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Practical actions for holistic agricultural drainage management for reduced nutrient losses: a case study in Latvia

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For decades nutrient enrichment and eutrophication have been recognized as the greatest threats to the Baltic Sea environment causing changes in the structure and functioning of the entire marine ecosystem. According to the Fifth Baltic Sea Pollution Load Compilation agriculture contributed from approximately 70% to over 90% of the anthropogenic diffuse riverine nitrogen load and 60-80% of the corresponding phosphorus load. In order to meet current nutrient reduction targets set by the HELCOM Baltic Sea Action Plan and reach good environmental status in the Baltic Sea by 2021, there is a need to implement more effective water protection measures, including in-field and edge-of-field practices, to reduce diffuse nutrient losses from agricultural sources. The specific objective of this study was to quantify the effects of bottom dams on nutrient and suspended solids retention in agricultural runoff.

The field study was conducted at the Vecauce research site near Auce City, located in the southwest part of Latvia. Agricultural land in the studied catchments is managed by the "Vecauce" (Training and research farm of the Latvia University of Agriculture) and several other farmers. This study presents water quality monitoring activities for a time period from October 2014 to December 2017. Water samples were taken twice a month at the inlet and outlet of agricultural drainage ditches affected by three bottom dams using a manual grab sampling approach. Water samples were analyzed for nitrate-nitrogen (NO_3-N), ammonium-nitrogen (NH4-N), total nitrogen (TN), orthophosphate-phosphorus (PO4-P), total phosphorus (TP) and suspended solids concentration according to the national standards.

The retention of nitrogen and phosphorus compounds has been observed at all of the bottom dams established at the Vecauce research site. From almost four-year monitoring period, the concentrations of suspended solids were reduced on average by 31, 38 and 59% for all three bottom dams when the laboratory test results of water samples collected before and after the structures were compared. Nitrogen and phosphorus compounds were consistently retained only in the case of one structure mainly due to insufficient water residence time for nutrient reduction processes. The results indicate that the mean concentrations of total nitrogen decreased in all three sites ranging from 1 to 8%, while the content of total phosphorus in the water was reduced only at the structure No. 10 by 22%. Hydrology plays an important role in terms of water quality at the inlets of the structures as it was observed that low flow conditions followed by increased discharge results in increased nitrate-nitrogen concentrations in the inflow water. Also, the nutrient removal efficiency is affected by hydrological characteristics. Low flow conditions resulted in higher nutrient removal rate when compared with high flow conditions.

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