigorous hydrological cycle, including more total rainfall and more frequent high intensity rainfall events. The average annual precipitation in Lithuania is 670 mm, but its distribution throughout the country is uneven, ranging from 500 to 900 mm. However, the latter is faced with increased droughts. Selyaninov Hydrothermal Coefficient used for identifying droughts during the active vegetation period, based on the water balance equation. While analysing the data of 1978–2018 in the central Lithuania, it is determined that the lowest quantity of precipitation was in spring (22%) and the highest quantity of precipitation was in summer (about 35%) and autumn (25%). During the research period, the biggest challenge is rainfall disbalance: the drought one year, and floods in others. These challenges particularly affect agriculture, especially increasing climate anomalies in the past decade. Climate change is closely linked to environmental protection, and agriculture can have significant impacts on the environment, especially pollution of water. About 60% of the territory of Nemunas River basin is used for agriculture, and about 30% of the area is composed of arable land. Agriculture places a serious burden on the environment in the process of providing humanity with food and fibres. It is the largest consumer of water and the main source of nitrate pollution of groundwater and surface water, as well as the principal source of ammonia pollution. Water pollution arising from agriculture has other dimensions. Nitrogen and phosphate enrichment of lakes, reservoirs and ponds can lead to eutrophication, resulting in high fish mortality and algae blooms. This is important because of the growing importance of aquaculture (FAO, 2003). One of the main impact on Lithuanian water bodies is caused by diffuse pollution, mainly from agricultural sources and residents who do not manage sewage well enough. Other important factors affecting the state of water bodies include hydromorphological changes in water bodies due to land drainage, water body dams and hydroelectric power plants, as well as international pollution and point pollution sources. Several measures are planned to improve the condition of water bodies. The most important of these are pollution prevention, biological manipulation, as well as reducing the effects of hydroelectric and hydromorphological changes, reducing pollution from diffuse and diffuse sources. The importance of the role of land reclamation as a water body is becoming increasingly recognized. In Lithuania, artificial drainage is a common agricultural practice. The total drained land area occupies 47% of the country's land area and 86% of the agricultural land area. Drainage has improved the quality of agricultural land, and the benefits of drainage are associated with many changes in the local environment (Povilaitis et al., 2015). Tile drainage systems serve as transport pathways of contaminants directly from agricultural land to streams, water leaches nutrients (mostly inorganic forms of N and P), and the increased nutrient inflow into surface water bodies leads to their eutrophication. In



Lithuania, 80% of total nitrogen and 53% of total phosphorus that enters streams originates from agricultural areas (Povilaitis et al., 2014). One of the reason - the drainage outflow increased during winter months in Lithuania. It is likely that higher winter outflows are related to higher winter air temperatures (a statistically significant increasing pattern at $p < 0.100$), resulting in earlier and faster snowmelt, less snow accumulation, and less water storage capacity in the snowpack.

Environmental protection is very important in Lithuania, and one of the task - to improve the ecological status of water body. There are three measures for it supported by EU: the first is for flood risk management, the second for water resources management and protection, and the third for water bodies' ecological status. According to the EU Water Framework Directive 2000/60/EC a decision was made to consider the river basins to be the most important objects of the management of the status of water bodies instead of individual polluters or other sources of pollution. Based on it, the main aim of water policy is to ensure "the good status of water bodies". Diffuse source agricultural pollution can account for 45-80% of all the load of nitrogen pollution washed to water bodies. In Lithuania, due to non-point source pollution 222 surface water bodies out of 1,177 do not meet the criteria of good ecological state. The ecological status of lakes and rivers is evaluated according to the values of indicators of physico-chemical, biological and hydromorphological quality elements (Environmental Protection Agency). Agriculture sector development is strongly influenced by the EU's Common Agricultural Policy. Lithuania applies mandatory measures on its whole territory in the context of the Nitrates Directive 91/676/EEC. The measures implementing that are set out in the water field development program for the year 2017-2023 and implementation plan of the water field development program for the year 2017-2023. The changes were made to the description of the requirements for the management of surface water bodies for the management of rivers or their sections, regulated for land reclamation (removal of sediment, restoration of the design depth of the river) in Lithuania from 1st April 2019. These changes are made in order to achieve the good ecological status of the rivers in Lithuania, as defined in the Water Law and the EU Water Framework Directive 2000/60/EC. It indicates that when planning management work on a regulated river bed or in separate sections of water with a total length of more than 2.5 km (or more than 1.2 km, if this river is included in the list of water bodies at risk), the environmental part requires at least three environmental measures. The measures taken should not jeopardize the effective functioning of the drainage system (Lietuvos, 2014).

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